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Volume 1

eds. Uli Sauerland and Stephanie Solt

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Z A S



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FOREWORD

In these volumes, we are very pleased to present a collection of papers based on talks and posters at *Sinn und Bedeutung 22*, which took place in Berlin and Potsdam on September 7-10, 2017, jointly organized by the Leibniz-Centre for General Linguistics (ZAS) and the University of Potsdam.

SuB22 received 183 submitted abstracts. Out of these, the organizing committee selected 39 oral presentations in the main session, 4 oral presentations in the special session ‘Semantics and Natural Logic’, and 24 poster presentations. There were an additional 6 invited talks. In total, 58 of these contributions appear in paper form in the present volumes.

We would like to take this opportunity to thank the many colleagues who helped to make SuB22 a success: our fellow organizers Guillermo Del Pinal, Mira Grubic, Manfred Krifka and Malte Zimmermann, without whom the conference would not have been possible; the nearly 200 reviewers from around the world; our invited speakers Márta Abrusán, Amy Rose Deal, Danny Fox, Hannes Leitgeb, Louise McNally and Philippe Schlenker; staff members Anja Gollrad, Ines Mauer and Azura Frömming, who dealt with countless practical details; our student assistants Carla Boos, János Litzinger, Norman Brackmann, Marius Küch and Henry Salfner, who ably supported us in the preparation phases and during the conference, as well as Meredith Alongi, Jordan Chark and Elizabeth Pankratz, who served as editorial assistants in the production of these proceedings; and of course the presenters, session chairs and audience members.

We would also like to acknowledge financial support from the Deutsche Forschungsgemeinschaft (grant KR 951/13-1), the Leibniz-Centre for General Linguistics, and the University of Potsdam, as well as surplus funds from SuB21 from the University of Edinburgh.

We look forward to seeing everyone in September 2018 in Barcelona for SuB23!

Berlin, July 2018

Uli Sauerland and Stephanie Solt

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Content vs. function words: The view from distributional semantics¹

Márta ABRUSÁN — *IJN, CNRS, ENS, EHESS, PSL, Paris, France*

Nicholas ASHER — *IRIT, CNRS, Toulouse, France*

Tim VAN DE CRUYS — *IRIT, CNRS, Toulouse, France*

Abstract. Counter to the often assumed division of labour between content and function words, we argue that both types of words have lexical content in addition to their logical content. We propose that the difference between the two types of words is a difference in degree. We conducted a preliminary study of quantificational determiners with methods from Distributional Semantics, a computational approach to natural language semantics. Our findings have implications both for distributional and formal semantics. For distributional semantics, they indicate a possible avenue that can be used to tap into the meaning of function words. For formal semantics, they bring into light the context-sensitive, lexical aspects of function words that can be recovered from the data even when these aspects are not overtly marked. Such pervasive context-sensitivity has profound implications for how we think about meaning in natural language.

Keywords: function words, lexical semantics, determiners, distributional semantics.

1. Introduction

Is there a categorical difference between the semantics of content (or open-class/lexical) words and function (or closed-class/logical) words in natural languages? Common wisdom in linguistic research holds that the answer is ‘yes’. According to this view, functional items encode the grammatical knowledge of language speakers, while content words are a reflex of world knowledge. In some incarnations of this view, the functional vocabulary is given by the language faculty, and is thus universal and biologically determined (see for example May 1991; Partee 1992; Chierchia 2013). It provides a syntactic skeleton into which lexical content is inserted, a mental coat rack onto which colourful content about the world can be hung.

Despite intuitions about the existence of the two classes, finding a precise semantic difference has proven to be difficult. The most frequently cited idea, borrowed from a tradition in logic aimed at defining logical constants, is that function words have meanings that are invariant across certain mathematical transformations of their domains.² Examples of transformations that have been proposed to diagnose logical constants include invariance under permutations (Tarski and Givant 1987; van Benthem 1989; Sher 1991), invariance under surjective functions (Feferman 1999), invariance under potential isomorphisms (Bonnay 2008), etc. What all these have in common is the underlying idea that logical meanings are topic-independent: the validity

¹We are grateful to the organisers of the Special Session on Semantics and Natural Logic for the invitation, the audience for helpful questions and an anonymous reviewer for copy-editing suggestions. The research reported here was supported by a Marie Curie FP7 Career Integration Grant, Grant Agreement Number PCIG13-GA-2013-618550, a grant overseen by the French National Research Agency ANR (ANR-14-CE24-0014), and by ERC grant number 269427.

²Another idea that was advanced is that function words involve higher types than lexical items (cf. Partee 1992). See also MacFarlane (2017) for a review of the philosophical literature on logical constants.

of a logical inference should not be dependent on the particular properties of what one is talking about. The appropriateness of the above ideas for diagnosing logical constants is a subject of lively debate, but they are clearly unsuitable for diagnosing function (logical) words of natural language (see Gajewski 2002; van Benthem 2002). This is because they predict certain lexical items to be logical (e.g. the predicates *self-identical*, *exist*), and they also predict that certain intuitively logical elements of natural language, e.g. the quantifier *every* or *each*, are not logical since they have a lexical restriction that they need to quantify over countable objects, hence **Every/Each milk is in the fridge*.

The intuitive distinction between the two classes of words seems at first to be supported by research in Distributional Semantics (DS). This computational approach to natural language semantics is based on the “distributional hypothesis” by Harris (1954), according to which one can infer a meaning of a word by looking at its context. Meanings of words differ in DS, because they will co-occur with different contexts with different probabilities. While the approach has been very successful in capturing the meanings of lexical words and lexical aspects of meaning in general (synonymy, hyponymy, etc.), there is very little evidence that DS can capture semantic properties of function words (though see Baroni et al. 2012; Bernardi et al. 2013; Hermann et al. 2013; Linzen et al. 2016). It is easy to see why: if logical meanings are topic-independent, their logical meanings will not be reflected by their distributions, and all logical words will have the same DS meaning.

However, the actual picture that emerges from DS is not a clear-cut division between the two classes of items. What we show in this paper is that when we approach function words (in particular, determiners) with DS methods, what comes to light is that logical items in natural language have a layer of non-logical meaning in addition to their logical meaning. Function words do not have purely logical content, but are a mixture of logical content and more “worldly” content comprised of lexical and distributional aspects of meaning. This is also one of the reasons why logical methods such as permutation invariance fail to diagnose functional items of natural language correctly. While DS is indeed blind to purely logical meaning, it brings to light the lexical and distributional aspects of functional items in natural language.

Our results suggest the following picture. There are context-invariant, logical aspects of meaning, and lexical/distributional aspects of meaning that tend to be modulated by the context. But the two types of meaning do not map neatly to two different types of words. More often than not, the total conceptual meaning of words is composed of both types of meaning, but to varying degrees. For example, an adjective such as *heavy* has, beside its lexical content relating to heaviness, a logical aspect of being a predicate over degrees. Aspects of the lexical meaning of heaviness can be modulated by context (*heavy elephant* vs. *heavy bleeding*), but not the logical meaning of being a degree predicate. A determiner such as *some* has, besides its logical meaning of being an existential quantifier, context-sensitive lexical aspects, for example an inference of uncertainty about identity on the part of the speaker. This type of lexical content of quantifiers has a high degree of contextual variability, similarly to other types of lexical content (e.g. *Some guy called you* vs. *There is some milk in the fridge*).

Our results connect to a growing body of evidence that challenges the traditional division between lexical and functional words. Firstly, one of the reasons why permutation invariance fails to correctly capture logical words in natural language is because of the sensitivity of these items to the properties of the linguistic and extralinguistic context. Sensitivity of certain quantifiers to the mass/count distinction, indefinites introducing discourse referents, the focus sensitivity of particles and negation, etc. are all examples of such lexical (or pragmatic) dependencies of the context. Such context-sensitivity is the essence of non-logical content.

A second, theoretical argument might come from language variation. The quantifier systems of even very closely related languages can be quite different. However, the variation, at least in the case of well-studied European languages, is not so much in the logical content expressed but more in the non-logical content associated with quantifiers. For example, indefinites in English (*a, some, any*) and German (*ein, irgendein, etwas*, etc.) differ not in their logical meanings but in the non-logical, lexical and distributional aspects associated with them.

A third reason for challenging the idea of a clean cut between the two types of words might come from historical linguistics: recent advances in this field seem to call into question the traditional idea according to which functional items are more stable than lexical items.³ For example, Greenhill et al. (2017) argue that grammatical features tend to change faster than basic lexical vocabulary. Similarly, a substantial part of the functional vocabulary belongs to the fast-changing items in the lexicon. This shows that functional items and grammatical features are not, generally speaking, the stable pillars in the dynamics of language change that they were often assumed to be. Various subsystems of language show differing patterns of dynamics, but the classification into these subsystems does not follow the lexical/functional division.

What our results add to the above theoretical arguments is that they bring to light the lexical and distributional aspects of the meaning of quantifiers, even when these are not overtly marked by the morphology. Our methods, based on distributional semantics, can associate latent semantic dimensions to these quantifiers. Some of these correspond to well-known aspects of quantifiers with a special distribution (e.g. *any*), and some correspond to semantic distinctions that are unmarked in English but marked in other languages, as in the case of *some*.

Our view of lexical semantics is a mixed model that incorporates elements from both traditional approaches to lexical semantics and distributional semantics. Traditionally, the lexical semantics of a word is the meaning that is associated with it in the lexicon. This meaning is assumed to depend on the circumstances of the evaluation (or contexts in the sense of Kaplan 1989) in the case of many lexical items, for example indexicals, demonstratives and possibly a large number of other items such as adjectives, attitude verbs, etc. Context-sensitivity, in these systems, means that the lexical meaning contains a variable whose value needs to be fixed by some context. For example, the cutoff-point for a degree adjective such as *heavy* might be supplied by the context and will be different for elephants and for mice. The lexical meaning offered by distributional semantics is context-sensitive in a much more radical way: the conceptual structures that we associate with words are gleaned from the contexts of use (dis-

³We advance this argument tentatively, since none of the authors is an expert in historical linguistics. Greenhill et al.'s (2017) article seems highly pertinent though, which is why we mention it here.

tributions) and might change with use over time and across different corpora. In the mixed model we assume here (see Asher et al. 2016) words have logical content (which we cannot derive from distributions, for the reasons described above) which plays a role not only in establishing their denotation but also in the composition of meaning as well; the logical content of an adjective, for instance, is that it must modify in some way a noun meaning, and all adjectives have that function, though their modification may proceed in different ways depending on whether they are subsective or non-subsective. However, all words also have lexical and distributional aspects which we can induce from our corpora via DS methods. These include what is traditionally thought of as the conceptual content associated with words (e.g. whatever makes an elephant an elephant) and also distributional (selectional) restrictions.⁴ While logical content is by nature context-invariant, lexical content is by nature context-sensitive in the sense that underspecified (‘clouds of’) meanings get precisified, shifted and modulated in context as in the case of *heavy bleeding* vs. *heavy box*. Our mixed model assumes that the two types of content complement and interact with each other.

Recognising the important aspect that the lexical (and pragmatic) aspects of function words play in their meaning also delineates which avenues are open for distributional semantics when it comes to approaching logical meanings. Lexical aspects of function words open a side-entrance by which it might be possible to approach the meaning of function words in natural language indirectly. One example of such an approach is Kruszewski et al.’s (2016) article, which proposes to tap into the meaning of negation in natural language by exploiting its focus-sensitive nature.

Our view also has consequences for the idea of the ‘Logicity of language’, proposed recently by Gajewski (2002), Fox and Hackl (2007) and Chierchia (2013), among others. These approaches rely crucially on the idea that there is a fundamental distinction between content and function words in natural language and that grammar is sensitive only to the content of functional vocabulary. If our approach is on the right track, then the presupposition of these accounts is not met in natural languages: the two types of content do not map to two different types of vocabulary. In Abrusán et al. (to appear) we spell out an alternative approach to explain the problems discussed in the ‘Logicity of language’ tradition that does not need this distinction.

In what follows, we first provide a brief introduction to the DS methods we used in Asher et al. (2016) and outline how these methods can inform us about meaning shifts. In Section 3 we show, based on preliminary results, what these methods give us when applied to determiner-noun combinations. In Section 4 we offer some speculations about what these findings imply for formal semantics.

⁴Although there is a conjunction in the expression ‘lexical and distributional’, in fact these are the same type of meaning from the point of view of DS.

2. Distributional Semantics and meaning shifts

Distributional Semantics, a computational approach to natural language semantics, can throw new light on meaning shifts in co-composition, as was shown in Asher et al. (2016). This paper outlines a close correspondence between Asher’s (2011) Type Composition Logic (TCL) and DS methods that we will describe below. Below we provide a brief description of some of the distributional methods we used in this work. For details concerning how to translate the results of the distributional study into a symbolic system, readers are invited to consult Asher et al. (2016).

2.1. Distributional Semantics

Distributional Semantics is based on the so called “distributional hypothesis” by Harris (1954), according to which one can infer a meaning of a word by looking at its context. Observe the following examples for illustration:

- (1) a. tasty *sooluceps*
 b. sweet *sooluceps*
 c. stale *sooluceps*
 d. freshly baked *sooluceps*

The reader, even though they have never heard the word *sooluceps* before, is able to infer from the above examples that it is some sort of food, perhaps a type of cookie. How is this possible? It must be that the adjectives that modify this noun provide a clue as to the meaning of the noun.

In distributional semantics this idea is generalised as follows. The co-occurrence frequencies of two entities are captured by word vectors. Observe first the following toy example in which the co-occurrence frequencies of 4 nouns with 4 adjectives in some corpus are given:

	red	tasty	fast	second-hand
raspberry	728	592	1	0
strawberry	1035	437	0	2
car	392	0	487	370
truck	104	0	393	293

Table 1: A toy example

One way of thinking about word meaning within Distributional Semantics is to assume that it is a vector in some space \mathbf{V} whose dimensions are contextual features. So in the above toy example, the meaning of *raspberry* is given by the vector that captures its co-occurrence frequencies with the adjectives *red*, *tasty*, *fast*, *second-hand*. A graphical representation of such vectors in two-dimensional space (since four-dimensional spaces are hard to draw) is presented in Figure 1, with the two dimensions being *fast* and *red*.

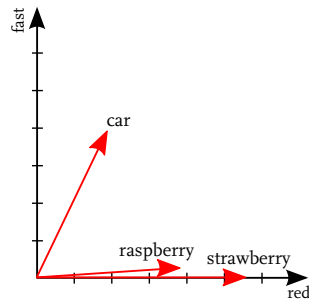


Figure 1: A graphical representation of word vectors in two-dimensional space

The graphical representation suggests a certain intuitive similarity between the words *strawberry* and *raspberry* as opposed to *car*: the vectors of the former two words have similar direction in vector space. This similarity can be captured mathematically by measuring the cosine similarity of the two vectors.⁵

2.2. Dimension reduction and aspects of meaning

When we move from toy examples towards real data, *words* \times *context* matrices become very large and very sparse, with thousands if not hundreds of thousands of rows and columns. Contexts can include words and/or grammatical features or dependency relations that appear within a window of any size, where the window might be the sentence that the word appears in, or simply a certain number of words preceding and following a word, or something else still. In order to bring out the ‘information content’ in such huge matrices, dimensionality reduction techniques are applied. A dimensionality reduction reduces the abundance of overlapping contextual features to a limited number of meaningful, latent semantic dimensions.

Singular value decomposition While rooted in linear algebra, singular value decomposition (SVD) has proven to be a useful tool in statistical applications. It is closely related to statistical methods such as principal components analysis and factor analysis. SVD stems from a well known theorem in linear algebra: a rectangular matrix can be decomposed into three other matrices of specific forms, so that the product of these three matrices is equal to the original matrix:

$$A_{m \times n} = U_{m \times z} \Sigma_{z \times z} (V_{n \times z})^T \quad (1)$$

where $z = \min(m, n)$. Matrix A is the original matrix of size $m \times n$. Matrix U is an $m \times z$ matrix that contains newly derived vectors called left-singular vectors. Matrix V^T denotes the transpose of matrix V , an $n \times z$ matrix of derived vectors called right-singular vectors. The third matrix Σ is a $z \times z$ square diagonal matrix (i.e. a square matrix with non-zero entries only

⁵Cosine similarity is just one of the various similarity measures that can be used, though probably the most popular (Turney and Pantel, 2010).

along the diagonal); Σ contains derived constants called singular values. A key property of the derived vectors is that all dimensions are orthogonal (i.e. linearly independent) to each other, so that each dimension is uncorrelated to the others.

The diagonal matrix Σ contains the singular values in descending order. Each singular value represents the amount of variance that is captured by a particular dimension. The left-singular and right-singular vector linked to the highest singular value represent the most important dimension in the data (i.e. the dimension that explains the most variance of the matrix); the singular vectors linked to the second highest value represent the second most important dimension (orthogonal to the first one), and so on. Typically, one uses only the first $k \ll z$ dimensions, stripping off the remaining singular values and singular vectors.⁶ If one or more of the least significant singular values are omitted, then the reconstructed matrix will be the best possible least-squares approximation of the original matrix in the lower dimensional space. Intuitively, SVD is able to transform the original matrix—with an abundance of overlapping dimensions—into a new matrix that is many times smaller and able to describe the data in terms of its principal components. Due to this dimension reduction, a more succinct and more general representation of the data is obtained. Redundancy is filtered out, and data sparseness is reduced.

SVD is the underlying technique of the well-known information retrieval and text analysis method called Latent Semantic Analysis (Landauer and Dumais 1997; Landauer et al. 1998). A key characteristic of the resulting decomposition is that it contains both positive and negative values. Though the decomposition contains usable latent dimensions, it turns out the negative values make the resulting dimensions difficult to interpret. The application of a non-negative constraint, as in the factorization technique described in the following section, remedies this shortcoming.

Non-negative matrix factorization Another dimensionality reduction technique we deem particularly useful for semantic analysis is non-negative matrix factorisation (NMF; Lee and Seung, 1999). There are a number of reasons to prefer NMF over the better known singular value decomposition used in LSA. First of all, NMF allows us to minimize the Kullback-Leibler divergence as an objective function, whereas SVD minimizes the Euclidean distance. The Kullback-Leibler divergence is better suited for language phenomena. Minimizing the Euclidean distance requires normally distributed data, and language phenomena are typically not normally distributed (Baayen 2001). Secondly, the non-negative nature of the factorization ensures that only additive and no subtractive relations are allowed. This proves particularly useful for the extraction of semantic dimensions, so that the NMF model is able to extract much more clear-cut dimensions than an SVD model. And thirdly, the non-negative property allows the resulting model to be interpreted probabilistically, which is not straightforward with an SVD factorization.

Given a non-negative matrix \mathbf{V} , NMF finds non-negative matrix factors \mathbf{W} and \mathbf{H} such that when multiplied, they approximately reconstruct \mathbf{V} :

⁶A typical choice for k would be 300.

$$\mathbf{V}_{n \times m} \approx \mathbf{W}_{n \times k} \mathbf{H}_{k \times m} \quad (2)$$

A graphical representation of NMF applied to a matrix of nouns by context words is given in Figure 2.

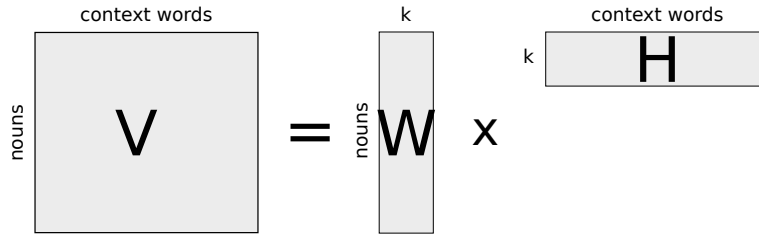


Figure 2: A graphical representation of NMF

As its name indicates, this factorization observes the constraint that all values in the three matrices need to be non-negative (≥ 0). Choosing $k \ll n, m$ reduces data significantly; for word-context matrices, k is typically chosen within the range 100–600.

As it turns out, reducing word-context matrices using NMF is particularly useful for finding topical, thematic information. For many of the k dimensions, the words with the highest value on that dimension seem to belong to the same topical field. Observe for example the nouns with the highest values on a number of example dimensions in Table 2 (computed from a word-context matrix extracted from Wikipedia). The examples indicate that NMF is able to automatically induce topically salient dimensions: dimension 60 has something to do with transport, dimension 88 with publishing, dimension 89 with computing and dimension 120 with living spaces. Although the labels of these dimensions are not given automatically, it is intuitive to think of these dimensions as semantic features, or topics. Factorisation also allows a more abstract way of representing the meaning of a word: we can now say that the meaning of a word is represented by a vector of size k whose dimensions are latent features.

dim 60	dim 88	dim 89	dim 120
rail	journal	filename	bathroom
bus	book	null	lounge
ferry	preface	integer	bedroom
train	anthology	string	kitchen
freight	author	parameter	WC
commuter	monograph	String	ensuite
tram	article	char	fireplace
airport	magazine	boolean	room
Heathrow	publisher	default	patio
Gatwick	pamphlet	int	dining

Table 2: Example dimensions ($k=300$)

Word embeddings Thirdly, we want to briefly touch upon a dimensionality reduction technique known as word embeddings. Though word embeddings are related to the factorization techniques mentioned above, the methods used to induce them operate somewhat differently. Word embeddings became popular with the recent surge of neural network methods for natural language processing applications (Collobert et al., 2011). By word embeddings, one usually denotes the low-level vector representations that serve as input to neural networks; the vector representations are typically automatically induced as parameters within the neural network, training on a particular task at hand. Word embeddings are often pre-trained in an unsupervised fashion by means of context prediction (Mikolov et al., 2013). As such, they are another instantiation of the distributional hypothesis.

As with SVD, word embeddings contain negative values, and therefore are more cumbersome when interpretation is concerned. Moreover, there is research that establishes a connection between SVD and induction methods for word embeddings (Levy and Goldberg, 2014). Still, there is a strong consensus within the NLP community that word embeddings provide adequate semantic representations, and as a result they might be useful for research on logical aspects of lexical items. We have not explored word embeddings in our research so far, but leave this interesting avenue for future work.

2.3. Composition: from aspects to meaning shifts

We have seen above how DS can generate vectors to capture individual word meaning and bring out latent dimensions that might correspond to semantic features. But what sort of semantic features would they be? In a purely denotational theory of meaning in which an expression would denote some sort of an intension, it is unclear how to represent these latent dimensions or indeed the collection of them as represented in a DS vector. In Asher et al. (2016), we took the view that DS vectors correspond to *internal* meanings or *types*, which the composition system uses to construct logical forms. Asher (2011), for instance, uses types to predict semantic anomalies and shifts in the meanings of polysemous words and already makes use of aspects in types, which we can think of as latent dimensions.

But how do we know that these latent dimensions could correspond to semantic features? One way to see this is to examine what happens in composition. If these latent dimensions affect composition and make empirically testable predictions about the semantic values of composing expressions, then that is evidence that these dimensions do correspond to semantic features. DS methods of composition involve the manipulation of vectorial or other algebraic representations of lexical content using various mathematical operations: vector addition, vector multiplication, and more complex forms of combination such as we will see below. The view from the DS approach connects to a growing body of work that assumes that the meaning of lexical words can be shifted or modulated in one way or another: either within the semantics (cf. e.g. Martí 2006; Stanley 2007; Asher 2011; Alxatib and Sauerland 2013) or within the pragmatics (Kamp and Partee 1995; Recanati 2010; Lasersohn 2012). Since we assume that meaning shift diagnosed by DS approaches happens at the compositional level, the view from DS is more in line with semantic approaches.

We have developed models of composition that show how the content of each word is modified during composition. Formally, our method is a DS implementation of the symbolic approach in Asher (2011). Asher’s TCL approach provides the basic logical meanings for all expressions, including for instance their basic type information and methods of composition. In addition, it assumes a rich set of subtypes of the type of entities, and this assumption drives TCL’s account of meaning shift in coercions and aspect selection in dual aspect nouns (Cruse 1986). However, like other symbolic methods, TCL has little to say about the content of the type associated with those subtypes. DS methods on the other hand tell us what the contents of those types are and how the compositional process modifies those contents. This method, applied for instance to the composition of an adjective with the noun it modifies, looks like this, where A is the adjective and N is the noun:

$$(2) \quad AN: \lambda x (\mathcal{O}_A(N(x)) \wedge \mathcal{M}_N(A(x)))$$

\mathcal{O} and \mathcal{M} are functors intended to capture the shift in meaning induced by the compositional process. For an expression like *heavy traffic* we would have:

$$(3) \quad \textit{heavy traffic} : \lambda x. (\mathcal{O}(\textit{heavy})(x) \wedge \mathcal{M}(\textit{traffic})(x))$$

The meaning of both nouns and adjectives can thus change in this system, according to the words they combine with. However, Asher (2011) does not supply a method for constructing the functors \mathcal{O} and \mathcal{M} . This is what we can do with DS automatically. Moreover, as we will see below in our discussion of a previous study on nouns and adjectives, different latent dimensions of meaning of both the adjective and the noun can be reinforced, depending on what these expressions combine with.

2.4. A distributional model for compositionality

In order to capture meaning shift as in the case of *heavy traffic*, the meaning of the adjective needs to be adapted to the context of the particular noun that it co-occurs with. That is, the distributional model needs to provide us with the functors \mathcal{O}_A and \mathcal{M}_N in the TCL approach. In Asher et al. (2016), we chose two different approaches that meet this requirement: one based on *matrix* factorization (Van de Cruys et al., 2011) and one based on *tensor* factorization (Van de Cruys et al., 2013). In what follows, we describe briefly the second method and the results we got with it. Note that the following paragraphs only provide a brief overview of the model; for more details, see Asher et al. (2016).

Tensor factorization The approach based on tensor factorization allows for a rich and flexible modeling of the interaction between adjectives and nouns, in order to provide an adequate representation of each when they appear in each other’s context. The key idea is to factorize a three-way tensor⁷ that contains the multi-way co-occurrences of nouns, adjectives and other dependency relations (in a direct dependency relationship to the noun) that appear together at

⁷A tensor is the generalization of a matrix to more than two axes or *modes*.

the same time. A number of well-known tensor factorization algorithms exist; we opted for an algorithm called Tucker factorization, which allows for a richer modeling of multi-way interactions using a core tensor. In Tucker factorization, a tensor is decomposed into a core tensor, multiplied by a matrix along each mode. For a three-mode tensor $\mathbf{X} \in \mathbb{R}^{I \times J \times L}$, the model is defined as follows:

$$\begin{aligned} \mathbf{X} &= \mathbf{G} \times_1 \mathbf{A} \times_2 \mathbf{B} \times_3 \mathbf{C} \\ &= \sum_{p=1}^P \sum_{q=1}^Q \sum_{r=1}^R g_{pqr} \mathbf{a}_p \circ \mathbf{b}_q \circ \mathbf{c}_r \end{aligned} \quad (3)$$

where \circ represents the outer product of vectors. By setting $P, Q, R \ll I, J, L$, the factorization represents a compressed, latent version of the original tensor \mathbf{X} ; matrices $\mathbf{A} \in \mathbb{R}^{I \times P}$, $\mathbf{B} \in \mathbb{R}^{J \times Q}$, and $\mathbf{C} \in \mathbb{R}^{L \times R}$ represent the latent factors for each mode, while $\mathbf{G} \in \mathbb{R}^{P \times Q \times R}$ indicates the level of interaction between the different latent factors. Figure 3 shows a graphical representation of Tucker decomposition.⁸

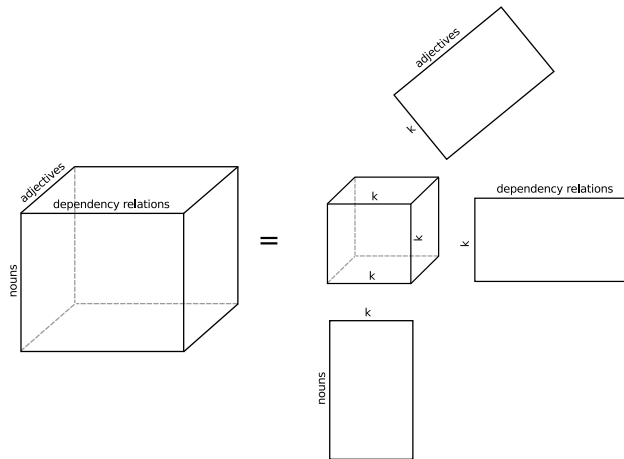


Figure 3: A graphical representation of Tucker decomposition

We carried out the factorization with non-negative constraints, and we found the best possible fit to the original tensor \mathbf{X} using Kullback-Leibler divergence, a standard information-theoretic measure. To ensure that the algorithm for non-negative Tucker decomposition finds a good global optimum, we initialized the three matrices using data that comes from non-negative matrix factorization, cf. Asher et al. (2016).

Computing meaning shifts We can now compute a representation for a particular adjective-noun composition. In order to do so, we first extract the vectors for the noun (\mathbf{a}^i) and adjective (\mathbf{b}^j) from the corresponding matrices \mathbf{A} and \mathbf{B} . We multiply those vectors into the core tensor, in

⁸where $P = Q = R = K$, i.e. the same number of latent factors K is used for each mode

order to get a vector \mathbf{h} representing the importance of latent dimensions given the composition of noun i and adjective j , i.e.

$$\mathbf{h} = \mathbf{G} \times_1 \mathbf{a}^i \times_2 \mathbf{b}^j \quad (4)$$

By multiplying the vector representing the latent dimension with the transpose of the matrix for the mode with dependency relations (\mathbf{C}^T), we are able to compute a vector \mathbf{d} representing the importance of each dependency feature given the adjective-noun composition, i.e.

$$\mathbf{d} = \mathbf{h}\mathbf{C}^T \quad (5)$$

The vector \mathbf{d} is in effect the DS version of TCL’s functor \mathcal{O}_A , which we now have to combine with the original noun meaning. This last step goes as follows in DS: we weight the original noun vector according to the importance of each dependency feature given the adjective-noun composition, by taking the point-wise multiplication of vector \mathbf{d} and the original noun vector \mathbf{v} , i.e.

$$\mathbf{v}'_d = \mathbf{d}_d \cdot \mathbf{v}_d \quad (6)$$

Note that we could just keep the representation of our adjective-noun composition in latent space. In practice, the original dependency-based representation provides a much richer semantics, which is why we have chosen to perform an extra step weighting the original vector.

Some implementational details We used the UKwAC corpus (Baroni et al., 2009), an internet corpus of about 1.5 billion words, to construct the algebraic structures for our approaches. We tagged the corpus with part-of-speech tags, lemmatized it with Stanford Part-Of-Speech Tagger (Toutanova and Manning, 2000; Toutanova et al., 2003), and parsed it using MaltParser (Nivre et al., 2006). We extracted our input tensor \mathbf{X} of 5000 nouns by 2000 adjectives by 80,000 dependency relations from the corpus. The tensor \mathbf{X} was weighted using a three-way extension of PMI (Van de Cruys, 2011). We set $K = 300$ as our number of latent factors. All similarity computations were performed using cosine as a similarity measure.

An example Finally, observe an example illustrating the unshifted meaning of the adjective *heavy* vs. the shifted meaning of the same adjective in the context of the noun *traffic*:

(4) **heavy**_A: *heavy*_A (.1000), *torrential*_A (.149), *light*_A (.140), *thick*_A (.127), *massive*_A (.118), *excessive*_A (.115), *soft*_A (.107), *large*_A (.107), *huge*_A (.104), *big*_A (.103)

(5) **heavy**_A, *traffic*_N: *heavy*_A (.293), *motorised*_A (.231), *vehicular*_A (.229), *peak*_A (.181), *one-way*_A (.181), *horse-drawn*_A (.175), *fast-moving*_A (.164), *articulated*_A (.158), *calming*_A (.156), *horrendous*_A (.146)

There is an evident shift in the composed meaning of *heavy* relative to its original meaning; there is no overlap in the lists (4) and (5) above except for *heavy*. We see this also in the quantitative measure of cosine similarity, sim_{cos} , between the original vector for *heavy* \vec{v}_0 and the modified vector for *heavy* \vec{v}_1 as modified by its predicational context: With the tensor model, on average, $sim_{cos}(\vec{v}_{orig}, \vec{v}_{mod})$ was 0.2 for adjectives and 0.5 for nouns. In addition, these different senses of *heavy* were reflected in the dimensions in which *heavy* occurred, thus confirming that aspects of meaning affect composition and meaning shift. Finally, Asher et al. (2016) validated these meaning shifts in terms of speaker judgments.

3. Determiners, logical meaning and shiftable meaning

We have seen above how distributional semantics can inform us about the nature of meaning shifts. The distributional method that we introduced above for calculating meaning shift adapts the vector of the original predicate to its predicational context using the latent dimensions derived during dimensionality reduction. The way the distributional method calculates meaning shifts implies that meaning shift crucially depends on the latent dimensions that we find during tensor factorisation: it is the semantic features implicitly present in the latent dimension that drive the meaning shift. Distributional semantics thus picks up the aspects of lexical meaning that vary with the context: these are the aspects of the meaning that are affected by changes in the distribution. As a result, DS can tell us about which aspects of meaning of an expression can shift; aspects of the meaning that correspond to (or interact with) semantic dimensions uncovered by distributional semantics methods are in principle shiftable. In contrast, aspects of the meaning that are invisible for DS are unshiftable. In Abrusán et al. (to appear), we argue that clashes in unshiftable content of a predicate and its argument lead to semantic anomaly, and shiftable contents lead to shifts of meaning in composition.

We now apply a distributional approach to determiners. Do determiners have meanings that can shift, or do they have only unshiftable meanings? Logical meaning, the meaning upon which valid inferences rest, must be present in all contexts, and so we expect it to be invisible for DS; in particular, we expect that it will not show up in dimensions of the latent space where certain contexts are operative. So, whether or not we get logical meaning or any other meaning to shift depends on whether we find latent dimensions with our dimensionality reduction methods that correspond to logical meaning.

In recent work we performed a number of preliminary experiments similar to the ones described in the previous section but this time with determiner-noun compositions. Specifically, we looked at four determiners, *a*, *any*, *some* and *every* using two different corpora: Wikipedia, and a corpus of unpublished novels collected from the web (Zhu et al., 2015).⁹ We extracted an input tensor \mathbf{X} of 5000 nouns by four determiners by 80,000 dependency relations from each of the two corpora. The tensors were weighted using a three-way extension of PMI, cf. Van de Cruys (2011). The tensor was factorized using tensor factorization, with $k = 30$ as our number of latent factors.

⁹The former corpus contains about 1 billion words, the latter about 1.5 billion words. Preprocessing was performed similarly to the approach described in Section 2.4.

In the resulting factorization, determiners and nouns as well as dependency relations are all linked to same latent dimension. We can now go and inspect each of the 30 latent dimensions manually, by looking at the list of highest ranked words in each dimension. In the corpus of novels, we found that out of the 30 dimensions, 5 had *some* as the most important determiner (i.e. the determiner with the highest value), 3 dimensions had *every* as the most important determiner, and in 1 dimension *any* was the most important. The remaining dimensions were dominated by the determiner *a*. We found similar results with the Wikipedia corpus: we found 3 dimensions with *some* being highly ranked, 3 dimensions with *any* being highly ranked and one dimension with *every* highly ranked. The rest of the dimensions were dimensions with the determiner *a* ranked most highly. In the following paragraphs, we try to identify a number of semantic characterizations linked to the latent dimensions.

Dimensions An intuitive evaluation of the semantic coherence of each of the 30 dimensions was conducted by the authors, and we have found that many of these seem to capture interesting semantic features, albeit not logical features. Here we describe the results of the Novels corpus.¹⁰ In the case of the determiner *some*, we found that two of the 5 dimensions seem to capture uncertainty or indifference about the identity of the discourse referent in question. We see this from trying to recompose the highest ranked determiner with the highest ranked nouns and other dependency features on a particular dimension, cf. examples in (6). Another two of the five dimensions capture measure or quantity readings with *some*, the difference between the two dimensions being that in one we found nouns that denote more concrete things (e.g. food), in the other we find more abstract nouns. The fifth dimension arguably captures kind or sort readings with *some*.

- (6) *some*
- a. [uncertainty, indifference]: e.g. some people argue; for some reason; on some level
 - b. [measure/quantity]: e.g. some food, some protection, some comfort, some help
 - c. [kind/sort]: e.g. some kind, some sort

With the determiner *every*, one dimension we got very robustly was a temporal dimension: the highest ranked nouns were all temporal. Another dimension seemed to capture part-whole relations, see (7b). (We could not make sense of the third dimension, which is why we omitted it here.)

- (7) *every*
- a. [temporal]: e.g. every day, every year, every minute
 - b. [part-whole]: e.g. every inch, every detail, every part

The dimension we got with the determiner *any* seems to correspond to the negative polarity (possibly also free choice?), with negation and the modals *could* and *would* being the highest ranked modifiers among dependency features.

¹⁰The results of the study on the Wikipedia corpus were similar, but less rich.

- (8) *any*
 [negative polarity]: e.g. not show any emotion, without any warning, at any moment

In the case of the determiner *a*, we mostly found topical dimensions, e.g. legal, publishing, building construction, political campaigns, people, etc. (especially in the Wikipedia corpus). In some dimensions *a* appeared exclusively within prepositional modifier phrases (*in a chair*; *with a grin*). The rest of the dimensions were uninterpretable to us. We must hence be careful about making too many claims about these dimensions of determiner meaning. However, we hope to demonstrate in future work that these dimensions recur in different corpora and when choosing different latent spaces. If this is the case, then we think this is good evidence that these semantic principles are part of the determiners' internal meanings.

Interpretation What we have described above is still work in progress, but it is already clear that we are not getting any dimensions via tensor factorisation that correspond to logical meaning. As a consequence, we are not going to get logical meaning to shift. This is not surprising given that logical meanings are supposed to validate logical deductions universally regardless of context. Thus the fact that logical meaning shouldn't shift with content comes with the definition of logical meaning and the universally valid inferences it purports to underwrite.

On the other hand, it seems to us that the dimensions that we do get correspond to some aspects of the *lexical/distributional* meaning of quantifiers. In light of this, one way to interpret our results with the determiner *a* is that this determiner does not have any extra conceptual content beyond its logical meaning. In the case of *any* we get a dimension that captures its peculiar distribution. Most interestingly, perhaps, the dimensions we find with the quantifier *some* correspond to non-logical aspects of its use that have puzzled semanticists for a long time. The first of these is uncertainty about identity (also known as the *epistemic* aspect of indefinites). Indefinites with an epistemic effect can be marked by a special determiner in many languages, e.g. in German or Spanish (cf. Kratzer and Shimoyama 2002; Alonso-Ovalle and Menéndez-Benito 2015). Other aspects of the determiner *some* include measure and kind readings. In some languages, all these different aspects are marked explicitly, e.g. in Hungarian and in many Slavic languages (cf. Haspelmath 1997; Szabolcsi 2015). In particular, the Hungarian determiner *some* incorporates *wh*-words and the relevant aspects of *some* are tied to the *wh*-word:

- (9) Indefinite determiners in Hungarian: VALA+WH-word N:
- a. *vala+mi* N [lit: some+what_N]:
 suggests uncertainty about the identity of N, e.g. some guy
 - b. *vala+milyen* N [lit: some+what_A]:
 kind or sortal reading: e.g. some kind of drug
 - c. *vala+melyik* N [lit: some+which]:
 partitive reading: one of the Ns
 - d. *vala+mennyi* N [lit: some+how-much]:
 amount reading: some amount of N
 - e. *vala+hány* N [lit: some+how-many]:
 count reading: some number of Ns

Note that *vala-* in itself is not a word and so every occurrence of the determiner *some* incorporates a *wh*-word. As a result, *some* in Hungarian is always classified into one of the readings signaled by the *wh*-word.¹¹ Below are some typical examples found on the web:

- (10) a. A bárban **valami pasas** énekelt Woody Guthrie számokat.
‘In the bar *some guy* was singing Woody Guthrie songs.’
- b. Próbált emlékezni, de nem ment. Mintha leblokkolt volna az agya, mintha **valamilyen gyógyszer** hatása alatt állt volna.
‘He was trying to remember, but couldn’t. As if his brain had gone blank, as if he was under the effect of *some drug*.’
- c. De mi van olyankor, ha **valamilyik családtag** allergiás?
‘But what happens if *some family member* has allergy?’
- d. A szeretetben mindig van **valamennyi őrület**. De az őrületben is mindig van **valamennyi ész**. (F. Nietzsche)¹²
‘In love there is always *some madness*. But there is also *some reason* in madness.’
- e. Volt **valahány gyerek** a kertben.
‘There were *some children* in the garden (I do not know how many).’

Finally, the dimensions we find with the quantifier *every* are somewhat puzzling and not easy to interpret. Probably, the part-whole distinction corresponds to a semantically relevant dimension, since universals (and also existentials) often appear with overt partitive constructions. In contrast, the temporal dimension we found might simply be an artifact of the extremely frequent use of *every* with temporal nouns in context.¹³

4. What does this mean for linguistics?

In the previous section, we showed that determiners, like open class nouns and adjectives, have aspects of meaning that cluster in some but not all latent dimensions. Given our experiments on adjective noun composition, we fully expect that composition of a determiner with a common noun phrase (NP) to form a DP will also exhibit shifts in meaning—not shifts in logical meaning (*every* doesn’t suddenly mean *some* or *many*) but shifts in the sort of meanings we have found in the latent dimensions like epistemic indefinites, the negative polarity semantic behavior of *any* and less well known aspects like the dimension of *every* that selects for temporal NPs. In this section, we speculate how our observations relate to semantics as more traditionally construed.

4.1. Different corpora: different meaning aspects?

In our studies we looked at two different corpora to provide us with contexts and finally a set of latent dimensions for our determiners. We also examined spaces with different numbers of latent dimensions. Happily, the aspects of determiner meaning that we reported on above

¹¹We find the same pattern in Hungarian with free choice items and also negative existentials: *akármilyen*, *akármelyik*, etc.

¹²“Es ist immer etwas Wahnsinn in der Liebe. Es ist aber immer auch etwas Vernunft im Wahnsinn.” - Thus Spoke Zarathustra (1885)

¹³To see if this is indeed the case, it would be interesting to compare *every* with *each* and *all*.

showed up across all the latent spaces. Moreover, at least some of the aspects we isolated are grammatically marked in languages other than English, and that in itself is evidence that they correspond to aspects of the semantics of the expressions. On the other hand, it is clear that the analysis of dimensions or the shifts in meaning that these dimensions induce in composition do not exhaust the meaning of expressions. No distributional semanticist, we believe, would conclude that, just because we don't see the logical meaning of *every* showing up in any particular dimension, it does not have the logical meaning that it evidently does. But then how do or should these different aspects of determiner meaning relate to the core logical meaning? In our DS model and the underlying theory of types that it implements, we suppose that since logical meaning is present in every context of use, and hence in every latent dimension, the operations we do to bring out certain aspects of meaning that are more present in some contexts will not affect the logical meaning of the determiner. The logical meaning is a constant component of the type, while the shiftable aspects of meaning are more or less present depending on what the determiner is composing with.

This view of composition already indicates how we might want to formulate an analysis of epistemic indefinite uses of *some*. If we follow our DS and TCL model, the epistemic use should come from a compositional account in which elements of the context of use of *some* reinforce this interpretation. Since our results are very much dependent on the kinds of context we choose, what context we use to analyze this epistemic use is an important question we need answer. With the right notion of context, the DS model of composition could then in principle tell us which contextual elements reinforce this interpretation.

There is also the question about what the various latent dimensions represent. Does each one of them in fact represent an aspect of the semantics of a determiner? Even the ones we can't interpret? If they don't represent semantic aspects, what do they represent? We don't know the answers to this question, but we feel that these are important questions to ask and to resolve for those who are using DS methods and believe that DS can offer an explanatory, theoretically satisfying model of meaning.¹⁴ A related question is, what about the differences we noticed across our two corpora? Some dimensions of meaning were more widespread in one space than another; in some spaces a dimension could be more amenable to interpretation than in others. Do these indicate a difference in semantics too?

4.2. On the cherry picking argument

The questions in the preceding subsection highlight a difficulty in studying latent dimensions of meaning using DS methods. If we can't interpret some dimensions or don't see any semantic relevance in them, then our selection of certain dimensions as being semantically informative can seem suspect. Looking through latent dimensions and "cherry picking" the ones we find interesting doesn't seem like the right way to do semantics as a science. However, once we see that differences in content in dimensions lead to shifting in composition and we can empirically

¹⁴These questions become all the more pressing once researchers start to exploit nonlinear and neural net methods for representing word meaning, as such architectures are intrinsically much more difficult to interpret than the linear algebraic techniques we use here.

test the effects of composition, the cherry picking argument loses its force. In addition, the fact that some of our dimensions are grammaticalized in some languages attests to their semantic relevance. The cherry picking argument, however, still points out a potential embarrassment about the dimensions that we can't interpret. Our inability to explain aspects of the model hampers its theoretical power.

4.3. The content vs. functional distinction

Logical and lexical aspects of meaning do not map neatly to two different types of words. There is no purely logical vocabulary nor purely lexical/conceptual vocabulary. Instead, this distinction cross-cuts word boundaries. The meanings of lexical as well as logical words have both logical aspects (their model-theoretic meaning) and lexical/conceptual aspects. We cannot neatly separate grammar and conceptual knowledge because they are packaged together within lexical entries. Similarly, the boundary between shiftable and unshiftable content does not map neatly to lexical vs. functional vocabulary: both closed and open class words can have shiftable and unshiftable aspects to their meaning.

Though our study described above is still work in progress, it suggests that there are aspects of the meaning of quantificational determiners that might shift, namely the conceptual content that they have on top of their logical meaning. We suspect that this is the case at least for the quantifiers that have such meanings, e.g. *some*, though probably not the determiner *a*. Assuming that the conceptual meaning of determiners also includes at least some reflex of their logical meaning (Szymanik and Zajenkowski 2010), we can say that there are parts of the conceptual content of quantificational determiners that might shift, and there is also a part of their conceptual content that is invariant with context. The first type of conceptual meaning corresponds to the semantic dimensions that distributional semantics can uncover. The second type of conceptual meaning is the conceptual reflex of the logical meaning of these items.

For example, in the case of the determiner *some*, the conceptual reflex of the existential quantification is non-shiftable. However, the other conceptual effects associated with it, e.g. uncertainty about identity, measure readings, kind readings, partitive readings, etc. might be shiftable.

5. Conclusion

In this paper we have argued, based on findings from Distributional Semantics, that both function and content words have lexical/distributional content in addition to their logical content. Our results, based on a preliminary study of determiners, indicate that the difference between the two types of words is a difference in degree rather than being categorical. These findings, if correct, have implications both for distributional and formal semantics. For distributional semantics, they indicate a possible avenue that can be used to tap into the meaning of function words. For formal semantics, they bring into light the context-sensitive, lexical aspects of function words that can be recovered from the data even when these are not overtly marked. Such pervasive context-sensitivity has profound implications for how we think about meaning in natural language.

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Korean classifier-less number constructions¹

Dorothy AHN — *Harvard University*

Abstract. Korean is a generalized classifier language where classifiers are required for numerals to combine with nominals. This paper presents a number construction where the classifier is absent and the numeral appears prenominal. This construction, which I call the classifier-less number construction (CI-less NC), results in a definite or a partitive reading where the referent must be familiar: ‘the two women’ or ‘two of the women’. In order to account for this, I argue that Korean postnominal number constructions are ambiguous between a plain number construction and a partitive construction. After motivating and proposing an analysis for the partitive structure, I argue that CI-less NC is derived from the partitive construction, explaining its distributional restriction and the interpretation.

Keywords: number construction, classifiers, partitives, Korean.

1. Introduction

Korean is a generalized classifier language where classifiers are required for numerals to combine with nominals. However, the language allows a construction where the classifier is absent and the numeral appears prenominal in some contexts, as shown in (1). Unlike the regular number construction shown in (2), (1) results in a definite or a partitive reading where the referent of *women* is familiar. I call the classifier-less number construction (CI-less NC). The existence of such construction has been noted before in the literature, but it was assumed to be a special case of direct combination of a small class of human or body-part denoting nouns with numerals (cf. Choi, 2005; Shin, 2017). That this construction results in a different meaning from the regular number construction is a new observation that, as far as the author knows, has not been discussed in the literature.

- (1) sey yeca
three woman
‘the three women’ or ‘three of the women’ [CI-less NC]
- (2) yeca sey-myeng
three woman-CL
‘three women’ [Regular NC]

The focus of this paper is to introduce this construction, discuss its distribution and the resulting meaning more carefully in comparison to other number constructions in the language, and propose a possible analysis. I start in Section 2 with an overview of Korean nouns in argument positions, discussing how numerals combine with nouns, and how definiteness is marked. Against this background I will closely examine the meaning of the CI-less NC in Section 3. It will be shown that the CI-less NC seems to have a definite, anaphoric reading, but does not

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require maximality. In Section 4, I present my proposal. I argue that Korean postnominal number constructions are ambiguous between two structures, one which is a plain, indefinite construction and the other which is a partitive construction. After I motivate the structure for the partitive construction, I argue that the CI-less NC derives from the partitive structure and discuss how the proposal accounts for the properties discussed in Section 3.

2. Background: Korean bare nouns and number phrases

Korean bare nouns — nouns without a determiner — are similar to bare nouns in other classifier languages such as Mandarin and Nuosu Yi in that they can appear in argument positions and allow kind and generic readings (cf. Kang, 1994; Nemoto, 2005; Jiang, 2017; a.o.).

- (3) koray-nun phoyuryu-i-ta.
whale-TOP mammal-COP
'Whales are mammals.' (Nemoto, 2005) [Kind]
- (4) kay-nun cicnun-ta.
dog-TOP bark
'Dogs bark.' (Kang, 1994) [Generic]

In addition, similar to Mandarin, Korean bare nouns allow indefinite, definite, and plural indefinite readings (cf. Kang, 1994 and Nemoto, 2005 for detailed discussion of Korean and Japanese).

- (5) na-nun ecey chayk-ul sa-ss-ta.
I-TOP yesterday book-ACC buy-PST-DECL
'I bought books/a book/the book yesterday.'

Definite readings of bare nouns need a closer look. Investigating the distinction between uniqueness-denoting definites ('weak definites') and familiarity-denoting definites ('strong definites') proposed in Schwarz (2009), scholars have argued that Korean bare nouns correspond to weak definites (Cho, 2016; Ahn, 2017). For example, Korean bare nouns appear in the globally unique context in (6), and in the situationally unique context in (7).

- (6) amsuthulong-un inlyu-sasang choycholo tal-ey chaklyukhay-ss-ta.
Armstrong-TOP man-history first moon-DAT land-PST-DECL
'Armstrong was the first to land on the moon in human history.' [Global Unique]
- (7) taythonglyeng-i hayngsa hyencang-ul pangmwunhay-ss-ta.
president-NOM event venue-ACC visit-PST-DECL
'The president visited the event venue.' [Situational Unique]

Bare nouns allow anaphoric readings as shown in (8), but such cross-sentential anaphora are also compatible with uniqueness-based analyses (cf. Ahn, 2017).

- (8) yeca-wa namca-ka wassta. yeca-nun kincanghan tus poy-ess-ta.
 woman-CONJ man-NOM came. woman-NOM nervous seem-PST-DECL
 ‘A woman and a man came. The woman seemed nervous’ [Anaphoric]

When a covarying interpretation is needed, a bare noun is not felicitous, and instead, an anaphoric marker *ku* is obligatory. Traditionally, *ku* in Korean has been analyzed as a distal demonstrative (Sohn, 1994; Chang, 2009; a.o.), but as Ahn (2017) argues, it is more appropriate to analyze *ku* as an anaphoric marker, because it resists an exophoric use where referents are pointed to, and only refers to entities that are familiar to the speaker and the hearer. This corresponds to the distribution of strong, familiar-denoting definites discussed in Schwarz (2009). In (9) shown below, the anaphoric link between the antecedent (the book on truffles in each library) and the pronoun is not necessary without *ku*. Without *ku*, the more natural reading is that in each library that has a book about truffles, I borrowed some books, not necessarily that particular book about truffles. With *ku*, on the other hand, the referent of *ku chayk* must covary with the quantified antecedent. Throughout this paper, I gloss *ku* simply as KU to avoid suggesting a specific analysis.

- (9) thulephul-ey tayha-n chayk-i issnu-n motun tosekwan-eyse na-nun *(ku)
 truffle-DAT about-RC book-NOM exist-RC every library-DAT I-TOPIC KU
 chayk-ul pillye-ss-ta.
 book-ACC borrow-PST-DECL
 ‘In every library that has a book about truffles, I checked out the book.’

In anaphoric cases, plural marking is required in Korean. While Korean plural marking has been assumed to be optional, Kim (2005) argues that the plural marker *-tul* is obligatory in demonstrative constructions.² In (10), for example, where *ku yeca-tul* in the second sentence refers to the same three women the speaker saw yesterday, plural marking is obligatory.

- (10) na-nun ecey yeca sey-myeng-ul pwassta. onul tto ku yeca-*(tul)-ul
 I-TOP yesterday woman three-CL-ACC saw. today again KU woman-PL-ACC
 pwa-ss-ta.
 see-PST-DECL.
 ‘Yesterday I saw three women. Today, I saw the women again.’

The obligatoriness of plural marking is not dependent on the presence of *ku*, however, as shown in (11). As long as the speaker intends to refer back to the three women she saw, plural marking is obligatory (Ahn and Snedeker in prep).

- (11) na-nun ecey yeca sey-myeng-ul pwassta. yeca-*(tul)-un kincanghan
 I-TOP yesterday woman three-CL-ACC saw. women-PL-TOP nervous
 tus poye-ss-ta.
 seem-PST-DECL
 ‘Yesterday I saw three women. They/the women looked nervous.’

²In Kim, the term ‘demonstrative’ is used traditionally to include not only the distal *ce* and the proximal *i* but the anaphoric *ku*.

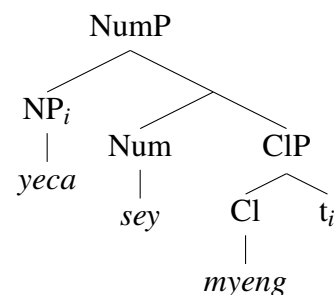
As Kim (2005) notes, number constructions constitute an exception to this plural marking requirement. When a number construction appears with a demonstrative, plural marking is not necessary, and in fact not felicitous. This is shown in (12) where a) adding the plural *tul* is odd, and b) the reading of *ku yeca sey-myeng* ('the three women') remains anaphoric without the plural.

- (12) na-nun ecey yeca sey-myeng-ul pwassta. onul tto ku yeca-(?tul)
 I-TOP yesterday woman three-CL-ACC saw. today again KU woman-(PL)
 sey-myeng-ul pwa-ss-ta.
 three-CL-ACC see-PST-DECL.
 'Yesterday I saw three women. Today, I saw the three women again.'

2.1. Korean number constructions

The structure for NumP assumed in this paper is shown below. I follow Choi (2005) in arguing that Korean nominal domain should be analyzed with a head-initial structure, and that the NP moves to the spec of NumP for linear order (also see Simpson et al., 2005 for a similar structure in other languages).

- (13) yeca sey-myeng
 woman three-CL
 'three women'



In addition to the postnominal construction in (13), Korean also allows a prenominal construction as shown in (14), and a floating quantifier construction as shown in (15) (cf. Choi, 2005; Shin, 2017). The prenominal construction involves a genitive-marked Num-Cl construction that precedes the noun, and the floating construction involves either a case-marked (15b) or a non-case-marked (15a) Num-Cl constituent that appears to be separated from the noun. Whether these are derived from the postnominal construction or not is still debated, but I focus only on the postnominal construction for this paper and refer interested readers to works like Ko (2005) and Shin (2017) for detailed syntactic and semantic discussions.

- (14) sey-myeng-uy yeca
 three-CL-GEN woman
 'three women' [Prenominal]

- (15) a. yeca-ka sey-myeng wa-ss-ta.
 woman-NOM three-CL come-PST-DECL
 'Three women came.' [Floating Quantifier]

- b. yeca-ka sey-myeng-i wa-ss-ta.
 woman-NOM three-CL come-PST-DECL
 ‘Three women came.’ [Case-marked Floaing Quantifier]

Korean number phrases result in an indefinite reading, as shown by the example below.

- (16) na-nun ecey yeca sey-myeng-ul pwassta. onul tto yeca sey-myeng-ul
 I-TOP yesterday woman three-CL-ACC saw. today again woman three-CL-ACC
 pwa-ss-ta.
 see-PST-DECL.
 ‘Yesterday I saw three women. Today, I saw three women again.’

In (16), the three women the speaker saw today are not the three women she saw the day before. It is infelicitous to use the regular number construction to refer to the same women anaphorically.

Thus, what we have seen so far is that Korean bare nouns allow kind, generic, indefinite, and weak definite readings. In strong definite readings, *ku* is obligatory. Number constructions in Korean require classifiers and receive indefinite readings. When *ku* or the plural marker *tul* is added, a number construction in Korean receives a definite, maximal reading. I discuss a new observation that Korean sometimes allows the classifier to be absent in certain contexts. What stands out about this construction is that unlike other number constructions possible in the language, it is restricted to an anaphoric, or a partitive anaphoric reading: ‘the two women’ or ‘two of the women’.

3. Classifier-less number construction

In CI-less NC, the numeral appears preminally without a classifier.³

- (17) sey yeca
 three woman
 ‘the three women’

The presence of phrases like *sey yeca* has been noted in the literature, but it has been analyzed as certain human or body-part denoting nouns directly combining with numerals (Choi, 2005; Shin, 2017). However, CI-less NC is not restricted to human or body-part nouns. In appropriate contexts, inanimates can appear in this construction too, as the examples below show.

- (18) twu uyca-(lul) ta kacye-wa.
 two chair-ACC all bring.IMP
 ‘Bring both chairs.’

³Here, I am only focusing on the Korean numerals rather than Sino-Korean numerals which do combine directly with certain measure nouns such as ‘centimeter’ and ‘liter’. With Sino-Korean numerals, measure words seem to take the role of the classifier. With Korean numerals, however, classifiers are obligatory.

- (19) sey mau*l*-i hana-lo thonghap*to*y-ess-ta.
 three village-NOM one-to be.integrated-PST-DECL
 ‘The three villages were integrated into one.’⁴

Moreover, the construction is restricted to simplex numerals from two to nine. For example, (20a) is felicitous, while (20b) sounds odd. While we are dealing with gradient judgements need more empirical data to confirm this, the generalization from consulting five Korean speakers was that the higher the number, the less felicitous the construction became.

- (20) a. yeset namca-nun wus-ess-ta.
 six man-TOP smile-PST-DECL
 ‘The six men smiled.’
 b. ??yel.han namca-nun wus-ess-ta.
 eleven man-TOP smile-PST-DECL
 (Intended) ‘The eleven men smiled.’

This restriction cannot be explained by an account that proposes a direct combination of nouns. Instead, the restriction seems to come from structural constraints. I explore this idea further in my analysis.

Another property of CI-less NC is that plural marking cannot co-occur with the construction, as shown in (21).

- (21) sey yeca-(*tul)
 three woman-PL

Semantically, what is interesting about this construction is that it receives what looks like an anaphoric or an anaphoric partitive interpretation. That is, *sey yeca* in (17) can be interpreted as ‘the three women’ or ‘three of the women’. The referent women must be familiar to both the speaker and the hearer. I discuss the definite-like interpretation in more detail below.

3.1. Definite reading

CI-less NC is notable in that it is restricted to a definite or a definite partitive reading. More specifically, it requires the referent to be familiar. It resists an indefinite reading, as the oddness of a presentational context in (22) shows. This was confirmed by six native speakers.

- (22) pang-ey twu yeca-ka iss-ess-ta.
 room-DAT two woman-NOM exist-PST-DECL
 ‘The two women were in the room.’
 #‘There were two women in the room.’ [# Presentational]

⁴[<http://www.cybernk.net/infoText/InfoHumanCultureDetail.aspx?mc=CC0701&sc=A34005001&tid=CC0700105418>]

The anaphoric reading is evident in the following two examples. The first involves a sentential anaphora, where *twu yeca* ('two women') in the second sentence must refer anaphorically to the two women that came.

- (23) *yeca twu-myeng-kwa namca-ka tulewa-ss-ta. twu yeca-nun*
 woman two-CL-CONJ man-NOM come.in-PST-DECL. two woman-TOP
yeypp-ess-ta.
 pretty-PST-DECL
 'Two women and a man came. The two women/*Two women were pretty.' [Anaphoric]

The second involves a donkey type covarying example, where the referent of *se ai* ('three child') must be the three children of each mother that the universal quantifier ranges over.

- (24) *ai sey-myeng-ul twu-n motwun emma-nun sey ai-lul ttokkathi iphinta.*
 child three-CL-ACC have-RC every mother-TOP three child-ACC same dress
 'Every mom who has three children dresses *(the) three children the same.' [Donkey]

There are three alternative constructions that result in the same covarying reading. These all make use of the anaphoric *ku*: *ku* with the full postnominal number construction in (25a), *ku* with plural *tul* in (25b), and *ku* with the CI-less NC in (25c). Recall that CI-less NC is not possible with plural marking, so adding a plural marker in (25c) would be infelicitous.

- (25) *ai sey-myeng-ul twu-n motwun emma-nun ...*
 child three-CL-ACC have-RC every mother-TOP
 'Every mom who has three children...'
 a. *ku ai sey-myeng-ul ttokkathi iphinta.*
 KU child three-CL-ACC same dress
 'dresses the three children the same.'
 b. *ku ai-tul-ul ...*
 KU child-PL-ACC
 c. *ku sey ai-(*tul)-ul ...*
 KU three child-PL-ACC

If only plural *tul* is present without *ku*, it has two readings: one that is identical to the covarying reading above, and another that refers to a different set of contextually salient children. For example, if there is a class full of children, and each week one of the mothers dresses the whole class, (26) could mean that every mom who has three children dresses the whole class the same.

- (26) *ai sey-myeng-ul twu-n motwun emma-nun ai-tul-ul ttokkathi iphinta.*
 child three-CL-ACC have-RC every mother-TOP child-PL-ACC same dress
 a. 'Every mom who has three children dresses the three children the same.'
 b. 'Every mom who has three children dresses the children the same.'

Thus, we see that CI-less NC behaves just like a number construction that is accompanied by *ku*, or a noun accompanied by both *ku* and plural *tul*. Another property CI-less NC shares with *ku* and *tul* is that it always receives a wide-scope reading, unlike specific indefinites that

allow quantificational or intermediate scope (Fodor and Sag, 1982; Ionin, 2006). Specifically, indefinites are ambiguous between quantificational and referential readings as shown in (27): either Mary read every book that a specific teacher recommended, or any book that any teacher recommended. Indefinites also allow intermediate scope as shown in (28): the resulting reading is that for every student, there was some teacher such that the student read every book that the teacher recommended.

(27) Mary read every book a teacher recommended. (Fodor and Sag 1982)

(28) Every student read every book that some teacher (of hers) had recommended.

The same kinds of ambiguity is available in number constructions in English.

(29) Mary read every book two teachers recommended.

(30) Every student read every book that two teachers (of hers) had recommended.

CI-less NC in Korean, however, only allows the referential, wide-scope reading:

(31) Jimin-un twu yeca-ka chwuchenhan motun chayk-ul ilk-ess-ta
 Jimin-TOP two woman-NOM recommended-RC every book-ACC read-PST-DECL
 ‘Jimin read every book two women recommended.’

(32) motun haksayng-un twu yeca-ka chwuchenhan motun chayk-ul
 every student-TOP two woman-NOM recommended-RC every book-ACC
 ilk-ess-ta
 read-PST-DECL
 ‘Every student read every book the two women recommended.’

The same pattern is shown by the full number construction with *ku* (*ku yeca twu-myeng*) and the noun with *ku* and plural marking (*ku yeca-tul*), as well as *ku* with CI-less NC (*ku twu yeca*).

Thus far, we have seen that CI-less NC receives a definite meaning, just like the full postnominal number construction with anaphoric *ku* or the noun with *ku* and plural marking *tul*. In the next section, I present one important property that distinguishes the CI-less NC from others: the lack of the maximality requirement.

3.2. No requirement of maximality

The data discussed so far suggests that the CI-less NC results in a definite, anaphoric interpretation. However, the construction does not always require maximality, which is not compatible with the hypothesis that CI-less NC is definite. For example, in (33), the reference to two of the women out of the three who came is possible with the CI-less NC.

- (33) yeca sey myeng-i wassta. twu yeca-nun anc-ass-ta.
 woman three CL-NOM came two woman-TOP sit-PST-DECL
 ‘Three women came. Two of the women sat down.’

This lack of maximality requirement is what distinguishes CI-less NC from other constructions that make use of *ku* or plural marking *tul*. Compare this with the construction with *ku* in (34) and with the plural marker *tul* in (35) below, where maximality is required.

- (34) yeca sey myeng-i wassta. {*ku twu yeca / ku yeca twu-myeng}-nun
 woman three CL-NOM came KU two woman KU woman two-CL-TOP
 anc-ass-ta.
 sit-PST-DECL
 ‘Three women came. The two women sat down.’

- (35) yeca sey myeng-i wassta. (ku) yeca-tul-un anc-ass-ta.
 woman three CL-NOM came KU woman-PL-TOP sit-PST-DECL
 ‘Three women came. The women sat down.’ (False if two women sat down)

The absence of a maximality requirement can be shown on the covarying example discussed above as well.

- (36) ai sey-myeng-ul twu-n motwun emma-nun twu ai-lul ttokkathi iphinta.
 child three-CL-ACC have-RC every mother-TOP two child-ACC same dress
 ‘Every mom who has three children dresses two of the children the same.’

In (36), the CI-less NC that appears in the scope of the sentence must covary with the mother that is quantified over. Thus, there is still an anaphoric link between the mother and the two of the children she has. However, maximality is not required, and thus, it is okay for CI-less NC to pick out only two out of the three that the mother has.

CI-less NC thus seems to have a (partitive) definite interpretation, where the referent must be familiar, but there is no requirement of a maximal reference. There is one exception, which is the numeral one. Unlike other simplex numerals, *han* (‘one’) in a CI-less NC allows an indefinite reading that is shown in the presentational example in (37).

- (37) enu maul-ey han wang-i sal-ass-ta.
 some village-DAT one king-NOM live-PST-DECL
 ‘There lived a king in some village.’

Numeral one does appear in partitive definite contexts, as shown in (38), but it resists a definite reading that refers to a familiar entity. For example, in (39), *han yeca* cannot refer to the same woman that came.

- (38) yeca sey myeng-i wassta. han yeca-nun anc-ass-ta.
 woman three CL-NOM came one woman-TOP sit-PST-DECL
 ‘Three women came. One of the women sat down.’

- (39) yeca han myeng-i wassta. han yeca-nun anc-ass-ta.
 woman one CL-NOM came one woman-TOP sit-PST-DECL
 ‘One woman came. One woman sat down.’

In the next section, I suggest one possible analysis of CI-less NC, where it is a partitive structure with a familiar entity for the referent. I start with a general proposal of Korean number constructions where they are ambiguous between a plain indefinite construction and a partitive construction, and then suggest that the CI-less NC is derived from the partitive construction.

4. Proposal

Following other works on classifier languages such as Chierchia (1998b), Dayal (2004), Jiang (2012), and others, I assume that Korean bare nouns are kind-denoting, and that a classifier is what turns kinds into sets of object level individuals, as shown in (40) and (41).

- (40) $[[\mathbf{CI}]] = \lambda k \lambda x [AT(\cup k(x))]$
 AT: predicate denoting set of atoms

- (41)
-

I also assume that numerals are predicate modifiers (Ionin and Matushansky, 2006), as shown below.

- (42) $[[\mathbf{three}]] = \lambda P_{et} \lambda x \exists Y_{et} [\prod (Y)(x) \wedge |Y|=3 \wedge \forall y \in Y P(y)]$

In addition to these assumptions, I make the following proposals. First, I argue that Korean number construction is ambiguous between the plain structure in (43) and the partitive structure in (44). Second, I argue that the CI-less NC is derived from the partitive structure, which accounts for its distribution and interpretation.

- (43)
-

- (44)
-

Note that it is also possible to pronounce both NPs in (46), further supporting the structure in (44). Thus, if we argue that [+part] is a covert variant of *cwung* that appears in partitive structures, both the structure and the ellipsis process can be motivated.

The semantics for the [+partitive] head is similar to the entry proposed for partitives in other works such as Ionin and Matushansky (2006) and Sauerland and Yatsushiro (2017), but different in the order in which the arguments are taken: as mentioned above, the NumP consisting of the unit NP is taken as the first argument of [+part].

$$(47) \quad \llbracket \text{+part} \rrbracket = \lambda P \lambda y \lambda x [P(x) \wedge x \leq y]$$

With these semantic entries the meanings of the two constructions can be composed. In both the plain number construction and in the partitive construction, the classifier combines with the kind-denoting noun *yeca* ('woman'), resulting in (48). Then, the numeral *sey* is combined in (49). Note that while I follow Dayal (2012) in using a shorthand **3** in (49), the full form of which is shown in (49a).

$$(48) \quad \llbracket \text{CI NP} \rrbracket = \lambda x [\text{AT}^{\cup} \text{woman}(x)]$$

$$(49) \quad \llbracket \text{3 CI NP} \rrbracket = \lambda x [\text{AT}^{\cup} \text{woman}(x) \wedge \mathbf{3}(x)]$$

a. $= \lambda x [\text{AT}^{\cup} \text{woman}(x) \wedge \exists Y_{et} [\prod(Y)(x) \wedge |Y|=3 \wedge \forall y \in Y P(y)]]$

This is the semantics of the plain number construction in (43), where the property is turned into an argument using common type-shifting operators (Dayal, 2012; Chierchia, 1998b; a.o.).

For the partitive construction, the resulting property in (49) is further taken as an argument of [+part], resulting in (50), which then combines with the DP. For (44), I assume that the DP takes a unique *yeca* in the context, but the DP can involve *ku*, resulting in an anaphoric reference.

$$(50) \quad \llbracket \text{+part 3 CI NP} \rrbracket = \lambda y \lambda x [\text{AT}^{\cup} \text{woman}(x) \wedge \mathbf{3}(x) \wedge x \leq y]$$

$$(51) \quad \llbracket \text{DP +part 3 CI NP} \rrbracket = \lambda x [\text{AT}^{\cup} \text{woman}(x) \wedge \mathbf{3}(x) \wedge x \leq \iota y[\text{woman}(y)]]$$

Thus, (44) is true of any x such that x is composed of woman atoms, has a cardinality of three, and is a part of 'the women'. This results in a partitive construction that has a definite referent.

Note that, on the surface, the plain number construction and the partitive construction cannot be distinguished. The partitive construction would only be motivated when proper subsethood reading to a familiar referent is required, as in (52).

$$(52) \quad \begin{array}{l} \text{na-nun ecey} \quad \text{yeca} \quad \text{sey-myeng-ul pwassta. onul yeca} \quad \text{twu-myeng-ul tasi} \\ \text{I-TOP} \quad \text{yesterday woman three-CL-ACC saw.} \quad \text{today woman two-CL-ACC} \quad \text{again} \\ \text{pw-ass-ta.} \\ \text{see-PST-DECL.} \\ \text{'Yesterday I saw three women. Today, I saw two of the women again.'} \end{array}$$

4.1. Accounting for the CI-less Construction

In the last section, I proposed that Korean postnominal number construction is ambiguous between two structures: the plain number construction that results in an indefinite reading, and the partitive construction with a familiar referent. The two constructions are not distinguishable on the surface because of the same ordering of the noun, the classifier, and the numeral. The Num Noun order of the CI-less NC, however, is only compatible with one of the two structures, namely the partitive construction. I show in the rest of this section that the CI-less NC is derivable from the partitive construction, and discuss how its properties can be accounted for.

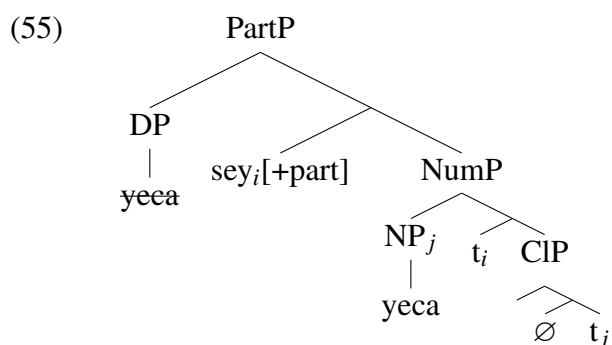
In order to derive the CI-less NC, I first focus on the distinction between complex and simplex numerals. I argue that simplex numerals, unlike complex numerals that require a full NumP (Ionin and Matushansky, 2006), can appear as simple Num heads. I will further argue that this allows simplex numerals to move, unlike complex numerals. Such constraints on the movement of larger items have been seen elsewhere, such as in V2 movements in German.

Second, I argue that in CI-less NC, the classifier head is null. I argue that this has consequences for linear order. The numeral that usually appears with a classifier differs in form from numerals used in counting in that it is adjectival. For example, while counting numbers are of the form in (53), numerals that appear with classifiers are shorter and require the lexical element that is modified to appear on the right.

(53) Counting: *hana, twul, ses, nes, taset*

(54) In number constructions: *han, twu, sey, ney, taset*

I posit that the numeral, when the classifier is null, must move to a position where there would be an appropriate lexical element to its right. Thus, I argue that the Num head moves to occupy the [+part] head. This results in the structure in (55).



In this construction, the unit NP is not ellided because *sey* requires a phonological element to its right due to the reason above. Thus, the whole NP in the DP argument is ellided. This, unlike the regular partitive construction, is possible now since [+part] is no longer null. The meanings compose in the same way as in the partitive construction.

4.2. Accounting for data

The characteristics of the CI-less NC observed in the previous section are summarized below:

- (56)
- a. Classifier is null
 - b. Results in a Num Noun order with no plural marking
 - c. Restricted to simplex numerals
 - d. Results in an (improper subsethood) partitive reading with a familiar referent
 - e. Numeral one only allows a proper subset partitive reading

In my analysis, I propose that CI-less NC is derived from the partitive construction. This accounts for the definite-like, but not maximal reading that we saw with CI-less NC. While in the regular partitive construction, the unit NP is ellided (because the null [+part] requires a lexical element to its left to incorporate into, and thus the whole NP cannot be ellided), in CI-less NC, I argue that the whole NP (the DP argument) is ellided. This was motivated by two processes: a) movement of the Num head into [+part] head, licensing it, and b) the adjectival numeral *sey* requiring a nominal element to its right. I argue that the movement of Num head is only possible when the numeral is occupying the Num head position, and this accounts for the restriction to simplex numerals. The adjectival nature of the numeral is not an issue when there is a classifier, but because there is no classifier, movement is triggered to position the numeral before some lexical element. The movement of the Num head to the [+part] head and the ellision of the whole NP (the DP argument) together account for the right Num Noun order.

I follow Sauerland and Yatsushiro (2017) in assuming that when the whole NP is ellided, proper subsethood is not required. This means that the partitive construction in principle can be used for improper subset partitives such as ‘two of the two women’, which is semantically not distinguishable from the regular ‘the two women’. Thus, the anaphoric uses found with CI-less NC with improper subsethood are also accounted for.

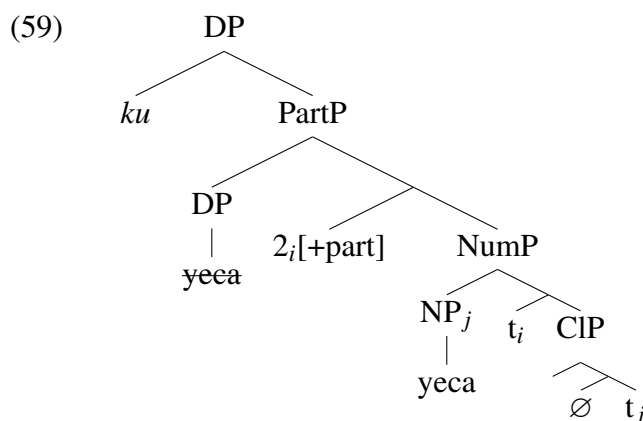
What about numeral one which receives an indefinite reading and a proper subset partitive reading, but no definite reading? One possible reason for the absence of the definite reading is a competition with a simpler alternative, which is the bare noun. For example, in (39) repeated below, one could use the bare noun.

- (57) *yeca han myeng-i wassta. han yeca-nun anc-ass-ta.*
 woman one CL-NOM came one woman-TOP sit-PST-DECL
 ‘One woman came. One woman sat down.’

- (58) *yeca han myeng-i wassta. yeca-nun anc-ass-ta.*
 woman one CL-NOM came woman-TOP sit-PST-DECL
 ‘One woman came. The woman sat down.’

The use of the marked CI-less NC may suggest that the speaker did not have enough information to use the less marked counterparts. This pragmatic story could account for why numeral one resists a definite, maximal reading, and is desirable because it would only work with numeral one, which the bare noun competes with, but not other numerals.

Recall that maximality was required when *ku* was added to the CI-less NC. This can be done straightforwardly by the following structure, if *ku* is analyzed as a strong definite that adds the meaning of ι with an index (Ahn, 2017).



(60) $[[\mathbf{ku}_i \text{ yeca sey yeca}]]^g = \iota x [AT^U \text{ yeca}(x) \wedge \mathbf{3}(x) \wedge x \leq \iota y [\text{yeca}(y)]] \ \& \ x=g(i)]$

Lastly, plural marking in some classifier languages is analyzed as a plural classifier (Dayal, 2012). If we assume that Korean plural marking is also a classifier, the empirical observation that the CI-less NC does not co-occur with plural marking may be explained. The consequences of analyzing Korean plurals as a classifier should be further investigated.

5. Conclusion

In this paper, I presented a new observation that Korean sometimes allows the classifier to be dropped in a number construction, in which the numeral appears prenominal. The resulting meaning of this CI-less NC was closely investigated, showing that while CI-less NC resembles a definite, anaphoric reading that results from adding the anaphoric marker *ku* to a number construction, there is no requirement of maximality. In order to account for this meaning, I first proposed that Korean postnominal number construction is ambiguous between a plain, indefinite construction and a partitive construction. The structure for the partitive construction where there is a covert [+part] head was motivated by an overt counterpart that makes use of *cwung* ('among'). Then, I argued that CI-less NC is derived from the partitive construction.

There are remaining details to be worked out. For example, one of the main novelties of the partitive structure I proposed is that the order of the arguments is flipped. It would be worth investigating how this is related to the assumption of head initialness that I adopted from Choi (2005). Also, while the absence of an overt classifier in CI-less NC is compatible with the partitive construction in which the Num head moves to the partitive head position, it is not yet clear whether this movement would be necessary. These issues are left for future investigation.

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Quantification in event semantics: Generalized quantifiers vs. sub-events¹

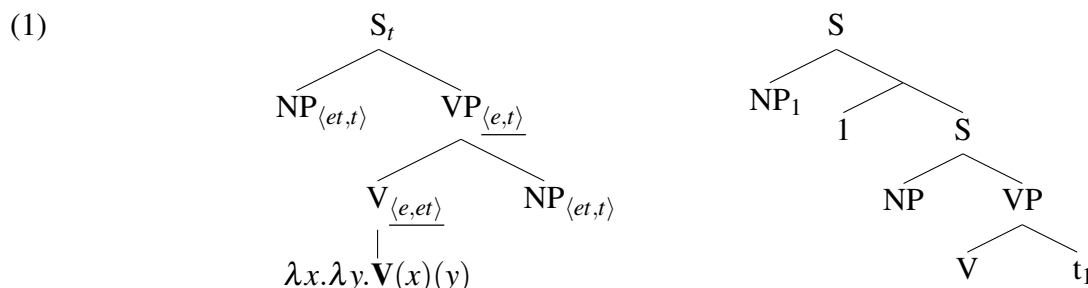
Sascha ALEXEYENKO — *University of Göttingen*

Abstract. The goal of this paper is to evaluate two approaches to quantification in event semantics, namely the analysis of quantificational DPs in terms of generalized quantifiers and the analysis proposed in Schein (1993) according to which quantifiers over individuals contain an existential quantifier over sub-events in their scope. Both analyses capture the fact that the event quantifier always takes scope under quantifiers over individuals (the Event Type Principle in Landman (2000)), but the sub-events analysis has also been argued to be able to account for some further data, namely for adverbs qualifying ‘ensemble’ events and for mixed cumulative/distributive readings. This paper shows that the sub-events analysis also provides a better account of the Event Type Principle if a broader range of data is considered, including cases with non-existential quantifiers over events: unlike the generalized quantifiers analysis, it can successfully account for the interpretation of indefinites in bare habituals and sentences that contain overt adverbs of quantification.

Keywords: quantification, event semantics, generic quantifier, habituals, Q-adverbs.

1. Introduction

In semantic systems that do not take events to be a basic semantic type, the interpretation and semantic behavior of quantificational DPs (QPs) have been intensely studied and are comparably well understood. QPs are standardly assumed to denote generalized quantifiers, type $\langle et, t \rangle$, which implies an asymmetry between subjects and non-subjects: differently from subject QPs, non-subjects produce a type clash in their base positions. This type clash is avoided by assuming that non-subject QPs undergo Quantifier Raising (QR) to a position of type t (S/IT/TP or VP/vP if subjects are generated VP/vP-internally), and Quantifier Raising is also used to model quantifier scope ambiguities. This state of affairs is schematically represented below.

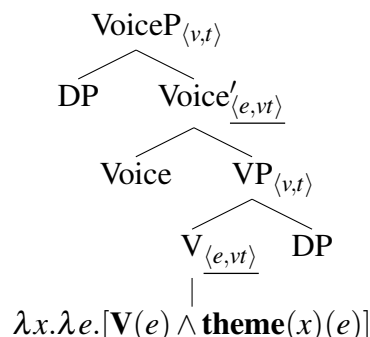


In event semantic frameworks, by contrast, there are more analytical possibilities available as to what quantificational DPs denote and what their semantic type is. To see this, (2) first shows

¹For comments on various versions of this paper, I would like to thank Graham Katz, Jan Köpping, Manuel Križ, Louise McNally, Cécile Meier, Viola Schmitt, Carla Umbach, Hedde Zeijlstra, and the audiences of the Language and Cognition workshop in Osnabrück, the Quantifiers and Determiners workshop in Toulouse, as well as SuB22 in Potsdam/Berlin. I am particularly grateful to Fred Landman, Susan Rothstein, and especially to Ede Zimmermann for discussions on an earlier version of this work.

the type composition in the lower verbal domain of a transitive clause, where v is the type of events.²

(2)



In this configuration, there is no asymmetry anymore between subjects and non-subjects: the sister constituents of the subject and object DPs in (2) have the same semantic type. Despite this difference from eventless frameworks, the analysis of quantificational DPs in terms of generalized quantifiers can be straightforwardly adopted also here, as is done, for instance, in Landman (2000). In this case, being of type $\langle e, t \rangle$, quantificational subjects and non-subjects alike must for type reasons obligatorily undergo QR to a position of type t , i.e. to TP.

However, the type composition in (2) also allows for an alternative treatment of QPs, namely as expressions of type $\langle \langle e, vt \rangle, vt \rangle$. In this case, QR to TP is not possible, but quantificational DPs can be interpreted in situ or be optionally QRed to VoiceP (position of type $\langle v, t \rangle$) for scope reasons. This kind of analysis was first proposed in Schein (1993), whose semantics of quantificational DPs contains a variable ranging over ‘ensemble’ events (sum events) and one ranging over sub-events (part events) and introduces an existential quantifier over sub-events in the scope of the quantifier over individuals. Thus, while the generalized quantifier semantics of, e.g., *every girl* is as in (3), Schein’s semantics of it is as in (4), where \sqsubseteq is a part-of relation.

$$(3) \quad \llbracket \text{every girl} \rrbracket = \lambda P. \forall x [\mathbf{girl}(x) \rightarrow P(x)]$$

$$(4) \quad \llbracket \text{every girl} \rrbracket = \lambda P. \lambda e. \forall x [\mathbf{girl}(x) \rightarrow \exists e' [e' \sqsubseteq e \wedge P(x)(e')]]$$

Both analyses capture the fact that the event quantifier always takes scope under quantifiers over individuals (cf. the Event Type Principle in Landman (2000)): due to obligatory QR to TP in the generalized quantifier analysis (GQ analysis, henceforth) and due to the presence of an existential quantifier over sub-events in the sub-event analysis (SE analysis, henceforth). However, the SE analysis has also been argued to be able to account for some further data, namely for adverbs qualifying ensemble events and for mixed cumulative/distributive readings (cf. Schein, 1993; Kratzer, 2002; Ferreira, 2005), which will be discussed in more detail below in section 2.

The goal of this paper is to show that, in fact, the SE analysis also provides a better account of the Event Type Principle if a broader range of data is considered. So far, it has mainly been

²Here and below, I do not differentiate between vP (Chomsky, 1995) and VoiceP (Kratzer, 1996), whose role is to introduce the external argument in their specifier positions.

cases involving a universal quantifier over individuals and an existential quantifier over events (i.e., episodic interpretation) that have been looked at when comparing the GQ analysis and the SE analysis. The paper extends the scope of this comparison to the inverse configuration, that is, to cases with an existential quantifier over individuals and a generic or universal quantifier over events, and shows that the SE analysis but not the GQ analysis can successfully account for the interpretation of indefinites in bare habituais and in sentences that contain overt adverbs of quantification.

The structure of the paper is as follows. Section 2 introduces the SE analysis and discusses the advantages that it has been claimed to have over the more traditional GQ analysis. Section 3 presents data concerning bare habituais and sentences with adverbs of quantification which have not been considered yet in connection with the comparison between the GQ analysis and the SE analysis and which form the empirical basis of the paper. Subsequently, sections 4 and 5 discuss two alternative approaches to the semantics of habituality and evaluate the GQ analysis and the SE analysis with respect to how successful they are in modeling the interpretation of indefinites in bare habituais and overtly quantified sentences, given that these approaches to habituality are adopted. In particular, section 4 shows that neither of the two analyses produces the desired results if a quantificational approach to habituality in terms of a generic quantifier is adopted. In turn, section 5 presents an alternative non-quantificational approach to habituality and shows that in combination with it, the SE analysis can successfully account for the semantic behavior of indefinites in bare habituais and overtly quantified sentences, whereas the GQ analysis cannot. Section 6 concludes.

2. Quantification and events

This section introduces the main features of the SE analysis of QPs in comparison with the more traditional GQ analysis and the reasons why it has been proposed. As has already been discussed in the introduction, the type composition in (2) allows QPs to be of type $\langle\langle e, vt \rangle, vt \rangle$. Given this semantic type, the QP *every girl* could have the following denotation, which would be only a small departure from the standard GQ semantics in (3):

$$(5) \quad \llbracket \text{every girl} \rrbracket = \lambda P. \lambda e. \forall x [\mathbf{girl}(x) \rightarrow P(x)(e)]$$

Quantificational DPs of this semantic type can either be interpreted in situ, or they can undergo optional QR to a position of type $\langle v, t \rangle$ (for instance, VoiceP), i.e. a position at which the event argument is not quantified over yet. This implies that quantifiers over individuals introduced by such QPs will always be in the scope of the event quantifier. However, the event quantifier has been observed to take the lowest scope possible with respect to other scope-taking elements such as other quantifiers or negation (cf. Schein, 1993; Landman, 2000), as the examples below demonstrate.³

- (6) John kissed every girl.
- a. $\forall x \gg \exists e$
 - b. $*\exists e \gg \forall x$

³Throughout the paper, ‘ \gg ’ means ‘has scope over’.

(7) John didn't kiss Mary.

- a. $\neg \gg \exists e$
 b. $*\exists e \gg \neg$

This fact, which, following Landman (2000), I will call the Event Type Principle, is straightforwardly accounted for by the GQ analysis insofar as it requires QPs to undergo obligatory QR to a position of type t , i.e. above the event quantifier. By contrast, the semantics in (5) fails to account for the Event Type Principle, and for this reason Schein (1993) argues that an $\langle\langle e, vt \rangle, vt \rangle$ type semantics of QPs should rather be as below (repeated from (4)):

(8) $[\text{every girl}] = \lambda P. \lambda e. \forall x [\mathbf{girl}(x) \rightarrow \exists e' [e' \sqsubseteq e \wedge P(x)(e')]]$

Instead of containing just one variable ranging over events, the semantics in (8) contains two: one over 'ensemble' events (sum events) and one over their sub-events. The single event variable in standard (neo-)Davidsonian event semantics corresponds here to the variable ranging over sub-events, which is existentially quantified over in the nuclear scope of quantifiers over individuals. This is precisely what accounts for the Event Type Principle in this framework.

Before proceeding to the advantages that this analysis has been argued to have, I should note that, in fact, the semantics in (8) is too weak, as pointed out by Ferreira (2005). This is because it places no restrictions on the identity of the 'ensemble' events: thus e.g. in (6), the sum event containing individual events of kissing of a girl by John should be an event of girl-kissing by John itself, while (8) would give us that the sum event can be any event that contains events of kissing of a girl by John as its sub-events, even if it also contains other kinds of sub-events. For this reason, Ferreira (2005) suggests that Schein's semantics of QPs should be modified such that it includes a further restriction on the sub-events which ensures that they are all of the right kind:

(9) $[\text{every girl}] = \lambda P. \lambda e. [\forall x [\mathbf{girl}(x) \rightarrow \exists e' [e' \sqsubseteq e \wedge P(x)(e')]] \wedge \forall e' [e' \sqsubseteq e \rightarrow \exists x [\mathbf{girl}(x) \wedge P(x)(e')]]]$

Both Schein's semantics in (8) and Ferreira's semantics in (9) get the scope facts (i.e. the Event Type Principle) right, as is shown below for *John kissed every girl* using the denotation in (9) and ignoring tense.

(10) a. John kissed every girl. $\exists e \gg \forall x \gg \exists e'$
 b. $\exists e [\mathbf{agent}(\mathbf{john})(e) \wedge \forall x [\mathbf{girl}(x) \rightarrow \exists e' [e' \sqsubseteq e \wedge \mathbf{kiss}(e') \wedge \mathbf{theme}(x)(e')]] \wedge \forall e' [e' \sqsubseteq e \rightarrow \exists x [\mathbf{girl}(x) \wedge \mathbf{kiss}(e') \wedge \mathbf{theme}(x)(e')]]]$

However, the original motivation for the SE analysis hasn't been to account for the Event Type Principle: the GQ analysis can account for it in a much simpler way. The reason why Schein proposed this analysis is that it can also account for some further data which are problematic for the standard GQ analysis, namely adverbs qualifying ensemble events and mixed cumulative/distributive readings. Adverbs that qualify ensemble events are illustrated in the examples

The goal of this paper is to show that, in fact, the SE analysis also provides a better account of the Event Type Principle than the GQ analysis if, in addition to cases involving a universal quantifier over individuals and an existential event quantifier, inverse cases with an existential quantifier over individuals and a generic or universal event quantifier are considered as well. Hence, the next section presents data concerning the interpretation of indefinites in bare habituals and in sentences that contain overt adverbs of quantification.

3. Bare habituality vs. overt quantification

3.1. Interpretation of indefinites

This section introduces the first crucial piece of data, which concerns the semantic behavior of indefinites in bare habituals and in sentences containing overt adverbs of quantification, more specifically, the availability of narrow scope readings of indefinites in these contexts.

The semantics of bare habitual sentences, such as the ones in (14) below, is usually assumed to contain a silent generic quantifier GEN (see, e.g., Krifka et al., 1995), an unpronounced generic counterpart of overt adverbs of quantification (Q-adverbs) like *always* or *often*.

- (14) a. John smokes.
 b. John smokes a pipe.
 c. John smokes cigarettes.

Quantificational adverbs like *always* as well as quantificational adverbials like *every morning* introduce quantifiers over events or times⁵, which enter into scope relations with other quantifiers, as the sentences below with the singular indefinite *a cigarette* demonstrate. Hence, both scope configurations are available in these examples, even though only one of them is pragmatically felicitous: the wide scope reading of *a cigarette* suggests that the same cigarette is repeatedly smoked over a long period of time, which is in conflict with world knowledge (notice that, by contrast, *a pipe* or the plural indefinite *cigarettes* are pragmatically fine).

- (15) John smokes a cigarette **every morning**.
 John **always** smokes a cigarette.
 a. $\# \exists \gg \forall$
 b. $\forall \gg \exists$

If GEN is indeed a quantifier like the one introduced by *always* or *every morning*, one would expect bare habituals containing indefinites to display analogous scope ambiguities. However, this does not seem to be the case, as examples like (16) suggest: while the wide scope reading of *a cigarette* is pragmatically infelicitous like before (notice that the bare habitual with *a pipe* in (14) is fine), the fact that (16) is odd altogether suggests that the narrow scope reading of *a cigarette* is not available for some reason, as has been repeatedly pointed out in the literature

⁵In later sections, I will argue that Q-adverb(ial)s like *always* and *every morning* introduce quantification over times. For now I am staying neutral in this respect however, given that it is commonly assumed that Q-adverbs quantify over events.

(possibly the earliest mentioning of this fact can be found in Carlson (1977)).⁶

- (16) #John smokes a cigarette.
 a. # $\exists \gg \text{GEN}$
 b. * $\text{GEN} \gg \exists$

Note that, under the assumption that (16) contains the generic quantifier GEN, the scope facts in (16) seem to be just another manifestation of the Event Type Principle discussed above: the event quantifier (in this case, GEN) takes the lowest scope possible with respect to quantifiers over individuals. In the literature on genericity and habituality, the obligatory wide scope of indefinites in bare habituals has often been accounted for by assuming that there is something special about GEN as compared to overt Q-adverbs. One possibility, explored in Cohen (2013), is to assume that the null generic quantifier differs from overt adverbs of quantification insofar as it is introduced by type-shifting, whence its narrow scope. More commonly, however, a more radical departure from the analysis of bare habituals in terms of GEN is entertained, whereby they are assumed to contain a scopeless non-quantificational generic operator, rather than the generic quantifier GEN (for various versions of this analysis, see Carlson, 1977; Rimell, 2004; van Geenhoven, 2004; Ferreira, 2005; Kratzer, 2008; Boneh and Doron, 2013). Sections 4 and 5 will discuss both the quantificational and the non-quantificational treatment of bare habituals in more detail. Before we get there, however, another important piece of data concerning bare habituals needs to be introduced.

3.2. Q-adverbs in habituals

Another crucial piece of data concerning habituals has to do with the fact that, in languages which have specialized habitual tense forms, these tense forms can combine with adverbs of quantification. This can be seen even in English, which does not have rich aspectual morphology, in the case of simple present habituals and, more clearly, the *used to* construction, as the examples below show:

- (17) a. John used to smoke.
 b. *John used to smoke **once/yesterday**.
 c. John used to smoke **every day**.
 d. John used to **always** smoke (on the phone).

The incompatibility of the *used to* form with adverbs like *once* and *yesterday* shows that it is a

⁶Note that sentences like (16) are fine in the presence of overt or implicit (contextually specified) restrictors, as the examples below demonstrate:

- (i) John smokes a cigarette $\left\{ \begin{array}{l} \text{when he is nervous} \\ \text{after dinner} \end{array} \right\}$.
 (ii) A: What does John do before going to sleep?
 B: He smokes a cigarette.

I won't be concerned with such cases in this paper, simply assuming that they contain a silent *always* as a default adverb of quantification (Lewis, 1975), which is licensed if an overt or implicit restrictor is present. In this way, the examples above are just a sub-case of the paradigm in (15).

specialized habitual form, which cannot occur in episodic environments. On the other hand, it is perfectly compatible with adverbs of quantification, such as *always* and *every day*. The same is of course also true of the simple present form, which occurs not only in bare habituals, but also in sentences containing adverbs of quantification.

This fact holds in a more transparent way for languages with richer aspectual morphology that have specialized habitual marking, such as, for instance, Hindi/Urdu and Ewe, cf. the examples below. In particular, the specialized habitual morpheme *-taa* in Hindi/Urdu can co-occur with quantificational adverbials like *every day*; in fact, the habitual aspect *must* be used when such adverbials are present. The same holds for the habitual marker *-na* in Ewe.

- (18) Raam (roz / *ek baar / *kal) sigret pii-taa thaa.
 R. every_day one time yesterday cigarette drink-HAB be.PAST
 ‘Ram smoked/would smoke (every day/*once/*yesterday).’ (Hindi/Urdu)⁷
- (19) Agbenyo yi-na suku ŋdi sia ŋdi.
 A. go-HAB school morning that morning
 ‘Agbenyo goes to school every morning.’ (Ewe)⁸

The fact that the habitual verbal morphology is not only compatible with adverbs of quantification, but is even required in their presence, is often not taken into consideration in the analyses of the semantics of habituality. However, this fact is crucial for understanding habitual semantics, given that the habitual morphology should be attempted to be given a unified analysis across its uses in bare habituals and habituals with overt adverbs of quantification. In particular, the problem is that it is not immediately clear how to avoid double event plurality without assuming semantic inertness of habitual markers in the presence of Q-adverbs. The next section will show that this is a serious problem for a quantificational analysis of habituals.

4. Quantificational analysis of habituals

4.1. The GQ analysis

This section discusses the quantificational analysis of habituals and shows that, in combination with the GQ analysis of QPs, it fails to adequately model the semantic behavior of indefinites in bare habituals and habituals containing adverbs of quantification in a unified way.

Let us first spell out the quantificational analysis of habituals based on the silent generic quantifier GEN in somewhat more precise terms. GEN is usually assumed to be a modalized quantifier with quasi-universal force, which is designed to account for such properties of generics as, e.g., their non-accidental law-like nature and their tolerance to exceptions (cf. Dahl, 1975; Chierchia, 1995; Krifka et al., 1995; Cohen, 1999; Greenberg, 2003). Furthermore, given that the habitual is a variety of the imperfective aspect, it is plausible to assume that its semantics is introduced by a special aspectual head. On the quantificational analysis of habituals, the

⁷Gurmeet Kaur, p.c.

⁸Agbojo and Litvinov (1997).

denotation of this habitual Asp head, which is null in English, may be formalized for example along the following lines:

$$(20) \quad \llbracket \text{HAB} \rrbracket = \lambda P. \lambda t. \exists e [t \subseteq \tau(e) \wedge \text{GEN}e' [e' \sqsubseteq e \wedge \mathbf{C}(e')]] [P(e')]$$

Like any imperfective head, HAB takes a property of events, quantifies over the event variable, maps the event to its run time by means of the temporal trace function τ (cf. Krifka, 1989), and relates the event time to some reference time t , such that the reference time is included in the event time (cf. Reichenbach, 1947; Klein, 1994; Giorgi and Pianesi, 1997; Kratzer, 1998). What is special about HAB in (20) as compared to other imperfective heads is that the event quantifier is generic rather than existential and that the reference time is located within the run time of the entire habitual sequence rather than any of its sub-events.⁹

Now, given the denotation of HAB in (20), the GQ analysis unproblematically accounts for the obligatory wide scope of indefinites in bare habituals and, thus, for the pragmatic infelicity of sentences like *John smokes a cigarette*: because of the obligatory QR of QPs above the event quantifier, the only scope configuration it can derive for such sentences is $\exists x \gg \text{GEN}e$. What is more, this scope configuration gets derived without any further assumptions (such as, e.g., type-shifting in Cohen (2013)), since QPs must undergo QR above the generic quantifier, while the aspectual head HAB, which introduces the generic quantifier, cannot be QRed.

However, the GQ analysis encounters a problem with habitual sentences containing adverbs of quantification under the assumption that also such sentences contain HAB, as the data discussed in the previous section suggest. Thus, for instance, *John smokes a cigarette every morning* would have the following two scope possibilities if the GQ analysis is adopted in combination with the semantics of HAB in (20):

- (21) John smokes a cigarette every morning.
- a. $\forall \gg \exists \gg \text{GEN}$
 - b. $\exists \gg \forall \gg \text{GEN}$

In both cases, there is too much event plurality: both of the readings imply that a habitual series of smoking events occurs per morning, yielding an unusual short-lived habituality. Moreover, in both cases the indefinite takes scope over the generic quantifier, which should result in pragmatic infelicity, contrary to fact.

Note, finally, that this problem of double event plurality is not restricted to cases with adverbs of quantification, but also occurs when other, non-temporal quantifiers are present, as, e.g., in the example below. Again, the readings that this sentence is predicted to have imply that John habitually smokes in each of the pubs.

- (22) John smokes a cigarette in every pub he walks into.

⁹The semantics of HAB does not necessarily need to be formalized in such a way that it contains a variable over sum events, i.e., the entire habitual sequences, like in (20). Alternatively, it can also be defined by means of convex closures (cf., e.g., Boneh and Doron, 2008).

Intuitively, the situation could be saved if the event quantifier was existential in such cases, i.e. if the aspectual head contributed an episodic semantics. This would mean, however, that the habitual morphology will have to have a different semantics in sentences containing adverbs of quantification and other quantifiers introducing pluralities than its semantics in bare habituals, and thus a unified analysis of habituality would not be possible.

4.2. The SE analysis

The quantificational approach to habituals faces the problem of double event plurality in combination with the SE analysis of QPs in the same way as it does in combination with the GQ analysis. In addition, however, it also fails to account for the semantic scope of indefinites in bare habituals—something that the GQ analysis has no problems with, as we have seen in the previous section. In particular, given the semantic type of QPs on the SE analysis ($\langle\langle e, vt \rangle, vt \rangle$), they can only be QRed to positions below the event quantifier, if they undergo QR at all. Yet this implies that bare habitual sentences like *John smokes a cigarette* will always get the scope configuration $GENe \gg \exists x$, and so should be pragmatically fine, contrary to fact. What is more, it is not clear how to derive the wide scope readings of indefinites in bare habituals at all.

The scope configuration that we would want for bare habitual sentences on the SE analysis is rather $\exists e \gg \exists x \gg GENe'$, where existential quantification over sum events is contributed by the aspectual head, whereas generic quantification over sub-events is introduced in the nuclear scope of quantifiers over individuals, as proposed by Schein (1993). However, this would mean that quantificational determiners *a*, *every*, and so on, will have to be assumed to be ambiguous between two meanings that differ only with respect to the event quantifier that these determiners host in their nuclear scope, namely one with an existential and one with a generic quantifier. In addition, it would also be unclear how to motivate the fact that habitual morphology contributes existential quantification over events.

Thus, independently of the choice of the analysis of QPs, the analysis of habituality in terms of the generic quantifier does not seem to allow for a unified account of the semantic behavior of indefinites in bare habituals and in habituals containing overt quantification. The next section will consider an alternative, non-quantificational approach to habituality.

5. Non-quantificational analysis of habituals

5.1. Habituals as sum events

The semantics of habituals has a common alternative analysis to the one in terms of the generic quantifier GEN. According to it, a habitual series should be modeled as a sum of (proper) part events, rather than as quantification over events. There are various implementations of this idea in the literature (cf. Carlson, 1977; Rimell, 2004; van Geenhoven, 2004; Ferreira, 2005; Kratzer, 2008; Boneh and Doron, 2013), which differ in the details of the proposed semantics of habitual sentences. For the purposes of this paper, these details are not crucial, as the focus of the paper is on the comparison between the GQ analysis and the SE analysis with respect

to certain data concerning habituals, rather than on the semantics of habituals as such. Hence, concentrating on the core idea of the non-quantificational treatment of habituals as plural events and glossing over a lot of other details concerning their semantics, the denotation of the non-quantificational version of the habitual aspectual head HAB may be formalized in the following way, where σ is the sum operator:

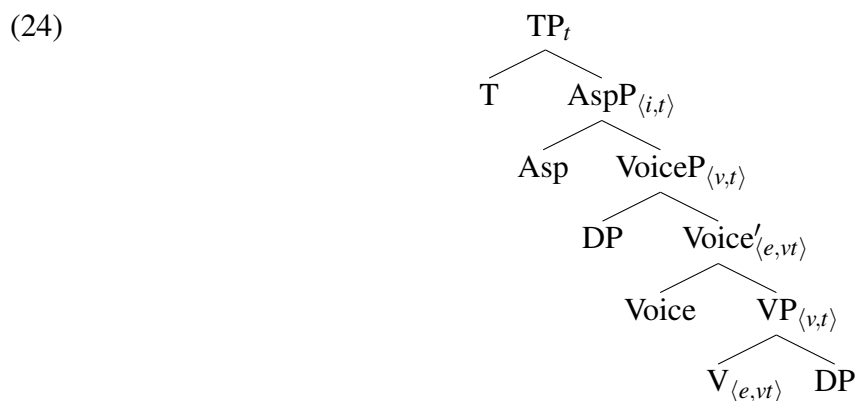
$$(23) \quad \llbracket \text{HAB} \rrbracket = \lambda P. \lambda t. \exists e [t \subseteq \tau(e) \wedge e = \sigma e' [\text{stage}(e')(e)] \wedge P(e)]$$

Note that the semantics in (23) states that the individual events within the habitual series are its stages rather than just parts, that is, it employs the stage-of relation, which has been proposed in Landman (1992) to model the semantics of progressives. This reflects a common view in the literature that, being two varieties of the imperfective, the progressive and the habitual should be modeled alike (e.g., in terms of inertia futures) and that the only difference between them is that PROG selects sets of singular events, while HAB selects sets of plural events (cf. Ferreira, 2005; Deo, 2009; Altshuler, 2014). Here, the complex modal-temporal semantics of habituality will be abbreviated into the predicate **stage**.

Equipped with the semantics of HAB in (23), we can now see whether the two analyses of QPs in combination with the non-quantificational approach to habituality are able to account for the semantic behavior of indefinites in bare habituals and in habituals containing overt adverbs of quantification in a unified way.

5.2. Bare habituals

Let us start with bare habituals, using again *John smokes a cigarette* as a test example. Before spelling out its semantics under the GQ and SE analyses, (24) first illustrates my assumptions with respect to the basic syntactic architecture of a transitive clause and the corresponding type composition (cf., e.g., Giorgi and Pianesi, 1997; Kratzer, 1998; Alexiadou et al., 2003). Here, i is the type of times, or, more precisely, time intervals.



It has already been mentioned before that the aspectual head Asp relates the event time to the reference time. By contrast, the function of the tense head T is to relate the reference time and the utterance time. Accordingly, the locus of event time adverbials (such as, e.g., *on Monday*,

but also *every morning* and *always*) is VP/VoiceP, the locus of reference time adverbials (e.g., *by tomorrow* or *until July 18*) is AspP, while the locus of utterance time adverbials (e.g., *now*) is TP.

Now, given the syntax in (24), the LF of *John smokes a cigarette* under the GQ analysis will be as in (25), where *a cigarette* undergoes obligatory QR to TP for type reasons. (26) provides the interpretation we get for this LF using the non-quantificational denotation of HAB in (23) and assuming that PRES in matrix clauses denotes the deictic pronoun **now** referring to the time of utterance (cf., e.g., von Stechow, 2009).¹⁰

(25) [TP [a cigarette]₁ λ₁ [TP PRES [AspP HAB [VoiceP John smoke t₁]]]]

(26) ∃x[cigarette(x) ∧ ∃e[**now** ⊆ τ(e) ∧ e = σe'[stage(e')(e)] ∧ smoke(x)(john)(e)]]

This semantics adequately represents the pragmatically infelicitous reading that *John smokes a cigarette* has: it states that the same cigarette is smoked in the entire habitual series. Moreover, no other scope possibility is available in this case, as desired.

In fact, the situation is not much different under the SE analysis, as (27) and (28) below show: even though *a cigarette* can now be interpreted in situ (or be QRed to VoiceP, which would be truth-conditionally equivalent), nothing changes in its ‘wide’ scope relation with respect to the sum operator, and therefore the pragmatically odd reading obtains as the only possibility.¹¹

(27) [TP PRES [AspP HAB [VoiceP John smoke a cigarette]]]

(28) ∃e[**now** ⊆ τ(e) ∧ e = σe'[stage(e')(e)] ∧ ∃x[cigarette(x) ∧ smoke(x)(john)(e)]]

Thus, in combination with a non-quantificational approach to habituality, both analyses of QPs are able to account for the wide scope of indefinites in bare habituals.

5.3. Overt quantification

Let us now turn to habituals containing overt adverbs of quantification, such as *John smokes a cigarette every morning*. As already mentioned above, I assume that phrases like *every morning* are (quantificational) event time adverbials, and thus are VP/VoiceP-adjuncts. Furthermore, I also assume that they are in fact PPs, whose null P head relates the time they introduce to the run time of the event, as shown below (Q-adverbs such as *always* are treated in the same way, being the spell-out of phrases like ‘all times’/‘every time’).

(29) [PP P [DP every morning]]

¹⁰To make the semantic formulae below more readable, I will represent the meaning of verbs with *n* syntactic arguments as *n*-ary relations, instead of representing their arguments as separate θ -role conjuncts.

¹¹Indefinites don’t introduce quantification over sub-events in the nuclear scope of the existential quantifier (cf. Schein, 1993; Ferreira, 2005); thus, the denotation of *a cigarette* is $\lambda P.\lambda e.\exists x[\text{cigarette}(x) \wedge P(x)(e)]$. Note that if *a cigarette* had a denotation along the lines of (9), it would get a narrow scope in bare habituals.

$$(30) \quad \llbracket P \rrbracket = \lambda t. \lambda P. \lambda e. [P(e) \wedge \tau(e) \subseteq t]$$

Now, under the GQ analysis, both *a cigarette* and *every morning* denote generalized quantifiers (the latter over times: $\lambda P. \forall t [\mathbf{morning}(t) \rightarrow P(t)]$) and thus have to undergo QR to TP. Below the interpretation which *John smokes a cigarette every morning* gets under this analysis is shown, with *every morning* scoping above *a cigarette*:

$$(31) \quad [{}_{\text{TP}} [\text{every morning}]_2 \lambda_2 [{}_{\text{TP}} [\text{a cigarette}]_1 \lambda_1 [{}_{\text{TP}} \text{PRES} [{}_{\text{AspP}} \text{HAB} [{}_{\text{VoiceP}} \text{John smoke } t_1 [{}_{\text{PP}} t_2]]]]]]]$$

$$(32) \quad \forall t [\mathbf{morning}(t) \rightarrow \exists x [\mathbf{cigarette}(x) \wedge \exists e [\mathbf{now} \subseteq \tau(e) \wedge e = \sigma e' [\mathbf{stage}(e')(e)] \wedge \mathbf{smoke}(x)(\mathbf{john})(e) \wedge \tau(e) \subseteq t]]]]]$$

This semantics is problematic for several reasons. First, it states that there is a habitual series of smoking events per morning, which is not the most natural interpretation of *John smokes a cigarette every morning*, if this sentence has that reading at all. Moreover, the same cigarette is smoked in all sub-events of each of such habitual sum events, which should trigger pragmatic infelicity, contrary to fact. And finally, the run time of each of these habitual events is included in the time of the respective morning, but at the same time, the run times of all of them include now (i.e., these are ongoing events), which is difficult to make sense of. Note that the inverse scope possibility (with *a cigarette* scoping above *every morning*) is available as well, but does not make things better.

Let us now see what happens under the SE analysis. The denotation of *every morning* will be in this case as below (cf. (9)):

$$(33) \quad \llbracket \text{every morning} \rrbracket = \lambda P. \lambda e. [\forall t [\mathbf{morning}(t) \rightarrow \exists e' [e' \sqsubseteq e \wedge P(t)(e')]] \wedge \forall e' [e' \sqsubset e \rightarrow \exists t [\mathbf{morning}(t) \wedge P(t)(e')]]]$$

If *a cigarette* is interpreted in situ and *every morning* undergoes QR to VoiceP, *John smokes a cigarette every morning* gets the following interpretation:

$$(34) \quad [{}_{\text{TP}} \text{PRES} [{}_{\text{AspP}} \text{HAB} [{}_{\text{VoiceP}} [\text{every morning}]_1 \lambda_1 [{}_{\text{VoiceP}} \text{John smoke a cigarette } [{}_{\text{PP}} t_1]]]]]]]$$

$$(35) \quad \exists e [\mathbf{now} \subseteq \tau(e) \wedge e = \sigma e' [\mathbf{stage}(e')(e)] \wedge \forall t [\mathbf{morning}(t) \rightarrow \exists e' [e' \sqsubseteq e \wedge \exists x [\mathbf{cigarette}(x) \wedge \mathbf{smoke}(x)(\mathbf{john})(e')] \wedge \tau(e') \subseteq t]] \wedge \forall e' [e' \sqsubset e \rightarrow \exists t [\mathbf{morning}(t) \wedge \exists x [\mathbf{cigarette}(x) \wedge \mathbf{smoke}(x)(\mathbf{john})(e')] \wedge \tau(e') \subseteq t]]]]]$$

The semantics above adequately captures the most natural reading of *John smokes a cigarette every morning*. It states that there is an ongoing habitual series of smoking events whose sub-events distribute over mornings, and that there is a potentially different cigarette that is smoked in each of the morning smoking events. This is the pragmatically fine narrow scope reading of *a cigarette*; the pragmatically infelicitous wide scope reading can be captured as well, as desired, if *a cigarette* is QRed above *every morning*.

Thus, this shows that only the SE analysis is able to provide an adequate semantics for habitual sentences containing overt adverbs of quantification, provided that a non-quantificational approach to habituality is adopted, while the GQ analysis is not.

6. Conclusion

This paper has shown that, if a non-quantificational approach to habituality is adopted, the GQ analysis and the SE analysis of QPs are not equally suitable for event semantics, as only the latter successfully accounts for the semantic behavior of indefinites in bare habituals and in habituals containing overt adverbs of quantification in a unified way. This is a further argument, in addition to the existing arguments from adverbs qualifying ‘ensemble’ events and mixed cumulative/distributive readings, in favor of an analysis of quantificational DPs that makes use of sub-events.

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Acquaintance content and obviation¹

Pranav ANAND — *UC Santa Cruz*

Natasha KOROTKOVA — *University of Konstanz and University of Tübingen*

Abstract. This paper is about what Ninan (2014) (following Wollheim 1980) calls the *Acquaintance Inference* (AI): a firsthand experience requirement imposed by several subjective expressions such as Predicates of Personal Taste (PPTs) (*delicious*). In general, one is entitled to calling something delicious only upon having tried it. This requirement can be lifted, disappearing in scope of elements that we will call *obviators*. The paper investigates the patterns of AI obviation for PPTs and similar constructions (e.g., psych predicates and subjective attitudes). We show that the cross-constructional variation in when acquaintance requirements can be obviated presents challenges for previous accounts of the AI (Pearson 2013, Ninan 2014). In place of these, we argue for the existence of two kinds of acquaintance content: (i) that of bare PPTs; and (ii) that of psych predicates, subjective attitudes and overt experiencer PPTs. For (i), we propose that the AI arises from an evidential restriction that is dependent on a parameter of interpretation which obviators update. For (ii), we argue that the AI is a classic presupposition. We model both (i) and (ii) using von Stechow and Gillies's (2010) framework for directness and thus connect two strands of research: that on PPTs and that on epistemic modals. Both phenomena are sensitive to a broad direct-indirect distinction, and analyzing them along similar lines can help shed light on how natural language conceptualizes evidence in general.

Keywords: evidentiality, firsthand experience, knowledge, predicates of personal taste, subjectivity

- Cleveland. It's a beautiful city.
- Yes?
- Yeah.
- It's got a big, beautiful lake. You'll love it there.
- Have you been there?
- No, no.

Stranger than paradise

JIM JARMUSH

1. Introduction

This paper is devoted to what Ninan (2014) (following Wollheim 1980) calls the *Acquaintance Inference* (AI): a firsthand experience requirement imposed by several subjective expressions such as Predicates of Personal Taste (PPTs) (*tasty, fun*),² psych predicates (*look, sound*) and subjective attitudes (*find, consider*); see also (Stephenson 2007, Anand 2009, Pearson 2013, Klecha 2014, Ninan 2014, Kennedy and Willer 2016, Bylinina 2017). Asserting sentences in (1), the speaker is committed to having a relevant firsthand experience with the object in

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²For the purposes of this paper, we do not distinguish between predicates of taste proper and e.g. aesthetic predicates such as *beautiful*, as both types of predicates have the AI.

question: gustatory (1a), auditory (1b), or visual (1c).

- (1) a. PPT
The cake was **delicious**, #but I never tasted it.
- b. PSYCH PREDICATE
The piano **sounded** out of tune, #but I never heard it.
- c. SUBJECTIVE ATTITUDE
I **consider** the dress blue and black, #but I never seen it.

The AI also survives under negation:

- (2) a. PPT
The cake wasn't **delicious**, #but I never tasted it.
- b. PSYCH PREDICATE
The piano **didn't sound** out of tune, #but I never heard it.
- c. SUBJECTIVE ATTITUDE
I don't **consider** the dress blue and black, #but I never seen it.

At the same time, even though the AI cannot be explicitly denied or negated, it may disappear in the scope what we will call *obviators*, exemplified with epistemic *might* in (3) below:

- (3) a. PPT
✓The cake was **might have been delicious**, though I never tasted it.
- b. PSYCH PREDICATE
✓The piano **might have sounded** out of tune, though I've never heard it.
- c. SUBJECTIVE ATTITUDE
✓I **might have considered** the dress blue and black, though I've never seen it.

The central puzzle of this paper is the contrast in (3) and (1): Why is obviation possible while explicit denial is not? A larger issue that is related to the epistemology of personal taste but that we are not going to discuss is why subjective expressions have the AI in the first place (see (Bylina 2017, Muñoz 2017) for ontological explanations). We concentrate instead on the status of the AI and the cross-constructural variation in AI obviation that poses challenges for previous accounts of the AI. Our verdict is that there are in fact two types of acquaintance content. With 'bare' PPTs (i.e., ones unmodified by *to/for* phrases), we propose that the AI arises from an evidential restriction that is dependent on a parameter of evaluation that obviators update. With psych predicates, subjective attitudes and overt taster PPTs (*tasty for me*), we argue that the AI is a classic presupposition. Section 2 introduces the empirical landscape. Section 3 discusses previous approaches to the AI (Ninan 2014, Pearson 2013) and their shortcomings. Section 4 presents our direct proposal couched in terms of von Fintel and Gillies's (2010) kernels. Section 5 concludes.

2. Empirical landscape

This section discusses what types of situations can constitute direct experience with different PPTs, categorizes contexts in which the AI disappears and talks about the patterns of AI obviation with different subjective expressions.

2.1. Directness

Before we proceed, a discussion of issues related to the nature of firsthand experience is in order. First of all, while some PPTs, such as *tasty* (1a) or *delicious*, dictate the type of experience, some others, such as *gorgeous* (4) or *beautiful*, exhibit more freedom, with sensory modality depending on the specific stimulus:

- (4) My blindfolded dance last night was **gorgeous**. I couldn't see what I was doing, but I could feel my body in each position.

What exactly counts as firsthand depends on a situation. First, the experience does not have to be complete: in fact, even smaller samples entitle the experiencer to a judgment about the stimulus (5a), which is in contrast with no experience at all (5b):

- (5) a. INCOMPLETE EXPERIENCE:
 ✓I only watched { the trailer / the first five minutes }. This movie is **boring**.
 b. NO EXPERIENCE:
 #The new Allen movie is **boring**. I haven't watched it, but they are all the same.

Examples like (5b) above should not be confused with cases of type-token ambiguity (6):

- (6) a. TYPE
 Massaman curry is delicious, ✓I've tried it before at another restaurant.
 b. TOKEN
 This Massaman curry is delicious, #but I haven't tried it yet.

Second, the presence of an AI does not always indicate immediate perception. For example, I am entitled to call the San Juans beautiful even if I have only seen a picture of the range. However, the boundary between firsthand and non-firsthand is not clear-cut. While I am not entitled to calling the curry tasty upon looking at a picture or reading a recipe, I may well be upon seeing other patrons ordering it or reading reviews, and judgments about those latter cases vary.

Finally, world knowledge needs to be factored in. Different tasters will have different thresholds for what can be classified as firsthand. A professional photographer looking at a histogram or a professional musician looking at a string of notes would be entitled to make an aesthetic judgment, while a layperson would not.

The above issues related to the nature of firsthand experience are not unique to PPTs alone and arise with other natural language expressions dealing with evidence, including evidentials (REFS: faller, mcreedy) and epistemic modals (von Fintel and Gillies 2010). For example, different languages with grammatical evidentiality may conceptualize the same situation, such as inference from observable results, in different ways (Korotkova 2016). While a thorough discussion is beyond the scope of this paper, the central observation still stands: PPTs encode a type of firsthand experience, however construed, and our direct knowledge proposal in Section 4 captures this intuition.

2.2. Obviators

As shown in Section 1, the AI is not always present and disappears in the scope of epistemic *might* (3). The list of what we call *obviators* is in fact broader and includes epistemic *must* (7a), epistemic adverbs (7b), futurate operators (7c) and predicates of clarity (7d) (cf. also Pearson 2013, Klecha 2014, Ninan 2014).

(7) The cake delicious, but I never tasted it.

- a. EPISTEMIC MODAL AUXILIARIES:
✓**must/might** have been
- b. EPISTEMIC ADVERBS:
✓**probably/possibly/maybe** was
- c. FUTURATE OPERATORS:
✓**will/is going to** be
- d. PREDICATES OF EVIDENCE/CLARITY:
✓**obviously/certainly/apparently** was

Klecha (2014) argues that obviation diagnoses the presence of a modal operator. We propose instead that obviators convey *indirectness* of some sort (see also Winans 2016 on *will*) and thus do not commit ourselves to a theory where all obviators belong to the same semantic category (pace Klecha 2014). Fittingly, grammatical markers of indirect evidentiality also follow the pattern, as illustrated with Turkish *miş* in (8) (see Şener 2011 on evidentiality in Turkish):

(8) Turkish (Turkic: Turkey)

- a. BARE FORM:
#Durian güzel, ama hiç dene-me-di-m.
durian good, but ever try-NEG-PST-1SG
Intended: ‘Durian is good, but I’ve never tried it’.
- b. EVIDENTIAL *miş*:
✓Durian güzel-**miş**, ama hiç dene-me-di-m.
durian good-IND, but ever try-NEG-PST-1SG
‘Durian is good, *I hear/infer*, but I’ve never tried it’.

Additionally, hedges (9) and markers of emphatic certainty such as *I know* (10) lift the AI:

(9) HEDGES:

I assume/suppose/think that the cake was delicious, but I haven't tasted it.

(10) a. BARE FORM:

#Climbing the Half Dome is amazing. We should do it.

b. I KNOW:

✓I know that climbing the Half Dome is amazing. We should do it.

ONE SENTENCE ABOUT I KNOW & REF

In the rest of the paper, we restrict our attention to clause-mate obviators to avoid potential confounds related to the syntax of parenthesis.

2.3. Overt tasters: PPTs and otherwise

So far, we have been talking only about “bare” uses of PPTs, ones where the linguistic form does not make the relevant taster explicit. However, PPTs also admit overt tasters introduced by prepositions *to* and *for* in English, such as in *tasty to me* or *to Hobbes* (see Bylinina 2017 on cross-linguistic parallels). As (11) indicates, obviation patterns with covert³ and overt tasters are distinct:

(11) OVERT TASTER PPs:

The cake delicious to me, but I never tasted it.

a. EPISTEMIC MODAL AUXILIARIES:

#must/✓might have been

b. EPISTEMIC ADVERBS:

#probably/#possibly/#maybe was

c. FUTURATE OPERATORS:

✓will/✓is going to be

d. PREDICATES OF EVIDENCE/CLARITY:

#obviously/#certainly/#apparently was

The AI of bare PPTs is lifted in the scope of *all* operators from (11). However, overt tasters impose much stricter conditions on obviation. Under many accounts of PPTs (see Coppock 2018 for a recent discussion), the possibility of having an explicit taster expressed via a PP is often treated as an argument for making PPTs dyadic predicates, with either an overt taster (via a PP with a semantically inert P) or a covert pronominal-like taster supplied for bare uses (a.o. Stephenson 2007, Stojanovic 2007, Pearson 2013, Bylinina 2017). Such theories would thus predict that overt and covert tasters should behave the same with respect to obviation. As (11)

³We are not committed to a view such that tasters are always represented in the linguistic structure and will use the term *covert taster* descriptively to refer to a situation when the taster is not present in the surface structure.

shows, this prediction is not borne out, which can be used as an argument against theories that treat overt and bare uses on a par.

In introduction, we have shown that other subjective expressions, namely psych predicates and subjective attitudes, also have an AI (1b, 1c) that disappears in the scope of *might* (3b, 3c). The overall obviation pattern with those expressions resembles that of PPTs vis-à-vis the presence of an overt experiencer. For psych predicates that do not have an overt perceiver, the AI can be lifted by obviators from section 2.2, as shown in (12) below:

- (12) PSYCH PREDICATE WITHOUT AN EXPERIENCER:
The cake delicious, but I never tasted it.
- a. EPISTEMIC MODAL AUXILIARIES:
✓**must/might** have looked
 - b. EPISTEMIC ADVERBS:
✓**probably/possibly/maybe** looked
 - c. FUTURATE OPERATORS:
✓**will/is going to** look
 - d. PREDICATES OF EVIDENCE/CLARITY:
✓**obviously/certainly/apparently** looked

For cases where the experiencer is overtly present in the linguistic form, the obviation pattern is constrained in the same way it is with overt taster PPTs (11), as illustrated in (13) for psych predicates and in (14) for subjective attitudes:

- (13) PSYCH PREDICATE WITH AN EXPERIENCER:
The cake delicious to me, but I never tasted it.
- a. EPISTEMIC MODAL AUXILIARIES:
#**must**/✓**might** have looked
 - b. EPISTEMIC ADVERBS:
#**probably**/#**possibly**/#**maybe** looked
 - c. FUTURATE OPERATORS:
✓**will**/✓**is going to** look
 - d. PREDICATES OF EVIDENCE/CLARITY:
#**obviously**/#**certainly**/#**apparently** looked

- (14) SUBJECTIVE ATTITUDE:
I the cake delicious, but I never tasted it.
- a. EPISTEMIC MODAL AUXILIARIES:
#**must**/✓**might** have found
 - b. EPISTEMIC ADVERBS:
#**probably**/#**possibly**/#**maybe** found
 - c. FUTURATE OPERATORS:

✓will/✓is going to find

- d. PREDICATES OF EVIDENCE/CLARITY:
#obviously/#certainly/#apparently found

Examples (11), (13) and (14) demonstrate that expressions where the experiencer whose first-hand experience is tracked by the AI is overt all pattern together and allow obviation only in a limited set of contexts: under futurate markers *will* and *going to*, and under epistemic *might*. We suggest that such cases of obviation are simply instantiations of local accommodation in the scope of a future (or counterfactual) operator, which does not obviate the AI *per se* as much as temporally displaces it. Indeed, if one attempts to counter that displaced AI, contradiction results:

- (15) a. #Even if I hadn't tried the cake, I might have found it delicious.
b. #Even though I am never going to ever try it, the cake is going to be delicious to me.

Bare PPTs and psych predicates, on the other hand, are more liberal. These facts are summarized in table 1 below.

OBVIATORS	COVERT EXPERIENCERS		OVERT EXPERIENCERS		
	PPT	Psych predicates	PPT	Psych	Subjective attitudes
<i>must</i>	✓	✓	#	#	#
<i>might</i>	✓	✓	✓	✓	✓
epistemic adverbs	✓	✓	#	#	#
predicates of clarity	✓	✓	#	#	#
futurate markers	✓	✓	✓	✓	✓

Table 1: Obviation facts

The next section is about previous approaches to the AI obviation. We will show that they are not fine-grained enough to account for the discrepancy in behavior between overt and covert tasters and that not all of them actually explain the main puzzle, namely the possibility of obviation in the first place. In section 4, we present our account and use obviation as a tool to adjudicate between different approaches to PPTs.

3. Previous approaches

3.1. Pragmatics: Ninan (2014)

Ninan (2014) offers a pragmatic account according to which the AI arises due to an epistemologically grounded norm of assertion.⁴

⁴As Ninan himself notes, the exact inventory of the norms of assertions is actively debated in epistemology and philosophy of language (Williamson 2000, Lackey 2007, Weiner 2005), and it is not essential for his analysis whether assertions require knowledge rather than, say, justified belief.

(16) In order to know the truth of *x is tasty*, the speaker must have prior experience with *x*.

Asserting unmarked sentences typically assumes such knowledge, which results in the infelicity of explicit denials, as illustrated in (17, repeated from 1a):

(17) #The cake was delicious, but I never tasted it.

If one were to assert that the cake is tasty, one could do it only in case they have tried it, as per (16). However, the second conjunct states that the speaker has no experience with the cake, which yields a clash. Under this approach, (17) is odd not because of the semantics of PPTs but due to a conflict between what is said and what the speech act of assertion requires. Such an explanation is along the lines of classic?traditional?popular?widespread accounts of Moore's paradox (REFS). It predicts that, just like with Moore-paradoxical sentences (Yalcin 2007), the oddness would go away in attitude reports, an environment that demarcates the divide between semantics and pragmatics. As the non-contradictory (18) shows, the prediction is borne out (as we discuss in section 4, Ninan's is not the only way to account for the felicity of (18)):

(18) Jay thought that the cake was delicious and that he has never tasted it.

Ninan (2014) correctly predicts that negated sentences with PPTs still carry an AI because linguistic negation does not affect knowledge requirements. Obviation, on the other hand, is possible because marked (e.g. modalized) propositions are not subject to the convention in (16). The pragmatic account therefore successfully explains the Puzzle. However, there are at least two challenges faced by this type of proposal.

The first problem is the cross-constructural variation in AI obviation. As shown in section 2.3, obviation is limited with overt tasters, the relevant contrast repeated in (19) below:

- (19) a. COVERT TASTER:
 ✓The San Juans must be beautiful, but I have never seen them.
 b. OVERT TASTER:
 #The San Juans must be beautiful to me, but I have never seen them.

Ninan does not discuss overt tasters, but it seems reasonable to assume that the convention in (16) would be insensitive to the linguistic form of the taster and apply to sentences with overt taster PPs just as well. It is then expected that obviation patterns with overt and covert tasters would be the same, contrary to fact.

The second problem for Ninan are the so-called non-autocentric uses (Lasersohn 2005). Generally, PPTs describe the speaker's tastes. However, PPTs can be also used to talk about third party's judgments (cf. Stephenson 2007):

(20) Rotting flesh is delicious (to a vulture). (adapted from Egan et al. 2005)

Non-autocentric readings also have an AI (21a) that is subject to obviation (21b). Ninan's (2014) pragmatic approach rooted in the *speaker's* knowledge does not predict it.

(21) EXOCENTRIC AI

- a. Hobbes's new food is tasty, #but no cat has ever tried it yet.
- b. ✓Hobbes's new food { **must be** / **obviously is** / **will be** } tasty, but no cat has ever tried it yet.

Based on the data from overt tasters and the non-autocentric AI, we conclude that Ninan's proposal undergenerates and does not fully account for AI obviation.

3.2. Semantics: Pearson (2013)

A different approach to the AI is due to Pearson (2013). The core components of her proposal relevant to our discussion here are an experience presupposition and first-person genericity (see ?Anand 2009; and especially Moltmann 2010, 2012). The formal details (in a simplified version) are laid out below.

(22) $\llbracket \text{tasty-to} \rrbracket^{c,i} = \lambda x \lambda o : x \text{ has tried } o \text{ in } \text{WORLD}(i). 1 \text{ iff } o \text{ is } \textit{tasty} \text{ to } x \text{ in } \text{WORLD}(i)$

The presupposition in (22) ensures that statements with PPTs are only felicitous when the taster x has firsthand experience with the stimulus o . It cannot be cancelled, which accounts for the infelicity of explicit denials (3), and projects out of negation, which explains why even negated PPTs trigger an AI (2).

Pearson argues that PPTs display the signature behavior of individual-level predicates (e.g. *tall*; Carlson 1980) such as universal interpretations with bare plurals and infelicity in existential constructions. She further adopts Chierchia's (1995) analysis of individual-level predicates, wherein all such predicates are inherently generic, and argues that PPTs always come with GEN:⁵

- (23) a. This is tasty.
- b. [This_{*i*} [GEN *t_i* is tasty]

GEN binds the taster argument x and is restricted by quantificational domain restriction *Dom*:

⁵Czypionka and Lauer (2017) argue against Chierchia's (1995) proposal, but the genericity of PPTs can be, and has been, formalized in a number of other ways, see (?Anand 2009, Moltmann 2010, 2012), so this specific worry is not important for our criticism of Pearson's approach.

(24) $[\forall \langle x, w' \rangle : x \in Dom]$ [the cake is tasty-to x in w']

The experience presupposition projects universally yielding the following:

(25) $[\forall \langle x, w' \rangle : x \in Dom]$ [x has tried o in w']

Unlike Ninan (2014), Pearson can account for the non-autocentric AI. This is achieved in the following way. By default, the speaker is included in Dom , which reflects the intuition that most uses of PPTs are about the speaker's tastes. However, there are cases when the speaker's tastes are irrelevant. This is precisely the situation with classic non-autocentric uses of PPTs (20), where the speaker is not the "target audience" and thus not in Dom (Pearson does not specify when exactly the speaker can be irrelevant, which, as we will see below, is problematic). However, the presence of an AI does not depend on who the taster is because the presupposition is generic. This explains that even non-autocentric uses will have an AI (21a) that is no different from an autocentric one.

Pearson attempts to solve the Puzzle by using reasoning from indirectness (her discussion is based on *must*, but can easily be extrapolated to other obviators from section 2.2). According to von Stechow and Gillies (2010), Lassiter (2016), *must* signals the lack of direct evidence for its predjacent. In case of statements with PPTs, it would mean that the speaker (in default cases) has no firsthand evidence for o 's tastiness. And if the speaker hasn't tried o , the speaker will be irrelevant and thus not in Dom . When the speaker is not in Dom , the generic presupposition does not apply to them and obviation is felicitous.

This type of proposal explains obviation, but, as pointed out by Ninan (2014), it overgenerates. Reasoning from indirectness should carry over to explicit denials. If the speaker can be irrelevant with *must*, which indicates that they have no firsthand experience, then by the same token the speaker should be irrelevant with explicit denials. However, obviation is allowed, while continuations in (1). So Pearson does not actually solve the Puzzle.

Her proposal faces further problems. It predicts that the speaker, when not in Dom , is necessarily irrelevant and is not committing to a judgment on o if/when they do try it. The prediction is false, since an explicit continuation as in (26) leads to contradiction.

(26) Just look at it! The cake { is / must be } delicious, #but I am going to find it disgusting.

Finally, by connecting the AI to genericity, Pearson's (2013) analysis predicts that the verifying instance-hood of dispositional generics like the example in (27a) should pattern like PPTs. However, the obviation with these generics is even more constrained (27b). That is, the existence of a verifying smiling instance in (27a) does not seem to be obviatable by operators such as *obviously*:

- (27) a. Flavio smiles.
 b. Even though your son hasn't smiled yet, based on his age, he **obviously** { #does / ✓can }.

We conclude that Pearson's proposal does not account for AI obviation. In the next section, we present an account that does.

4. A direct proposal

We take the acquaintance content of PPTs to comment on direct evidential grounds for a proposition and model the AI following the account of directness proposed by von Fintel and Gillies (2010) (vF&G) for epistemic *must*.

4.1. Framework for directness

von Fintel and Gillies (2010), and later Lassiter (2016), argue that epistemic *must* is sensitive to evidential grounds for a proposition. Their point of departure is as follows. Statements with epistemic *must* are infelicitous if the predjacent *p* was learned via immediate perception and felicitous if *p* was inferred, as the minimal pair in (28) and (29) illustrates:

- (28) *Looking out of the window and seeing a downpour:* PERCEPTION
 a. ✓It is raining.
 b. # It must be raining.
- (29) *Seeing people with wet umbrellas:* INFERENCE
 a. # It is raining.
 b. ✓It must be raining.

To account for the contrast between (28) and (29), vF&G propose that *must* can only target information that is not known directly. They assume an epistemological framework in which knowledge comes in (at least) two flavors: propositions that are known directly, e.g. via immediate perception, and propositions that are known but indirectly, e.g. via reasoning. This is formalized using *kernels* (30):

- (30) KERNELS
 a. A kernel *K* is a set of propositions that encode direct knowledge
 b. *K* directly settles (whether) *p* iff $\exists q \in K [q \subseteq p \vee q \subseteq \neg p]$
 c. The proposition $\bigcap K$ is a vanilla epistemic modal base: the set worlds compatible with what is known directly and indirectly

Importantly, $\bigcap K$ may entail *p* without *K* directly settling whether *p*. *K* directly settles whether it is raining in (28) but not in (29). Under the proposed analysis, *must* presupposes a lack of

direct settlement (i.e., indirect evidence); this then accounts for the contrast in (28) and (29):

(31) MUST

- a. $\llbracket \text{must } p \rrbracket^{c,i}$ is defined only if K does not directly settle $\llbracket p \rrbracket^c$
- b. If defined, $\llbracket \text{must } p \rrbracket^{c,i} = 1$ iff $\bigcap K \subseteq \llbracket p \rrbracket^c$

Unlike what (28,29) would suggest, the licensing of *must* (and hence the notion of direct evidence) is hardly straightforward. For one thing, relative to context, it may even admit immediate perception. Professional epistemologists—trained to be skeptical of their own eyes—may use *must* even when they visually observe rain, and such cases have been used in the recent literature (Giannakidou and Mari 2016, Goodhue 2017) to argue that *must* tracks the lack of knowledge rather than the lack of directness. We believe that vF&G’s observation about the indirectness of *must* can be reconciled with recent criticisms once more research is done on the link between types of knowledge and evidence for claims. For the purposes of this paper, we maintain that *must* carries an evidential signal which can be formalized using kernels.

4.2. PPTs, kernels and obviation

The analysis advocated by vF&G puts epistemic modals in a loose category of linguistic expressions that deal with the divide between direct and indirect evidence. Grammatical markers of evidentiality come to mind first (see e.g. Bybee 1985, Izvorski 1997, Matthewson et al. 2007 on the relation between epistemic modality and evidentiality), but the overall number of such expressions is larger. And if there are distinct phenomena such that their felicity conditions depend on the presence or absence of firsthand experience, then it is only natural to analyze them along similar lines. In this section we do precisely that.

We propose that the AI of PPTs and other subjective expressions is another instance of kernel-dependence. In doing so, we do not commit ourselves to a worldview such that all expressions that are “about” evidence must belong to the same semantic category. Instead, we use the concept of (in)directness to link those expressions and, as we will show, specific formal details vary even within PPTs. We use kernels as a convenient formal object that may be manipulated, with the above caveats that they may be incomplete or misguided.

We will treat kernels as interpretative coordinates, much like information states for Yalcin (2007) (cf. also Hacquard 2006). We also use the judge parameter, first proposed by Lasnik (2005), to determine who the taster is in each particular situation. Indices of evaluation are thus minimally 4-tuples: $\langle \text{world, time, kernel, judge} \rangle$. Note that our goal is to give a precise implementation for the AI and that we are largely agnostic about other aspects of the semantics of PPTs. The judges are here for purely representational reasons. It is easy to reformulate our insights within other theories (see MacFarlane 2014, Zakkou 2015, Lasnik 2017, Coppock 2018 for an overview). Finally, we assume that evaluation of a proposition for truth conventionally sets the kernel to that of the speaker’s or non-autocentric judge’s directly experienced knowledge.

Our semantics for PPTs is given in (32):

- (32) a. $\llbracket \textit{tasty} \rrbracket^{c, \langle w, t, K, j \rangle} =$
 $\lambda o : K$ directly settles whether o is tasty for j in w at t . 1 iff o is tasty for j in w at t
 b. K directly settles whether p iff $\exists q \in K [q \subseteq p \vee q \subseteq \neg p]$

Applied to a sentence with a PPT (33a), such semantics yields (33b):

- (33) a. This cake is delicious.
 b. $\llbracket \textit{The cake is delicious} \rrbracket^{c, \langle w, t, K, j \rangle}$
 $= \lambda o : K$ directly settles whether cake is delicious for j in w at t . 1 iff cake is delicious for j in w at t

The semantics in (32) and (33) says nothing about the judge having firsthand experience with the stimulus. We propose that the AI arises because, ontologically, the only way to directly settle whether something is tasty is for the relevant taster to try it. An unmodified sentence with a PPT will be undefined otherwise. Because we model the direct settlement requirement as a presupposition, the AI is predicted to be present in both affirmative and negative sentences (34, repeated from 2a):

- (34) The cake wasn't delicious, #but I never tasted it.

Non-autocentric uses of PPTs are unproblematic under this view. The judge does not have to be the speaker even in root clauses, and given that K and j are not semantically connected, the presence of an AI will not depend on who the judge is.

The explanation of the Puzzle is done in two steps. The first step is to exclude explicit denials (35, repeated from 1a):

- (35) The cake was delicious, #but I never tasted it.

Per (32), PPTs like *delicious* are only defined if K directly settles whether the stimulus is tasty to the judge. And this can be settled just in case the judge has tried the stimulus. The second conjunct explicitly states that the judge hasn't tried the cake. The first conjunct will not be defined whenever the second one is true, which correctly predicts that explicit denials would be infelicitous.

The second step is to account for obviation, illustrated in (36, repeated from 7a):

- (36) ✓The cake must have been delicious, but I never tasted it.

We propose that the contrast between obviation and explicit denials stems from grammatical facts about obviators, an approach that allows us to avoid problems faced by Ninan (2014) and Pearson (2013). Specifically, we propose that epistemic modals and other markers of indirect-

ness update the kernel (like attitudes for Yalcin (2007)). The mechanics is exemplified in (37) below with epistemic *must*.

We propose that *must* eliminates the direct-indirect distinction in its scope by overwriting K with $\{\bigcap K\}$ (37a), which leads to a requirement that the relevant information state is decided on the prejacent (37b).

- (37) a. $\llbracket \text{must } p \rrbracket^{c, \langle w, t, \mathbf{K}, j \rangle} = \llbracket \text{must} \rrbracket^{c, \langle w, t, K, j \rangle} (\llbracket p \rrbracket^{c, \langle w, t, \bigcap \mathbf{K}, j \rangle})$
 b. Given the semantics for PPTs:
 $\llbracket \text{must [the curry is tasty]} \rrbracket^{c, \langle w, t, K, j \rangle}$ is defined
 iff $\{\bigcap K\}$ directly settles whether the curry is tasty
 c. vF&G's semantics for *must*:
 $\llbracket \text{must} \rrbracket^{c, \langle w, t, K, j \rangle}$
 $= \lambda p : K \text{ does not directly settle whether } p. \bigcap K \subseteq p$

Per (37b), the directness requirement of PPTs disappears under *must*: it is only required that the prejacent is known, but it does not matter whether it is known directly or indirectly. Therefore, continuations that explicitly state that the judge has no firsthand experience, as in (36), are felicitous. (*must*'s general exclusion of direct knowledge in (37c) accounts for the fact that is odd to utter (38)):

- (38) # I tried the cake. It must be tasty.

We propose that other obviators follow the scheme in (37), but leave precise details for future research.⁶

4.3. Overt tasters

As we have shown in section 2.3, obviation is subject to cross-constructural variation. When the taster is covert, which is the case for 'bare' uses of PPTs and psych predicates, obviation is allowed with different markers of indirectness such as epistemic modal auxiliaries, epistemic adverbs, futurate operators and predicates of clarity (section 2.2). However, obviation is highly restricted with overt tasters: PPTs with *to* phrases, psych predicates, and subjective attitudes. The contrast is illustrated in (39) and (40, repeated from 19):

- (39) PRESENCE OF AN AI
- | | |
|--|--------|
| a. The San Juans are beautiful, #but I have never seen them. | COVERT |
| b. The San Juans are beautiful to me, #but I have never seen them. | OVERT |

⁶In addition, while we follow vF&G in treating *must* as a marker of epistemic necessity, this aspect of their analysis is not crucial for us. The strength of *must* is a matter of a debate (see discussion in Lassiter 2016) and one can easily recast our approach to obviation within theories that treat *must* as weak, e.g. along the lines of classic Kratzerian semantics (Kratzer 1981, 1991).

(40) AI OBVIATION

- a. ✓The San Juans must be beautiful, but I have never seen them. COVERT
 b. #The San Juans must be beautiful to me, but I have never seen them. OVERT

The facts in (39) and (40) present challenges for the accounts of the AI that do not differentiate between two types of acquaintance content. Such cases or overt tasters in general are not discussed explicitly by either Ninan (2014) or Pearson (2013), but based on the overall shape of their respective theories, we think that neither of them predicts our data.⁷

Furthermore, the new data from obviation allow us to formulate a constraint on theories of PPTs (without taking a stand as to which one is correct). The existence of overt tasters is often taken as evidence that PPTs always take a taster argument (a.o. Stephenson 2007, Stojanovic 2007, Pearson 2013) whose semantics is the same in both covert and overt realizations. Such theories do not predict the contrast in (39) and (40). On the other hand, theories with a disjoint treatment of bare vs. overt uses (cf. Lasersohn 2005, MacFarlane 2014) do not face this problem. Therefore, obviation facts support such treatment.

We extend our analysis of ‘bare’ uses to overt tasters DPs and propose that overt judges depend on the DP’s doxastic kernel (41):

- (41) $\llbracket \text{tasty to } \alpha \rrbracket^{c,i} = \lambda o : \text{the kernel of } \llbracket \alpha \rrbracket^{c,i} \text{ in } w \text{ at } t \text{ directly settles whether } o \text{ is tasty to } \llbracket \alpha \rrbracket^{c,i} \text{ in } w \text{ at } t. \text{ 1 iff } o \text{ is tasty to } \llbracket \alpha \rrbracket^{c,i} \text{ in } w \text{ at } t$

For non-obviated cases, the semantics (42) is the same as with ‘bare’ uses in (33) (modulo the judge) and the AI arises because of the direct settlement requirement:

- (42) a. The curry is delicious to me.
 b. $\llbracket \text{The curry is delicious to me} \rrbracket^{c,\langle w,t,K,j \rangle} = \lambda o : K \text{ directly settles whether curry is delicious to } speaker(c) \text{ in } w \text{ at } t. \text{ 1 iff cake is delicious to } speaker(c) \text{ in } w \text{ at } t$

With obviators, things differ. Obviators update the K coordinate, but overt tasters ignore that coordinate. The presupposition triggered by the PPT is thus unaffected, and it projects. This mean that when the overt taster is the speaker, contradiction (or a sense of forgetfulness, at least) will typically arise, as in (43):⁸

⁷As discussed in section 3.2, Pearson’s (2013) account of obviation relies crucially on the presence of a generic operator and on the possibility of the taster to be excluded from its quantificational domain. With overt taster PPs in mind, she briefly mentions that not all uses of PPTs may be generic, but a further elaboration would be needed to see how this approach fares with respect to the cross-constructural variation in AI obviation.

⁸This is exactly the behavior that the presuppositional analysis in Pearson (2013) predicts for ‘bare’ PPTs. While Ninan (2014) rightly criticizes it for ‘bare’ PPTs, it makes the right predictions for overt forms.

- (43) $\llbracket \text{must [the curry is delicious to me]} \rrbracket^{c, \langle w, t, K, j \rangle}$ is defined if
- a. **[imposed by *must*]** iff K **does not directly settle** whether the curry is delicious to me
 - b. **[imposed by PPT]** iff the speaker’s kernel directly **settles** whether the curry is delicious to me

Though we have only provided a semantics for PPTs here, we assume other subjective expressions behave similarly: the AI stems from a presupposition sensitive to a kernel-coordinate, which obviators overwrite; in turn, overt tasters pick out a distinct kernel, leading to a classic presupposition.

5. Conclusions

This paper explores the nature of the Acquaintance Inference, a firsthand experience requirement present with several subjective expressions across affirmative and negated sentences. The AI cannot be explicitly denied, which indicates that it is not an implicature, but can be sometimes lifted, a phenomenon we call obviation. We formulate the novel empirical generalization that covert and overt experiencers behave differently across obviation contexts.

Our analysis is rooted in research on (in)directness. We argue that PPTs and other AI-triggering subjective expressions comment on the evidential grounds for a proposition. We show that obviation is possible with linguistic expressions that convey indirectness, including epistemic modals and futurate markers in English as well grammatical markers of indirect evidentiality in languages like Turkish. A consequence of this approach is that obviation should be treated as a diagnostic of indirectness, not modality (pace Klecha 2014).

We further argue that obviators collapse the distinction between direct and indirect knowledge, which in turn makes it possible to use a PPT in their scope even in situations when the taster has no prior experience with the stimulus. To formalize our claims, we use von Stechow and Gillies’s (2010) kernels. Beyond the formal niceties, the broader goal of the paper is to highlight a connection between PPTs and epistemic modals, and hence to shed light on how natural language conceptualizes evidence in general. In future work, we hope to push this idea further by investigating the interaction of subjective expressions with *bona fide* markers of direct evidentiality and their relation to other expressions with similar restrictions, such as English copy-raising constructions (Asudeh and Toivonen 2012, Rett, Hyams, and Winans 2013) and expressions dealing with internal states across languages, e.g. egophoricity (Coppock and Wechsler 2018).

We also hope to examine the properties of obviators more closely. Though we consider clause-mate obviators, our semantics can extend to attitude verbs to predict that they, too, act as obviators (cf. Yalcin 2007), which accounts for (18). But, by treating obviation as elimination of the direct-indirect distinction, we predict that (44a) and (44b) should be synonymous.

- (44) a. I'm certain it is raining.
 b. I'm certain it must be raining.

That they are not suggests that more must be said about how indirectness and obviation interact, a task we leave to future work.

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No explanation for the historical present: Temporal sequencing and discourse

Pranav ANAND — *University of California, Santa Cruz*

Maziar TOOSARVANDANI — *University of California, Santa Cruz*

Abstract. Discourses in the historical (or narrative) use of the simple present in English prohibit backshifting, though they allow forward sequencing. Unlike both reference time theories and discourse coherence theories of these temporal inferences, we propose that backshifting has a different source from narrative progression. In particular, we argue that backshifting arises through anaphora to a salient event in the preceding discourse.

Keywords: tense, discourse coherence, coherence relations, perspective.

While the present tense in English is typically described as indexical to the time of utterance, it has long been acknowledged that it can be used “historically” to describe situations that have already taken place or “narratively” for those that are simply imagined. This historical present (or, HP) is often described as more vivid or dramatic than the simple past, enabling the speaker to “recall[] or recount[] the past as vividly as if it were present” (Palmer, 1965: 39), as if the events were unfolding before her eyes (see also Leech 1971: 6–7, Close 1981: 106).

- (1) Mr. Tulkinghorn **takes** out his papers, **asks** permission to place them on a golden talisman of a table at my Lady’s elbow, **puts** on his spectacles, and **begins** to read by the light of a shaded lamp. (Dickens, *Bleak House*)

Vividness aside, here we discuss a novel contrast between the HP and simple past that concerns how events are temporally ordered in simple multi-sentence discourses. The simple past in English evinces a famous ambiguity: its temporal interpretation can advance in tandem with linear order (2a) or be backshifted (2b).

- (2) a. *Narrative progression*
The administration fired^{e₁} Mike. He lost^{e₂} his house. $e_1 < e_2$
b. *Backshifting*
The administration fired^{e₁} Mike. He met^{e₂} with the ambassador. $e_1 > e_2$

In contrast, while the HP allows narrative progression (3a), it prohibits backshifting (3b), a fact which, to our knowledge, has not previously been observed.

- (3) a. The administration fires^{e₁} Mike. He loses^{e₂} his house. $e_1 < e_2$
b. The administration fires^{e₁} Mike. He meets^{e₂} with the ambassador. $*e_1 > e_2$

Since at least Partee (1984), the source of such temporal inferences has loomed large in the literature. Earlier *reference time theories* focused principally on cases of narrative progression,

building elaborate semantic models of how the reference time of a sentence is anaphoric to preceding discourse (Partee 1984; Hinrichs 1986; Dowty 1986; Webber 1988; Kamp and Reyle 1993, a.o.). For most of these approaches, though not Webber's, reference times could never resolve to a time prior to the most recent event, and so the existence of backshifting in the interpretation of past tense discourses was a stubborn inconvenience.

More pragmatic *discourse coherence theories* arose in response, which posit that speakers infer coherence (or rhetorical) relations between sentences, drawing on a small inventory of such relations each with specific spatio-temporal consequences (Kehler 2002; Lascarides and Asher 1993; Asher and Lascarides 2003, a.o.). For instance, when a Narration relation is inferred between two sentences, to use Asher and Lascarides's terminology, they have a forward moving temporal interpretation; but when an Explanation (i.e., causation) relation is inferred, they instead have a backshifted interpretation.

Both these approaches assume that narrative progression and backshifting arise from the same source. Based on the contrast in (2a–b), however, we argue that they are not a package deal. There is a distinct mechanism for backshifting that the HP explicitly interferes with. Palmer's quote above furnishes an intuitive characterization of where things go awry: the HP is a form of ersatz real-time description — backshifting is prohibited because the simulated “now” is ever moving forward. This paper advances a formal framework that makes good on this intuition.

This theory involves two independent pieces. The first is a general theory of temporal sequencing that allows narrative progression “for free,” while backshifting is explicitly anaphoric (cf. Webber 1988). The second is a bicontextual semantics for present tense that unifies the canonical use of the simple present in English and the HP (Anand and Toosarvandani, to appear). As we hope to show, once the temporal sequencing system is precisely delineated, the semantics of the present tense will conspire to eliminate the possibility of backtracking.

1. No going back!

For discourse coherence theories, temporal sequencing arises from larger coherence effects. The contrast in (3a–b) might, under such a view, be the manifestation of more general restrictions on intersentential discourse relations. Asher and Lascarides (2003: 471) propose something along these lines to account for the obligatory backshifting exhibited by the past perfect.

- (4) a. Max arrived^{e₁} late for work. He had taken^{e₂} the bus.
 b. The council built^{e₁} the bridge. The architect had drawn up^{e₂} the plans. $e_1 > e_2$
 (Lascarides and Asher, 1993: 470)

Their constraint essentially eliminates all but Explanation and Elaboration discourse relations with the past perfect. In particular, it preempts Narration, which produces narrative progression.

- (5) *Connections when Changing Tense* (Lascarides and Asher, 1993: 471)
 $\square(\langle \tau, \alpha, \beta \rangle \wedge sp(\alpha) \wedge pp(\beta) \rightarrow C_{pp}(\alpha, \beta))$

Extending this idea to the contrast in (3a–b), the HP would be prohibited from entering into an Explanation relation, which is compatible with backshifting; it would thus only occur with forward-moving relations, such as Narration. This does not stand up to closer scrutiny, however. First, an HP sentence can be coherently followed by a sentence in a range of tenses — simple past, present perfect, past perfect — that do allow backshifting interpretations. These would presumably be linked by an Explanation relation.

- (6) The administration fires^{e1} Mike. He {met, has met, had met}^{e2} with the ambassador.
 $e_1 > e_2$

Moreover, a sentence in the HP can be connected by the full range of discourse relations to a preceding sentence, including Explanation, just as long as there is no backshifting. In other words, two HP sentences can stand in an Explanation relation (7a), as well as an Elaboration (7b), Background (7c), or Violated Expectation (7c) relation, with the eventualities they describe simply overlapping.

- (7) a. *Explanation*
 Liz collapses^{e1} onto the couch. She is exhausted^{s2} from practice. $e_1 \circ s_2$
- b. *Elaboration*
 Donald has^{e1} a lovely meal that night. He eats^{e2} lots of well-done steak.
 $e_1 \supset e_2$
- c. *Background*
 Senecal opens^{e1} the door. The room is^{s2} pitch black. The fan is running^{s3}.
 $e_1 \circ s_2 \circ s_3$
- d. *Violated Expectation*
 I offer^{e1} him a drink with dinner, but $\left\{ \begin{array}{l} \text{he refuses}^{e2} \\ \text{\#he drinks}^{e2} \text{ one earlier} \end{array} \right\}$. $e_1 < e_2$
 $e_1 > e_2$

In short, the restriction on intersentential discourses in the HP is a purely temporal one, not one that can be stated in terms of coherence relations

- (8) *Constraint on Intersentential Historical Present (CHP)*
 An eventuality can temporally follow or overlap the eventuality just described, but cannot temporally precede it.¹

To ensure the ecological validity of the CHP, we examined N. K. Jemisin's *Obelisk Gate*, a recent 450 page novel written in the HP that is notable for complex temporal shifts throughout

¹As we discuss in Section 5, intra-sentential relations are more liberal. Backshifting possible in the HP with overt connective (e.g., *after*, *because*, *even though*).

- (1) a. He returns^{e1} to the gym after he breaks^{e2} his leg. $e_1 > e_2$
 b. He cancels^{e1} his gym membership because he breaks^{e2} his leg. $e_1 > e_2$
 c. Donald is forgiven^{e1} even though he breaks^{e2} the law. $e_1 > e_2$

the text, often within a single chapter. The book contains many instances involving backshifting, all involving either the simple past or present perfect. A selection of cases where substituting in the simple present (for the bolded verb) yields sharp ungrammaticality follows.

- (9) a. Nassun doesn't have any money beyond her allowance you see and she'd already spent that on books and sweets when word **came** that a lorist was in town. (p. 5)
- b. He murmurs to her, "get your things. . ." Jija's mother **married** again a few years back and now she lives in Sume, the town in the next valley over, which will soon be destroyed utterly. (p. 10)
- c. He's completely the same, aside from being partially turned to stone, as the days when you and he **were** less than lovers and more than friends. Ten years and another self ago. (p. 12)
- d. Her teeth **have been filed** to points, even though sanzeds supposedly **stopped** doing that centuries ago. (p. 17)
- e. There are no travelers on the road though you can tell that the ash is thinner there. People **have been by** recently. (p. 30)
- f. But she tries, because once upon a time, this man **was** her world. (p. 312)

There is exactly one clear counterexample to our generalization, and it comes in a chapter that quickly sketches several crisscrossing plot threads — one at a time — across six months time. The basic skeleton of this section is delineated below.

- (10) Six months pass. . . (p. 235)
 Tonkee's arm survives the reattachment. . . She lives^{e1}. . . (p. 235)
 Hjarka starts courting^{e2} Tonkee. . . She's mostly just confused. . . (p. 236)
 Tonkee brings^{e3} the council a new predictive model. . . some comm members will start showing deprivation symptoms within a year. . . (p. 237)
 Ykka doesn't want to tell anyone. . . You and the other council members agree^{e4} reluctantly. . . (p. 239)
 But because of Ykka's silence, a Breeder **visits**^{e5} you a few days after you bring^{e1'} Tonkee home to finish recuperating. (p. 239)
 Alabaster **suffers**^{e6} another bad infection during these six months. He **survives**^{e7} it only by. . . (p. 240)

$$e_1 < e_{1'} < e_5 < e_2 < e_3 < e_6 < e_7 < e_4$$

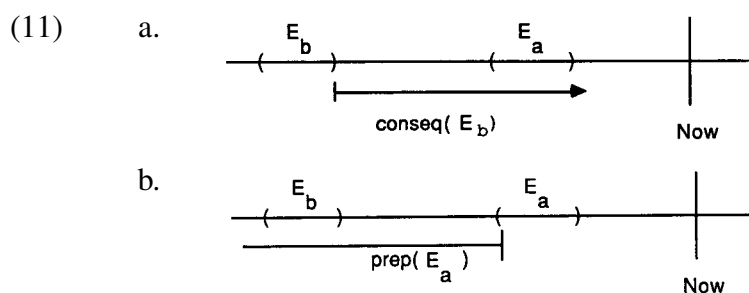
The offending sentence describes a visit (e_5) to the addressee (Essun) that happens very soon after events pick up in the chapter, but that is presented linearly rather far after the culmination of the first main thread (the prediction of a food shortage by a recently healed scientist, Tonkee).

However, this sentence itself starts another thread (about Essun's romantic entanglements), and it comes with a paragraph break that indicates the start of a new topic. Hence, it may signal a break in overall discourse coherence. Regardless of the ultimate explanation for this pattern, the

fact that it is the only exception to our generalization in the entire novel (despite considerable temporal shifts) is a testament to its essential correctness.

2. Problems for reference time theories

The CHP presents significant problems for a discourse coherence theory. For reference time theories, on the other hand, it is not this generalization that is problematic, but the possibility of temporal backshifting with the simple past. The Temporal Discourse Interpretation Principle in Dowty (1986), for instance, simply prohibits it. A notable counterexample is Webber's (1988) theory, in which reference times can be anaphoric to *subparts* of events: anaphora to a consequent state yields narrative progression (11a), while anaphora to a prestate (preparatory phase) yields backshifting (11b).



While Webber does not link these anaphoric processes to morphosyntactic categories, the CHP might be seen as evidence that they should be. The only workable move would be to stipulate that the simple present cannot be anaphoric to prestates. This derives the CHP, but it is not clear why it should be. (Note that stipulating the inverse — that HP sentences do not make their prestates available for anaphora — would not allow backshifting with the simple past, as in (6).)

There have been attempts to relate backtracking to particular aspectual combinations. For instance, Bittner (2008) argues that backshifting results from English being aspectually underspecified (unlike, say, Kallalisut). An erstwhile instantaneous event can be construed as a process, such that the event described by a subsequent sentence can be located inside the consequent state of one of its subparts. Thus, the second sentence in (2b) is backshifted when the firing event is seen as an extended process beginning at least as far back as the meeting with the ambassador. An argument for this underspecification come from what appears to be reference to an achievement as either an instantaneous event or a process.²

- (12) I came to the conference. $\left. \begin{array}{l} \text{At that instant, I knew I made a mistake.} \\ \text{The process was exhausting.} \end{array} \right\}$
(Bittner, 2008: 366)

²We think there is some reason to doubt this argument. If aspectual underspecification is responsible would not easily explain why, in (2b), the two sentences can be restricted by non-overlapping temporal frame adverbials: e.g., *Today, the administration fired Mike. Six months ago, he met with the ambassador.* Nor for why a durative temporal adverbial, such as *for the past six months*, is illicit with the first sentence.

However, to the extent that (12) allows both references, so does the corresponding HP version.

- (13) I come to the conference. $\left\{ \begin{array}{l} \text{At that instant, I know I made a mistake.} \\ \text{The process is exhausting.} \end{array} \right\}$

Thus, if aspectual underspecification is responsible for backshifting, it should be allowed with the HP, contrary to fact.

Rather than the first sentence, it might be the backshifted sentence itself that is ambiguous. Building on Kratzer (1998), Dickey (2001) claims that the simple past in English is ambiguous between a “true” past (reference time precedes the utterance time), which leads to narrative progression, and a past perfect, which leads to backshifting. By contrast, in Dutch, Dickey argues that the simple past always yields narrative progression, citing similar facts in German. From this perspective, the CHP might arise simply because the simple present lacks this kind of morphological syncretism.

But if simple past morphology in English disguises structural past perfect, it should be possible to replicate ambiguities associated with perfects. In one such ambiguity, sentence-final temporal adverbials can constrain either the event time or the reference time; in contrast, sentence-initial adverbials only constrain the reference time (Hornstein, 1990: 24–25).

- | | | | |
|------|----|----------------------------|---------------------------------|
| (14) | | ‘His leaving was at noon.’ | ‘By noon, he had already left.’ |
| | a. | He had left at noon. | ✓ |
| | b. | At noon, he had left. | # |
| (15) | | ‘His leaving was at noon.’ | ‘By noon, he had already left.’ |
| | a. | He left at noon. | ✓ |
| | b. | At noon, he left. | # |

If the simple past permitted a past perfect structure, it should have a reference-time constraining interpretation. But this is not the case, for either a sentence-final (15a) or sentence-initial (15b) adverbial. Thus, backshifting is unlikely to derive from an ambiguity in the simple past.

3. A bicontextual semantics for the present

We will present a theory of temporal sequencing that treats backshifting as anaphora to the preceding discourse. This builds on a bicontextual semantics for the present tense that we have argued for elsewhere (Anand and Toosarvandani, to appear). It assumes that natural language expressions are interpreted relative to two contexts: a *context of utterance* (*u*) and a *context of assessment* (*a*). Such bicontextualism has been deployed in several empirical domains, including for free indirect discourse (Doron, 1991; Schlenker, 2004; Sharvit, 2004, 2008; Eckardt, 2015) and future tense (MacFarlane, 2003), as well as predicates of personal taste and episodic modals (MacFarlane, 2014).

3.1. The semantics of tense

Individual expression can be sensitive to one, the other, or both of these contexts. Adopting the division that Sharvit (2004, 2008) proposes, local pronouns are sensitive to the utterance context, while tense is sensitive to the assessment context.

- (16) a. $\llbracket \text{I} \rrbracket^{u,a,g} = \text{SPEAKER}(u)$
 b. $\llbracket \text{you} \rrbracket^{u,a,g} = \text{ADDRESSEE}(u)$
- (17) a. $\llbracket \text{PRES}_i \rrbracket^{u,a,g}$ is defined iff $g(i) \subseteq \text{TIME}(a)$. When defined, $\llbracket \text{PRES}_i \rrbracket^{u,a,g} = g(i)$
 b. $\llbracket \text{PAST}_i \rrbracket^{u,a,g}$ is defined iff $g(i) < \text{TIME}(a)$. When defined, $\llbracket \text{PAST}_i \rrbracket^{u,a,g} = g(i)$

Sharvit takes temporal and locative adverbials, such as *tonight* (18a) and *here* (18b), to be sensitive to the assessment context.

- (18) a. $\llbracket \text{tonight} \rrbracket^{u,a,g} = \text{the night of the day surrounding } \text{TIME}(a)$
 b. $\llbracket \text{here} \rrbracket^{u,a,g} = \text{LOCATION}(a)$

While Sharvit assumes that the two contexts are always identical in root contexts, Anand and Toosarvandani (to appear) propose that the assessment context can be *freely chosen* at the root level, subject to pragmatic considerations, cf. Schlenker (2004)

- (19) *Canonical Present*
 $\text{TIME}(a) = \text{TIME}(u)$
- (20) *Historical Present*
 $\text{TIME}(a) < \text{TIME}(u)$

Overlap between the assessment time and the events being described corresponds to the felt vividness of the HP, i.e., the sense of narrating something unfolding before one's eyes (Palmer 1965: 39, Leech 1971: 6–7, Close 1981: 106).

In addition, assuming that the simple present is always perfective aspect — the run time of the eventuality is contained in the reference time — only stative predicates will be compatible with the canonical present, as only they describe an eventuality small enough to fit within the assessment time, which is just as narrow as the utterance time (Cowper, 1998; Wurmbrand, 2014; Todorović, 2015). In the HP, however, the assessment time is unmoored from the utterance context, and hence it can be wide enough to contain a non-stative eventuality.

3.2. Updating the assessment time

The time of the assessment context can, in principle, change across sentences. After the initial segment of a discourse, we propose that is freely updated, subject only to the *Constraint on Assessment Time Update (CATU)*.

(21) *Constraints on Assessment Time Update (CATU)*

For a sentence S and an eventualities stack E , S can be evaluated with respect to contexts u and a such that:

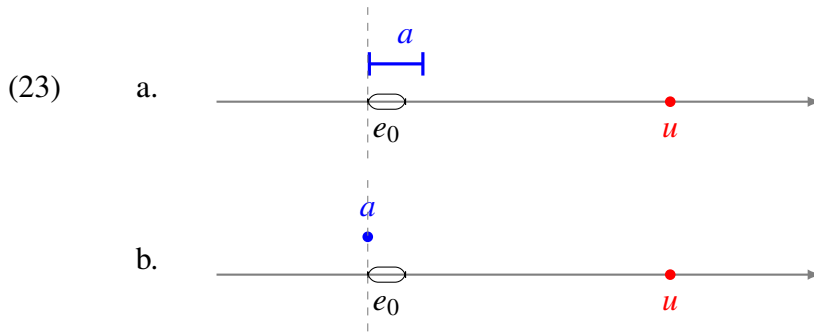
- a. $\text{TIME}(a) := \text{TIME}(u)$, or
- b. $\text{TIME}(a) := t$ such that $\forall t'(t' < t \rightarrow t' < \tau(e_0)) \wedge \forall t'(t' < \tau(e_0) \rightarrow t' < t)$

The first condition is natural: the utterance context is always a possible anchor for assessment time. The second condition invokes a *stack of eventualities* to which states or events are added (cf. Grosz and Sidner 1986; Webber 1988; Bittner 2003, 2005, 2008). As each sentence is interpreted, the eventuality it describes is pushed onto the stack. The top (e_0) represents the most recent and most salient eventuality in the discourse.

(22) *Eventualities stack*

$$E = \langle e_0, \dots, e_n \rangle$$

According to its second condition, CATU allows for the left boundary of $\text{TIME}(a)$ and $\tau(e_0)$ to coincide, though there is no limit on the length of $\text{TIME}(a)$. Both (23a) and (23b) are, in principle, possible updates of the assessment time. In practice, the width of the assessment time will be constrained pragmatically. The Maxim of Quantity will impose a narrower time interval, corresponding to a more informative utterance.



Before showing how this derives the (im)possibility of backshifting, something must be added for initial segments. At the beginning of a discourse, the assessment context can be anchored to the utterance context, but it need not be: a sentence in the HP can start off a discourse. In this case, no salient event has been introduced yet for $\text{TIME}(a)$ to be updated to. So, for initial discourse segments, we propose that the assessment time can be self-anchored, so that it shares the left boundary of the the event the sentence itself describes.

(24) *Constraints on Initial Assessment Times (CIAT)*

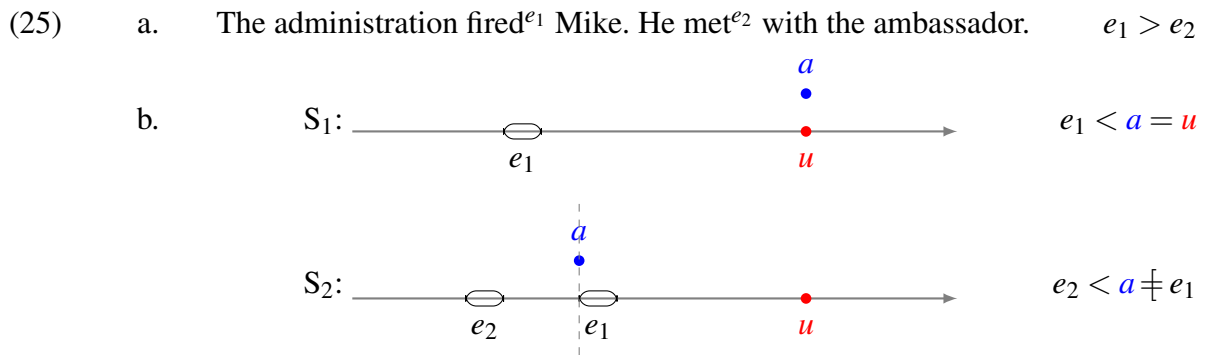
For a sentence S describing an eventuality e and an eventualities stack $E = \langle \rangle$, S is evaluated with respect to contexts u and a such that:

- a. $\text{TIME}(a) := u$, or
- b. $\text{TIME}(a) := t$ such that $\forall t'(t' < t \rightarrow t' < \tau(e)) \wedge \forall t'(t' < \tau(e) \rightarrow t' < t)$.

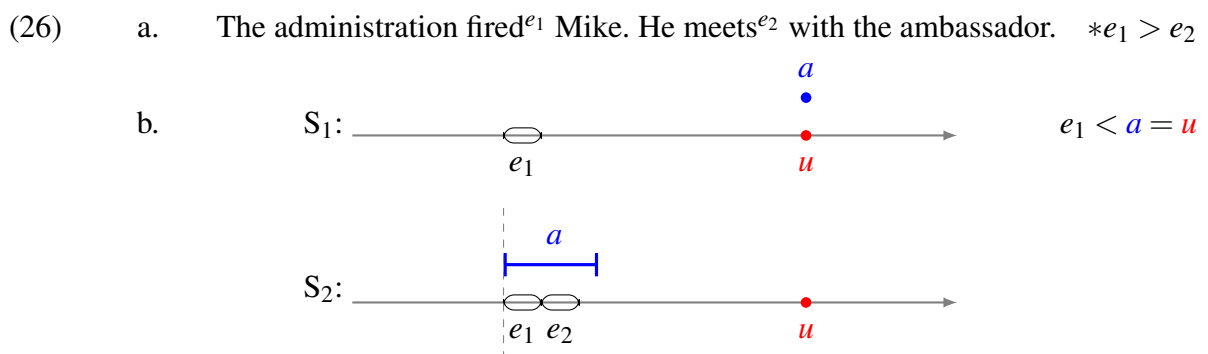
While CIAT determines the startup update, subsequent updates are constrained entirely by CATU. This derives the availability of backshifting with the simple past, as well as its unavailability with the HP.

3.3. Backshifting as anaphora

We take backshifting to arise *anaphorically* when $\text{TIME}(a)$ is updated to left-align with the most salient event in preceding discourse — that is, the top of the event stack. For a sentence in the simple past, backshifting is thus a possibility when it follows another sentence in the simple past.



But for a sentence in the HP, backshifting is ruled out entirely. Let us start with an HP sentence following one in the simple past. Then the assessment time can be updated to left-align with the most salient preceding event, but the semantics of present tense (coupled with perfective aspect) will locate the event described inside the assessment time, rather than anterior to it.

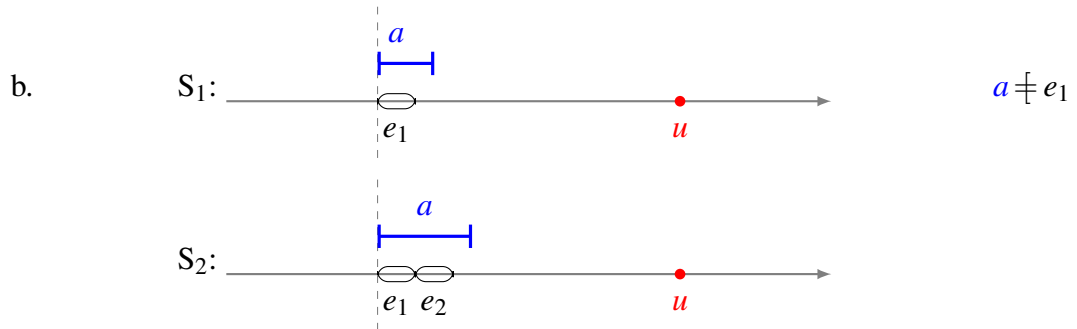


While the only interpretation the discourse in (26b) can have is a forward moving one, the earliest a sentence in the HP might be interpreted is as *overlapping* with the preceding sentence.



The same logic applies to a sequence of sentences entirely in the HP. The assessment time already precedes the utterance time for the first sentence. But with just the event it describes available as the top of the eventualities stack, there is no way of updating the assessment time so that the second sentence is temporally anterior, given the semantics of the present tense.

- (28) a. The administration fires^{e₁} Mike. He meets^{e₂} with the ambassador. $*e_1 > e_2$

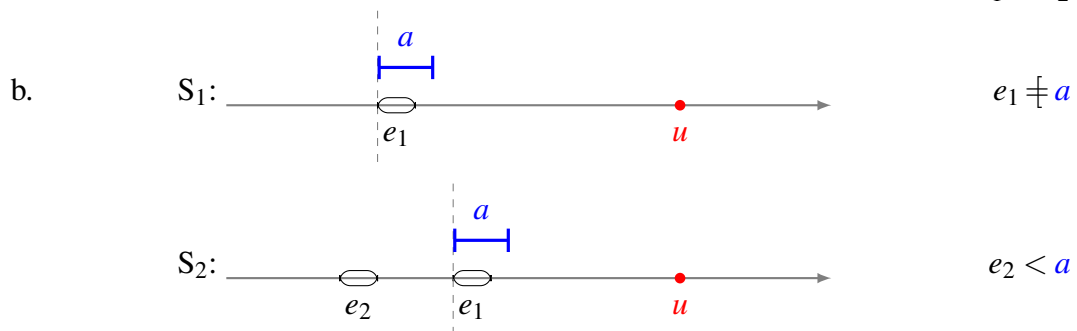


In sum, then, backshifting arises through anaphora to a salient event in the discourse. It is, as a consequence, impossible in the HP, which can only locate an event inside the assessment time.

3.4. Backshifting with the perfect

Just like the simple past, a sentence in the HP is able to “anchor” backshifting with a sentence in the simple past. This is also possible with the past perfect.

- (29) a. The administration fires^{e₁} Mike. $\left\{ \begin{array}{l} \text{He met}^{e_2} \text{ with the ambassador.} \\ \text{He had met}^{e_2} \text{ with the ambassador.} \end{array} \right\}$ $e_1 > e_2$



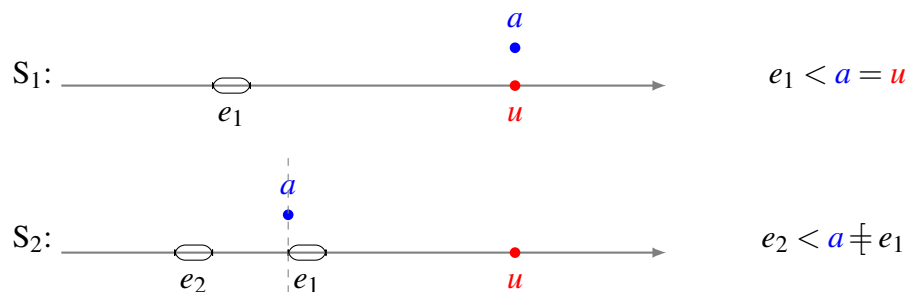
The simple past can have a backshifted interpretation here for the same reason it can in (25), except that no update of the assessment time is necessary. It is self-anchored prior to the utterance time by the first sentence, which the second sentence is then located temporally anterior to.

The equivalence of the past perfect in this discourse follows from its semantics. Building on Kamp and Reyle (1993), Anand and Toosarvandani (to appear) take it invoke a perspective

- a. $g(i) \subseteq \text{TIME}(a)$
 b. $\exists e \exists e' (P(e) \wedge \text{POST-STATE}(e', e) \wedge g(i) \subseteq \tau(e'))$

Then, just as depicted in (29b), the event described by the present perfect sentence will be anterior to the event of the first sentence.

An interesting effect arises when the antecedent sentence is in the simple past. While the present perfect is licensed with a backshifted interpretation, as in (34a), there is a felt difference to the parallel discourse with the past perfect in (31).

- (34) a. The administration fired^{*e*₁} Mike. He has met^{*e*₂} with the ambassador.
- b. 
 $e_1 < a = u$
 $e_2 < a \neq e_1$

Our account permits such discourses, as the assessment time can be updated to left-align with the top of the eventuality stack for the second sentence. But it does not account for the particular effect of using the present perfect here, as opposed to the past perfect. We suspect that it may arise from other well-attested differences between the present and past perfect, including lifetime effects, current relevance, and incompatibility with temporal adverbials (see, e.g., Portner 2003).

4. Narrative progression

If backshifting arises through anaphora to the preceding discourse, narrative progression must derive from another mechanism that is constant across differences in tense. We will not attempt here to state directly what this mechanism is. Rather, our approach will be simply to make space for it, given our semantics for tense and the conditions on updating the assessment context.

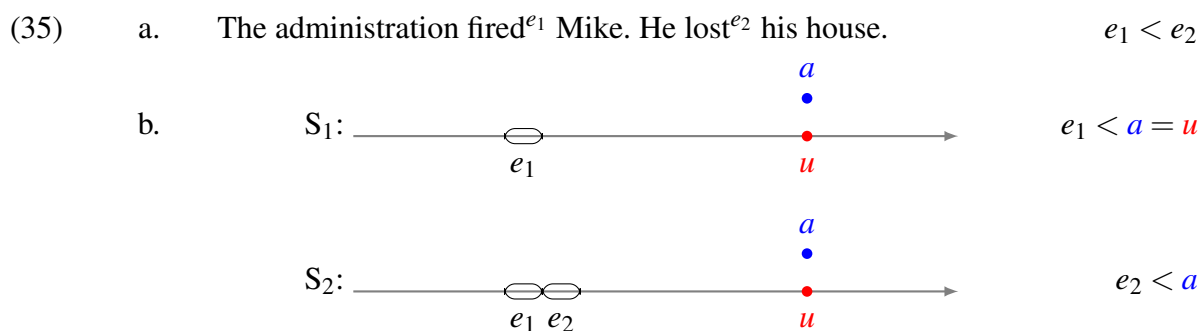
In reference time theories, narrative progression is a direct result of temporal anaphora, as constrained by grammatical aspect (Hinrichs, 1986; Partee, 1984; Dowty, 1986; Webber, 1988). In one version of such a theory, sentences in the perfective aspect introduce a novel time interval “immediately after” the event they describe, which can serve as the antecedent for the reference time of a subsequent sentence. A sequence of simple past sentences, then, can only be interpreted as forward moving.

In discourse coherence theories, narrative progression arises from the spatio-temporal constraints associated with a specific discourse relation, such as Asher and Lascarides’s (2003) Narration (see also Lascarides and Asher 1993 Altshuler 2016: 67–70), that is assumed as a de-

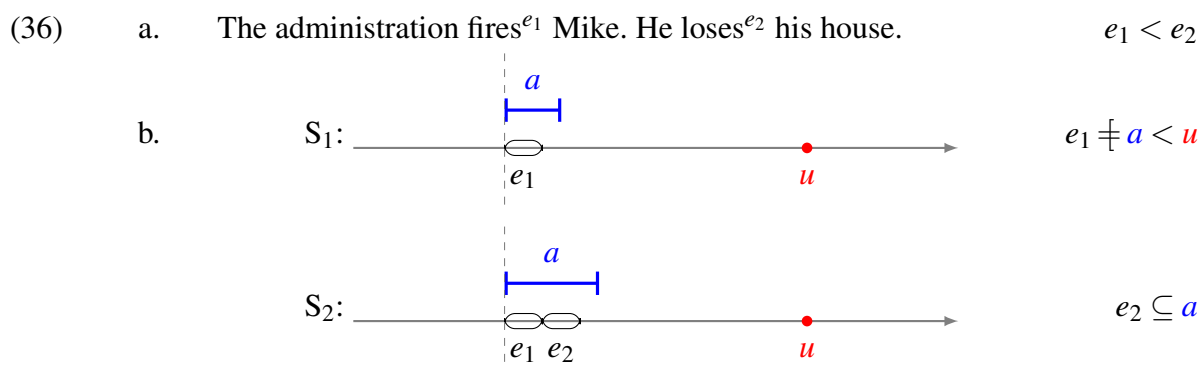
fault. That is, in the absence of contradictory grammatical or other information, speakers infer that events occur in a sequence and are tightly contiguous, both temporally and spatially.

These approaches share some common intuitions. To start, they agree that narrative progression is the default, arising in the absence of information to the contrary. This is tied, in some sense, to the Maxims of Manner and Relevance, which together mandate a forward moving interpretation. And, an important constraint under both approaches is that no significant event intervene between the events in a narrative. Either one must occur “just after” another (Partee, 1984: 254) or “where things are at the end of [the first event] is where they are at the beginning of [the second event]” (Asher and Lascarides, 2003: 162). This involves considerations of Relevance.

Given these considerations, narrative progression should arise whenever it is not blocked by conflicting information — by, for instance, backshifting through anaphora to a salient event. This happens in at least two contexts. For a series of sentences entirely in the simple past, when the assessment time is not updated, nothing prevents their forward sequencing.



Similarly, for a sequence entirely in the HP, each new event will be located within the same assessment time interval, which is not updated, in close temporal succession.



If the discourse in (36a) were extended with an additional sentence, this would necessarily describe an event located “just after” the last one, since there can be no significant events that intervene between the events already described (37a). This inference does seem like it can be

cancelled (37b), which is compatible with it being an implicature arising from Manner and Relevance.

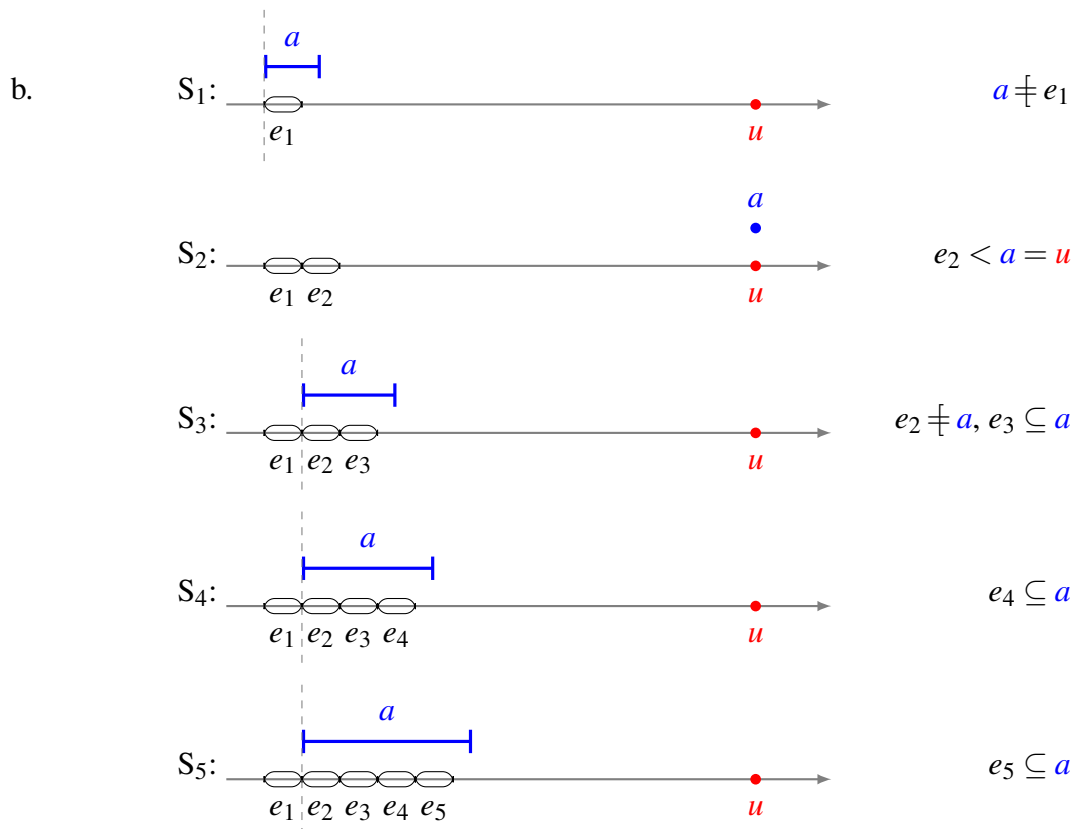
- (37) a. The administration fires^{e1} Mike. He loses^{e2} his house. #He misses^{e3} a house payment. *e1 < e3 < e2
 b. The administration fires^{e1} Mike. He loses^{e2} his house. Actually, he first misses a house payment, and then he loses his house.

In fact, events are forward sequenced regardless of the location of the assessment time and whether it has been updated, as long as narrative progression is not prohibited. As Schiffrin (1981: 46) shows, the HP can alternate freely with the simple past without there necessarily being any backshifting.

- (38) a. Then all of a sudden everybody **gets**^{e1} involved and they **made**^{e2} a mess. So uh... this lady **says**^{e3}... uh this uh Bert, "Oh, my son'll make them. He's an electrician." So he **makes**^{e4} them, and he **charges**^{e5} all the neighbors twenty dollars a set, and there I **paid**^{e6} three dollars. So I **called**^{e7} her a crook. And I **called**^{e8} her son a crook. So, they **were**^{e9} really mad at me.

$$e_1 < e_2 < e_3 < e_4 < e_5 < e_6 < e_7 < e_8 \circ s_9$$

(Schiffrin, 1981: 46)



Though the assessment time is variously updated to the utterance time or the top of the event

	FWD	BACK		FWD	BACK
PRES – PRES	✓ (36)	* (28)	PAST – PRES	✓ (38)	* (26)
PRES – PAST	✓ (38)	✓ (29)	PAST – PAST	✓ (35)	✓ (25)
PRES – PRES PERF	* (32)	✓ (32)	PAST – PRES PERF	*	✓ (34)
PRES – PAST PERF	* (29)	✓ (29)	PAST – PAST PERF	* (31)	✓ (31)

Table 1: Summary of discourse types accounted for

stack, the principles behind narrative maintain a forward moving interpretation across the events described.

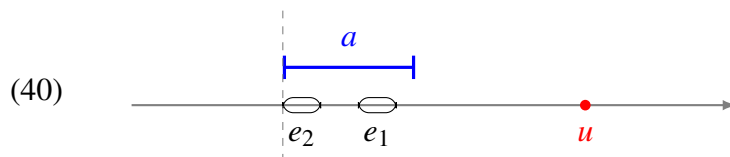
5. Conclusion and future prospects

Starting from the observation that backshifting is forbidden with sentences in the HP, we have motivated a more complex description of the pragmatics of temporal sequencing. At the same time, we have furnished an argument that temporal morpho-semantics can constrain discourse relations, a point that has gone unremarked given the literature’s focus on past-past sequences. As Table 1 shows, our account correctly predicts interpretive possibilities for all possible continuations of simple past and HP sentences.³ Moving forward, we hope to tackle three additional, more complex discourses than considered here.

The first are intra-sentential temporal adjunct clauses, which can yield apparent backshifting in the HP.

- (39)
- a. He returns^{e₁} to the gym after he breaks^{e₂} his leg. $e_1 > e_2$
 - b. He cancels^{e₁} his gym membership because he breaks^{e₂} his leg. $e_1 > e_2$
 - c. Donald is forgiven^{e₁} even though he breaks^{e₂} the law. $e_1 > e_2$

Here, we suggest that, internal to a sentence, $\text{TIME}(a)$ can be set wide enough to contain both events, whose order is determined entirely by the temporal connective.



Though these adjunct clauses permit intra-sentential backshifting, they shift prior to events introduced in previous sentences. For example, (41) presents five events, with the first four

³Our system does not account for the impossibility of forward sequencing with past–present perfect combinations. However, we suspect this arises for independent reasons: the present perfect in English famously does not allow forward sequencing in general.

- (i) Liz has entered the room. She has taken off her shoes. She has dropped her bag on a chair.

intuitively following each other in succession. While e_5 can be understood to squeeze between e_3 and e_4 , continuations which locate it before e_1 to e_3 are significantly degraded.

- (41) Mike is nominated ^{e_1} and confirmed ^{e_2} . Controversy swirls ^{e_3} . Then, the administration fires ^{e_4} him because he meets ^{e_5} with the ambassador ({{??before his nomination, ??before his confirmation, ??before the controversy's explosion}}).

In our current theory, two distinct principles are at play. While discourse-initially, $\text{TIME}(a)$ could be constructed to contain both e_4 and e_5 in the distant past, in (41), CATU will prevent the left boundary of $\text{TIME}(a)$ from retreating before $\tau(e_1)$ (the initial left boundary imposed by CIAT). This will then forestall e_5 from being located before e_1 . For e_2 and e_3 , this reasoning isn't enough, since any e_5 in between those and e_4 could still fall within the existing $\text{TIME}(a)$. Can we simply insert an event between two events linked by narrative progression? What we suggested in Section 4 is that since narrative progression comes with the inference that no noteworthy or relevant event intervenes between two narratively sequenced events, the only way to do this would be to shift $\text{TIME}(a)$ anaphorically to coincide with e_3 . And given the semantics for the present tense, this would mean neither e_4 nor e_5 could precede e_3 .

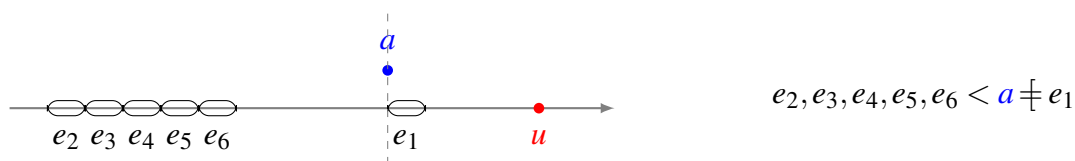
Beyond this issue, our theory of backshifting is currently framed in terms of a salient event, which would mean that temporal frame adverbials should not facilitate backtracking in the HP. Preliminarily, this prediction seems to hold for indexical adverbs like *on Tuesday*, but dependent temporal adverbials, in Hinrichs's (1986) terms, like *two days earlier* do seem to facilitate something akin to backshifting. We need to conduct further research into this.⁴

- (42) Carol is a well-liked and well-evaluated middle manager at Wells Fargo. But everything fell apart for her in the first week of January 2017.
- a. On Friday, Wells Fargo fired ^{e_1} her summarily. {**On Tuesday, Two days earlier**}, she brought ^{e_2} potential cases of fraud to her managers. $e_1 > e_2$
 - b. On Friday, Wells Fargo fires ^{e_1} her summarily. {***On Tuesday, ?Two days earlier**}, she brings ^{e_2} potential cases of fraud to her managers. $e_1 > e_2$

Finally, though we have considered only two sentence discourses, it is important to consider longer and more structured discourses. It is typically understood that discourse is organized hierarchically, with backward sequencing signalling an embedded discourse segment (Grosz and Sidner 1986; Mann and Thompson 1988; Asher and Lascarides 2003, a.o.), such as the move back in (43) to a cluster of events about Fred's morning regimen.

- (43) Fred arrived ^{e_1} at 10. He had got up ^{e_2} at 5; he had taken ^{e_3} a long shower. He had got ^{e_4} dressed and eaten ^{e_5} a leisurely breakfast. He had left ^{e_6} the house at 6:30.

⁴One reason we are cautious about claiming that this is backshifting is a feeling that the two sentences are less connected; it does not feel like second sentence furnishes an explanation for the first. This is reminiscent of the feelings Dickey (2001) reports for attempted backshifting in the Dutch simple past with initial temporal adverbial topics.



(Kamp and Reyle, 1993: 594)

This hierarchical organization broadens the set of possible antecedents for anaphora. While we restricted anaphoric anchors to only the eventuality described by the most recent sentence, when a discourse segment is embedded, the sentence dominating this segment also remains accessible as a possible antecedent (cf. *Right Frontier Constraint*; Polanyi 1988).

- (44) Fred arrived^{e₁} at 10. He had got up^{e₂} at 5. The night before, he had ironed^{e₃} his suit and had packed^{e₄} his suitcase, so he could get on the road quickly. $e_1 > e_2 > e_3 < e_4$
- a. He had left^{e₅} the house by 5:30 and gone directly to his destination. $e_2 < e_5$
- b. He greeted Mary as soon as he got there. $e_1 > e_5$

Thus, our system needs to grow to enable coherent returns to a higher discourse segment. A straightforward implementation of this would be to create stacks for each embedded discourse segment introduced. Then CATU would be understood as licensing anaphora only to those eventualities that introduce an embedded discourse segment, as only these are the top of an eventualities stack. We suspect that such an approach can handle the complex case in (10), but much further investigation is needed.

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Roles and the compositional semantics of role-denoting relational adjectives¹

Curt ANDERSON — *Heinrich-Heine-Universität Düsseldorf, SFB 991*

Sebastian LÖBNER — *Heinrich-Heine-Universität Düsseldorf, SFB 991*

Abstract. The semantics of adjectives related to nominals denoting societal roles, such as *presidential* (from *president*), have remained understudied. We examine the semantics of what we call role-denoting relational adjectives, providing a formal analysis using the notion of a frame, a unified representation for lexical knowledge, world knowledge, and context. The frames we propose are based on a constructivist philosophical understanding of social roles, leading us to posit a multi-tiered ontology of events and individuals. Using frames and our ontology, we provide a general semantics for role-denoting relational adjectives and roles.

Keywords: modification, adjectives, relational adjectives, events, non-intersective adjectives, roles, natural language metaphysics, frame semantics.

1. Introduction

1.1. *Presidential* affairs

Some role nominals such as *president* show an ambiguity between readings related to an official role and to readings related to the person inhabiting the role. In (1), the natural interpretation for the sentence is that the president as a private person visited his mother; no inference arises that this was part of the official duties of being president. However, in (2), that inference is possible. The natural interpretation is that this was an official visit as part of the duties of the office. Correspondingly, *president* in (1) refers to simply the person inhabiting the office, while in (2) the same nominal has a preference to refer to the person qua officeholder, the person inhabiting the role.

That these predications involve meanings of a particular sort (e.g., inferences regarding whether events are related to particular official responsibilities or not) can be demonstrated with certain modifiers such as *private* (for personal acts) and *as head of state* (for official acts), which serve to single out certain interpretations of these sentences.

- (1) The president visited his mother. (personal visit preferred)
- (2) The president visited the Canadian prime minister. (official visit preferred)

The different readings of these sentences are driven in large part by our understanding of social roles in the world. Heads of state (like Canadian prime minister Justin Trudeau) are visited in the course of carrying out the official duties and responsibilities of an office. On the other hand, one's family are (typically) not in a social role that would make them eligible for being visited

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in an official capacity. Thus, our understanding of the relationship between the responsibilities and duties of offices, of heads of state (and other state-level actors) and private persons bears directly on our conceptualization of the semantics of role terms.

English allows for ways of converting nouns to adjectives, such as with the *-al* suffix. When these role nominals arise as adjectives (i.e., *president* to *presidential*), however, a puzzle arises with attributions similar to the ones in (1) and (2). If we assume, as we will below, that the use of the adjective within an NP implicitly relates to a potential referent of the root noun, we observe that the adjective can relate (in this sense) only to the office, not to the incumbent, unlike the root noun itself. The pattern is demonstrated in (3), where the deverbal noun *visit*, when modified by *presidential*, allows only for a reading related to official action by a president; conversely, the sentence in (4) does not entail that the visit was an official visit.

(3) a presidential visit $\left\{ \begin{array}{l} \# \text{to the president's mother} \\ \text{to the Canadian prime minister} \end{array} \right\}$

(4) The president visited his mother.

NO ENTAILMENT: There was a presidential visit to the president's mother.

A distinction in the readings available manifests with adjectival modifiers versus Saxon genitives as well. Saxon genitives allow for a reading where the possessed object is interpreted as relating to the possessor as a person. However, the adjective only allows for an interpretation where the possessed object must relate to the possessor in the context of the role they inhabit. For instance, *the presidential desk* is the particular desk the president uses in their official duties, while *the president's desk* could refer both to the presidential desk, but also to a desk they may happen to use as a private person (such as a personal desk used in a home study). Similarly, while *the presidential advisor* is the advisor to the president for matters relating to the office of president, *the president's advisor* can also refer to an advisor who advises the president in a non-official way (such as a tax advisor).

(5) a. the president's desk (personal reading possible)
b. the presidential desk (role reading only)

(6) a. the president's advisor (personal reading possible)
b. the presidential advisor (role reading only)

Parallel observations apply to NN compounds: formations such as *president advisor* and *president office*, if acceptable, although unusual,² would only have the office reading. There is a simple explanation for the parallel observations concerning the A+N construction and compounds: neither the adjective nor the modifier of the compound refers to what the adjective's root noun and the first part of the NN compound would refer to when in referential use. In both cases, only the modified noun refers. In both constructions, the referent of the referring noun is

² German would have compounds with the first noun *Präsident* instead of A+N constructions with the adjective derived from *Präsident*: *Präsidentenberater* ("presidential advisor"), *Präsidenten eskorte* ("presidential motorcade"), *Präsidentenbesuch* ("presidential visit"), *Präsidentenamt* ("presidential office"), and so on.

N → A	<i>president – presidential</i> <i>Canada – Canadian</i>	<i>parent – parental</i>
A → N	<i>electricity – electric</i> <i>semantics – semantic</i> <i>civilian – civil</i>	<i>municipality – municipal</i> <i>electronics – electronic</i>
A = N	<i>military – military</i> <i>public – public</i>	<i>official – official</i>
A, N	<i>pope – papal</i> <i>mother – maternal</i> <i>mind – mental</i>	<i>lungs – pulmonary</i> <i>king/queen/prince/princess – royal</i> <i>body – physical</i>

Table 1: Pairs of adjectives and co-nouns / nouns and co-adjectives

related to what would be the referent of the root or modifier noun. Being related to does not amount to reference, though. There can be a presidential desk without there being a president, or presidential advisors without a president to advise.

1.2. Co-nominal adjectives

In this paper, we focus on role-denoting relational adjectives. These form a subclass of adjectives that are in a morphological relationship to nouns and/or in a particular semantic relationship to them. In the prototypical cases, there is a noun and a morphologically derived adjective; sometimes, N and A are of the same form; sometimes the direction of derivation is from A to N; and sometimes there is no synchronic morphological relationship at all. We will refer to adjectives of this type as “co-nominal” and call the nouns they relate to their “co-nouns”; conversely, we refer to the adjectives related to the nouns as their “co-adjectives”. Table 1 illustrates A-N pairs of different morphological relation.

We propose to analyze co-adjectives as having essentially the same meaning as their co-nouns, except for two differences: (i) Co-adjectives do not refer, unlike their co-nouns; (ii) the components of the adjective meaning that correspond to the referential and possibly further arguments of the noun are not arguments. The first point accounts for the fact that adjectives and first compound components are not syntactically accessible to determination; for that reason they are also not eligible to direct anaphora. The second observation explains why these adjectives and compound components are not subject to syntactic binding. We will therefore assume the following relationship between, for example, the noun *mother* and its co-adjective *maternal*. The meaning of *mother* can be represented as in (7a), with the referential argument variable marked by underlining. The meaning of the co-adjective *maternal* would be the same, but with free variables instead of lambda-bound ones, and no variable with referential status (7b).

- (7) a. *mother* = $\lambda x \lambda y. \mathbf{mother}(\underline{x}, y)$
 b. *maternal* = $\mathbf{mother}(x, y)$

Thus, the semantic relationship between co-nominal adjectives and their co-nouns is essentially one of identity, while the difference in terms of arguments to be bound and treated as referential is due to the difference in grammatical category. Co-adjectives, one could say, are nouns in the guise of an adjective, or nouns functioning like an adjective.

While the notion of co-nominal A highlights its relation to a semantically closely related noun, we also want a new term for these adjectives when they combine with a noun. The term ‘relational’ adjectives has rightly been criticized as sub-felicitous (see Morzycki (2016: p.49)). It also is used in a way so as to cover adjectives of different semantic classes such as *fake* in *fake gun*, *occasional* in *occasional smuggler*, *alleged* in *alleged thief*, *beautiful* in *beautiful dancer*, and truly relational ones like *municipal* in *municipal kindergarten*, each plausibly requiring a different compositional analysis. We therefore introduce a new term for adjectives that are used to express a relation between two things: linking adjective (LA). This adjective class will include all co-nominal adjectives. What we called role-denoting relational adjectives above are a special case of co-nominal LAs with a role-denoting co-noun.

The paper is organized as follows: In section 2 we briefly discuss the kind-based analysis of relational nouns in McNally and Boleda (2004) and the later analysis in Arsenijevic, Boleda, Gehrke, and McNally (2014). We criticize these analyses for their use of kinds and for not capturing the wide range of possible relations involved with relational (i.e. linking adjectives). In section 3 we develop the ontological assumptions underlying our analysis, including a discussion of frame semantics, the representational framework we use, in section 3.4. Finally, sections 4 and 5 are devoted to our analysis of role-related adjectives.

2. Existing accounts of relational adjectives

2.1. McNally and Boleda (2004)

McNally and Boleda (2004) argue that relational adjectives denote properties of kinds, in the sense of Carlson (1977), and not properties of ordinary individuals (as adjectives like *happy* or *green* are). McNally and Boleda (2004) build an account of RAs that takes inspiration from Larson’s 1998 analysis of non-intersective event-related modifiers like *beautiful*.

An observation with *beautiful*, going back at least to Siegel (1976), is that *beautiful* can have more than one pattern of modification: an intersective pattern where the adjective attributes a property to an individual, and a subsective pattern where the adjective attributes a property to an individual–event pair. Larson (1998) argues that adjectives like *beautiful* are always intersective, but can be predicates of different arguments when they are available. Abstracting away from the connective between the restriction of quantifier Q and its scope, in (8a), the modifier *beautiful* predicates of the individual who is a dancer (the individual **olga**), while in (8b), *beautiful* predicates of the event of dancing that the dancer participates in (event e).

- (8) a. $\llbracket \text{Olga is a beautiful dancer} \rrbracket = Qe [\mathbf{dance}(e, \mathbf{olga}) \dots \mathbf{beautiful}(\mathbf{olga})]$
 b. $\llbracket \text{Olga is a beautiful dancer} \rrbracket = Qe [\mathbf{dance}(e, \mathbf{olga}) \dots \mathbf{beautiful}(e)]$

McNally and Boleda (2004) adopt this strategy of predicating non-intersective adjectives on other parameters. Following Carlson (1977), they assume that kinds are a basic sort, a basic sort of (abstract individuals), but unlike Carlson, they further assume that common nouns have a slot in their argument structure for a kind as well as a non-kind individual, making the denotations of common nouns relations between kinds and individuals.³ The semantics for a common noun such as *architect* would thus look essentially like (9), where R is a relation that holds between a kind and an individual just in case that individual is a member of that kind.

$$(9) \quad \llbracket \textit{architect} \rrbracket = \lambda x_k \lambda y_o. R(x_k, y_o) \wedge \mathbf{architect}(x)$$

Having assumed kinds in their ontology, they proceed to suggest that certain adjectives denote properties of kinds rather than of individuals. The adjective *technical* (e.g., *technical architect*) is analyzed as denoting a property of kinds, as shown in (10).

$$(10) \quad \llbracket \textit{technical} \rrbracket = \lambda x_k. \mathbf{technical}(x_k)$$

Lastly, they make the Larsonian move of saying that adjectives predicating of kinds can predicate of the kind argument of common nouns, just as adjectives predicating of events may predicate in certain circumstances of the event argument of some nouns.

$$(11) \quad \llbracket \textit{technical architect} \rrbracket = \lambda y_o \exists x_k. R(x_k, y_o) \wedge \mathbf{architect}(x_k) \wedge \mathbf{technical}(x_k)$$

Criticism We object to the use of kinds in this way. Carlson introduces kinds as referents of generic indefinites or of species terms like *dog*. Ordinary common nouns in non-generic use, however, denote just a class, or type—of objects, not of kinds. It does not make much sense to assume that there are certain kinds that are architects, which is not the same as to assume that there are different kinds, i.e. subclasses, of architects. Even more questionable is the assumption that the adjective *technical*, along with a much more comprehensive crowd of other non-intersective adjectives, predicates about kinds. In our view, there is no property common to *technical architects*, *technical problems*, *technical colleges*, or *technical instructions*, except that they relate in some way or other to techniques. Not only do these things—be they kinds or just objects—have nothing in common if they are characterized as “technical” such things, they are even of ontological kinds so different that they can arguably be considered to not share any properties at all.⁴ Rather than assuming that LAs denote properties of kinds, we propose that these adjectives do not predicate at all. This accounts for the fact that they cannot be freely used predicatively.⁵ Analyzed like *maternal* in (7b), they do not have an argument to saturate.

We accept the attempt to “marry” A and N before they are applied to an object-type referent of the whole combination. For co-nominal As, this is essentially a marriage between two N concepts. There is no higher type involved than predication about objects, but the marriage is between concepts, not individuals (for example, a marriage of two type $\langle e, t \rangle$ concepts). In a conceptual approach to semantics, the concepts associated with nouns *define* a kind, or class, or

³ Type k for kinds, and type o for individuals (objects).

⁴ See Löbner (2017) on an ontology of objects in terms of possible attributes. The proposed formal approach to global frame-ontologies provides criteria for deciding if two individual objects can have properties in common.

⁵ On apparent counterexamples see the remarks in 2.2.

type, of objects by *describing* a single case. The meaning of *architect* describes an object of the type we call architects. The concept *technical* defines the abstract type of the adjective's co-noun *technique(s)*.⁶ These two concepts are married so as to form one coherent concept that includes both; let us notate this concept as *technique* $\circ\bullet$ *architect*. They must be linked in a way that technique(s) figure in the architect concept as we understand the notion of technical architect. $N1 \circ\bullet N2$ is a cover notation that does not stand for any particular way of linking two noun concepts. As we adopt frame format concept representations (or equivalently AVMs), the connection between the two concepts/frames will be implemented by unification.⁷

To summarize, we do not adopt a kind-based analysis. Rather, we propose to model the 'marriage' between a LA and an N as an operation which unifies the meanings of the two expressions.

2.2. Expansion of the kind-based approach to ethnic adjectives

Arsenijevic, Boleda, Gehrke, and McNally (2014) build on the analysis in McNally and Boleda (2004) in analyzing ethnic adjectives (EAs), adjectives such as *French* and *Canadian*. They argue that these adjectives always classify a nominal according to some physical location, such as a nation. Some examples are given in (12), where in these cases the modified nominal is said to have some relation to the nation the EA relates to.

- (12) a. French wine
b. French agreement (to participate in the negotiations)

The suggestion by Arsenijevic et al. is that the adjective encodes a thematic relation between a kind and a country, what they call **Origin**. This relation holds of kinds and countries only if the kind comes into existence within the spatial domain of the country:

- (13) **Origin**(x, y) iff x comes into existence within the spatial domain of y

EAs, like RAs, target the kind argument of the common noun they modify, making them intersective at the kind level. Crucially, the adjective, due to **Origin**, provides further constraints on this intersection. This is illustrated in (14).

- (14) $\llbracket \textit{French wine} \rrbracket = \lambda y_o \exists x_k [R(x_k, y_o) \wedge \textit{wine}(x_k) \wedge \textit{Origin}(x_k, \textit{France})]$

Both of these analyses model the non-intersectivity of RAs and EAs by predicating the adjective on a parameter other than the individual argument, with the analysis from Arsenijevic et al. (2014) adding an layer of complexity by explicitly naming the relation that obtains between a kind and the country named by the adjective. However, we think that this analysis is not adequate for ethnic adjectives, and also cannot be transferred to role adjectives.

⁶ Actually, this example is not easy to handle, as it is not quite clear what the co-noun of *technical* could be assumed to be if it is to account for all the widely varying semantic contributions the A can effect.

⁷ See Löhnner (2013: chapter 12) for the outlines of an account for analyzing N-N compounds along these lines.

Criticism We share the idea that there is some relation that links the referent of the A's co-noun to the noun the A combines with. However, it appears obvious to us that: (i) the linking relation, for LA's whose co-noun denotes a country, is not always **Origin**; (ii) the linking relation is not unilaterally contributed by the LA; and (iii) the linking relation applies at the level of objects, for example, between the country and the objects the noun denotes.

As to the first objection, consider the following examples (from the BNC online corpus):

- (15) *Canadian government, C. prime minister, C. immigrants (= immigrants to Canada), C. territory, C. citizenship, C. army, C. history, C. Rockies, C. border, C. dollar, C. reunion, C. geography, C. economics, C. policy, C. law, C. writer*

None of these can be paraphrased as '[N] with origin in the region of Canada.' Rather, in each case, a different relation obtains between Canada and the referent of the noun. Obviously, the second noun itself participates in selecting the relation. Among the nouns in (15), *government, prime minister, territory, citizenship, army*, and *policy* are relational nouns and *Canadian* specifies their relational argument as Canada, the state. Similarly, *geography* and *border* are relational nouns with a region or country as an argument, here specified as Canada, the region (note that Canada, the state, is ontologically not the same as Canada, the region). In these cases, the relation is not contributed by the RA, and it is not **Origin**. Rather, the relation is defined in the lexical meaning of N, which specifies the relation between the referential argument and the relational argument.⁸ This should not be taken to suggest that the linking relation is always contributed by the nominal concept; obviously, LAs combine with all types of nouns, including sortal nouns, which lack relational attributes.⁹ Among the examples in (15), *writer* is a sortal noun. A Canadian writer may be a writer born in Canada, or a writer living in Canada, or a writer participating in the Canadian literary scene; in any event we may assume a bridging relation like 'x was born in y,' 'x lives in y,' or 'x participates in the literary scene of y' that takes Canada and the writer as the y and the x arguments, respectively. Thus the possible relations come from both the LA and the N, and how the different sorts of thing they denote can be connected.

Linking adjectives may have 'sisters,' adjectives of the same form that are lexicalized as ordinary intersective property adjectives (PAs). *Canadian* is certainly among them; there is a lexicalized sense variant that means basically 'from Canada.' The origin of this adjective can be considered to be due to a lexicalization of the LA with a particular linking to the country noun. Thus, there are two adjectives: the co-nominal LA *Canadian* and a property adjective *Canadian*¹⁰ that implements a particular, frequent linkage of the LA; there is also the noun *Canadian* in the sense 'native or inhabitant of Canada.' There is nothing "inelegant" (Arsenijevic et al., 2014) in recognizing polysemy. In other cases of what appears to constitute predicative use of LAs, we assume that the LA is coerced into a PA by adding an argument and a relation to the co-noun content. For instance, there are predicative uses of the LA *public* like in (16):

⁸ See Löbner (2013: p. 69) on the possessum-possessor relation inherent to the meanings of relational nouns.

⁹ See Löbner (2011) on types of nouns, including sortal and relational.

¹⁰ Morzycki (2016: p. 14ff), apparently relating to the PA variant, uses *Canadian* as a paradigm case of an intersective adjective.

(16) The university is public, while nourished by the strong support of its alumni.¹¹

These uses seem to be acceptable only if there is support by using the LA frequently with a particular linkage supported by the argument noun of the predicative construction. The observation remains that this mechanism of coercion cannot be applied to the majority of LA-N combinations possible.¹²

2.3. Applying the findings to *presidential*

The objections raised against the use of kinds in analyzing relational adjectives and assuming a particular relation encoded in the adjective carry over immediately to combinations of *presidential* with a noun. Here, too, we encounter a wealth of relations between the president and the noun referent, as shown in Table 2.

<i>presidential N</i>	Relation
<i>presidential election</i>	election to determine the next president
<i>presidential office</i>	the office of president
<i>presidential office</i>	office for official action by the president
<i>presidential advisor</i>	advisor to the president for official action
<i>presidential visit</i>	visit by the president as the president
<i>presidential visit</i>	visit to the president as the president
<i>presidential motorcade</i>	motorcade [for] escorting the president

Table 2: Relations encoded by *presidential N*

3. Ontological background

3.1. Social ontology

Our analysis will depend to a large degree on the ontology we assume in order to be able to talk about things like roles, offices, and official action. Following Searle (1995) we assume a layered ontology, with a higher-level social ontology carried by a lower-level physical ontology of “brute facts”. A human being is an entity in the lower ontology, while when considered a person they constitute a social being, a potential actor in society. The crucial relation that links the social world to the underlying physical world is the relation “*X counts as Y in context C*” Searle (1995: p. 28). Nodding one’s head is a physical action that may count as the social action of approval; a piece of metal or paper may count as money, a person may count as the president of a state—all under appropriate circumstances which are ruled, for example, by convention or law. We assume that the social ontology is in itself multi-layered; the count-as relation may hold between entities of different levels within the social ontology (for example, when the person Angela Merkel

¹¹ <http://www.ccam-va.com/university-members/>

¹² Examples like this add to the argument against considering this co-nominal adjectives as predicating over kinds: this example involves reference to ordinary objects.

counts as the chancellor of Germany). The discussion of the *presidential* examples will relate to distinctions within the social ontology.

3.2. Office and person levels of action

We distinguish in the ontology between two different sorts of acts: acts that occur at the level of a person, and acts that occur at an official level. Social offices are defined (in large part) by the rights, duties and official acts involved with the social role. Depending on the institutional norms and laws, presidents (for instance) might be empowered to wage war, negotiate treaties, sign bills into law, and so on. These are abilities that are reserved for the officeholder in the context of their official role. However, being abstract institutions, offices themselves cannot execute acts; they have no way to directly enact the physical doings that will count as the respective social types of action. Official acts must be implemented by concrete persons (and ultimately by the physical human beings who, for instance, move their hand when signing a bill).

3.3. Connections between levels

We introduce three relations that mediate between ontological levels. The first is the function INC “incumbent.” INC, when applied to an office, returns the person who is the incumbent at the given index. The second is the function IMPL “implementation.” IMPL applies to official-level acts and returns the person-level act that implements it. The third is a relation C-CONST “constitution under circumstance.” The inverse of IMPL, it relates a lower-level act to the higher-level acts it constitutes or counts as. C-CONST is not a function; the relation is transitive, and it also cannot be excluded that one act c-constitutes two different types of acts in parallel.

The C-CONST relation is an application of the notion of “level-generation” from Goldman (1970). Goldman, in developing his theory of action, argues that pairs of acts can be in an asymmetric relation with each other, such that one act is dependent on the other to generate it. Different acts in a generation, or C-CONST relations, correspond to different ways of assigning a given doing simultaneously to different types of action, at different levels in our ontology. For example, if the president, as an official action, signs a bill into law, this act is at the same time an act of moving their hand holding a pen, writing their name, signing a document, and investing its content with legal force. The actor of all this can do the first three acts as a private person (in different contexts), but the last one only in office.¹³ The official act is generated by the more basic acts. Crucially, acts level-generating or implementing each other must have the same agent (modulo the agent’s level-role) and the same temporal extension.

As a final step, we suppose that the usual thematic roles (AGENT, THEME and so on) are defined as functions over both official-level and personal-level acts, returning individuals who fill those roles in those events. The overall picture we get for our ontology is diagrammed in Figure 1.

¹³ The notion of c-constitution is more general than Searle’s counts-as relation. The difference does not matter in this paper; see Goldman (1970: Ch. 2) for the broader notion.

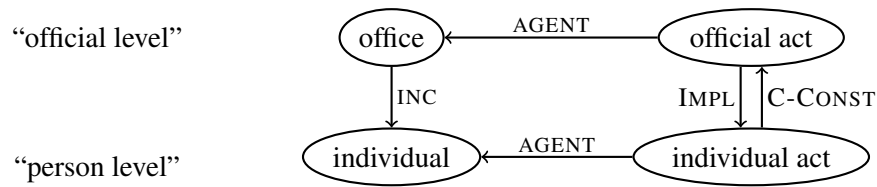


Figure 1: Diagram of a social ontology

3.4. Frames

Our analysis is developed using Frame Semantics (Petersen, 2007; Löbner, 2014, 2017), a theory regarding the structure of concepts based on the notion of frames in Barsalou (1992). Frames encapsulate lexical knowledge, world knowledge, or contextual knowledge in a single, unified format of representation. Thus, the frame theory we adopt is able to capture fine-grained semantic distinctions and not only features related to argument structure. A frame is a recursive attribute–value structure. An attribute is a function to capture a property, by assigning an individual entity in the underlying ontology a value for that attribute. For instance, an attribute *COLOR* would assign a color value to a visible object, *PRICE* a price to an economical good, *BORDERS* the borders to a region, or *HEAD [OF STATE]* the head of a state. Attributes have exactly one value for a given entity; they are functions, but the value may be described by a whole frame. This is what makes frames recursive structures. In a frame, one element is distinguished as representing the individual the whole frame describes.

Different styles for representing frames have emerged, such as the use of attribute–value matrices (AVMs), frame diagrams, and first-order logic. These representations are equivalent; frame diagrams can be transformed into AVMs or first-order predicate logical representation without loss of generality.¹⁴ We use a combination of frame diagrams and logical representations. For frame diagrams, nodes are represented with ovals or other graphic forms, with a double border for the central node, which represents the individual the whole frame describes. When relevant, nodes carry indices; they correspond to individual variables in the logical formulae. Nodes may also carry type labels; sometimes we will write the type-labels into the nodes. Arrows connecting nodes represent attributes, with the arrow pointing towards the value. Attribute arrows are always labeled. Composition of frames is modeled as unification (Carpenter 1992).

The use of frames in the chosen approach also involves ontological assumptions; the frame theory adopted is based on the assumption of an underlying global frame ontology which defines which attributes are available and admissible and which sorts and types of individuals are in the frame universe (Löbner, 2017: §2). The assumptions concerning social ontology are considered to be integrated in the frame-ontology. The functions *INC* and *IMPL* can be used as attributes for social-level offices (with a person incumbent) and social acts, respectively.

¹⁴ See Löbner (2017) for a general discussion.

4. *Presidency, president, presidential, and presidency*

4.1. The *preside* frame

As mentioned previously, we propose that the same concept is present in both *president* and *presidential*. The only differences concern the status of the frame elements. The *preside* frame (and thus the meaning of *president* and *presidential*) is based on the notion of an event of some person being the president of some organization. Crucially, this type of event is defined at a social level above the simple person level. We introduce the metalanguage predicate **preside** for the event of a presidency. For events of this type, there are three attributes (equatable to thematic roles) that are presently relevant. The first is **ORG** (for “organization”); it has as its value the organization that is presided over or headed. The second attribute is **HEAD**, which returns the one who heads the organization, roughly the agent of the presiding event. Finally, τ represents the temporal extension of the event. Figure 2 demonstrates the *preside* frame.

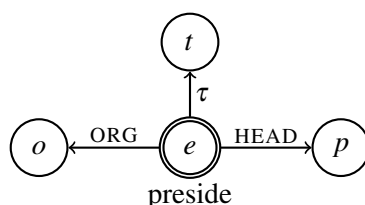


Figure 2: The *preside* frame

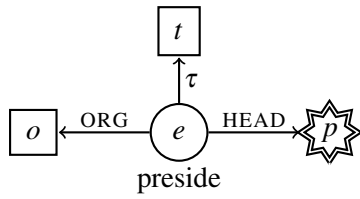
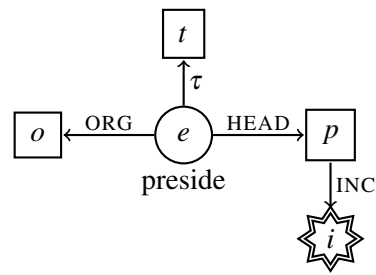
Our position is that certain role-denoting nominals such as *president* have an event in their lexical semantics that encompasses the official acts pertaining to that role. However, although we believe there is an eventive predicate in the lexical semantics of role nouns, this isn't a commitment to role nouns being derived in any sense from verbs or there being a co-verb to the noun. What matters is the lexical semantics of the nouns themselves.¹⁵ Additional evidence is provided by the fact that role nouns can combine with adjectives like *frequent* and *constant*. This type of adjective has been argued to be licensed by event structure (Grimshaw, 1990). It's possible to find attestations for *constant* and *frequent* modifying role nouns:

- (17) I was a **constant president** of our class in my elementary [school] years...¹⁶
- (18) Another character whose life intertwines with the protagonists throughout the novel was Carter Harrison, a **frequent mayor** of Chicago.¹⁷

¹⁵ That certain nouns can be supposed to have an event argument even if not morphologically derived from a verb was independently made in Larson (1998); he gives examples like *daily newspaper*, *just king*, *stray bullet*, and *fast horse*. See also Vendler (1967) for a predecessor of this proposal.

¹⁶ <http://www.onlinejobs.ph/jobseekers/info/67905>

¹⁷ <http://www.storycirclebookreviews.org/reviews/gildedcage.shtml>

Figure 3: *president* (‘office’)Figure 4: *president* (‘person’)

4.2. *President*

We observe that the noun *president* can be used to refer to individuals at either the official level or the person-level of the ontology we have constructed—in other words, to refer to a role-individual or to the person inhabiting the role. The examples in (19a) and (19b) illustrate this, where (19a) has *president* referring at the official level, and (19b) at the person level.

- (19) a. The president visited Canada as part of an official trip.
 b. #The president visited his mother as part of an official trip.

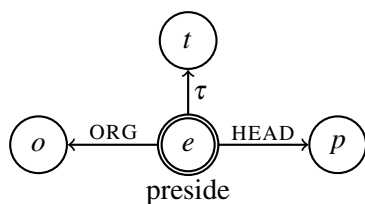
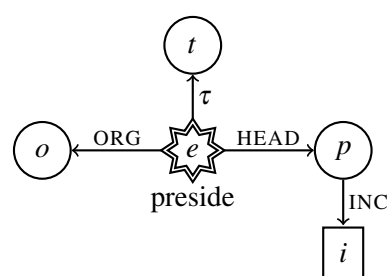
The frame in Figure 3 (represented using predicate logic in (20)) represents the core of the meaning of the noun *president*. Many attributes would have to be added to the value node of the HEAD attribute for an adequate description of a president. The frame is essentially the frame for *preside*, except that the grammatical status of the nodes is specified and the central node is shifted to the president node *p*. This shift is what makes the frame represent the president (in the ‘office’ sense) rather than an event of ‘presiding.’

$$(20) \quad \textit{president}_{\textit{office}} = \lambda o \lambda t \lambda p [p = \text{HEAD}(\iota e. \mathbf{preside}(e) \wedge \tau(e) = t \wedge \text{ORG}(e) = o)]$$

In lexical frames, we mark elements to be bound as arguments in syntax with rectangular boxes; in the corresponding predicate logic formula, their indices (essentially variables) receive lambda-binding. Referential nodes are surrounded by a star. The central node is marked by a double border. In Figure 3, the central node is the one for the president (in the ‘office’ sense) indexed with *p*, a referential node; the node *o* is an argument node representing the relational argument of *president* (the organization). The node *t* represents the time argument; for the sake of simplicity, *president_{office}* is only defined for time periods of a full presidency. We supply the variable *e* with an iota operator since we consider it adequate to assume that there can be only one “presiding” event at a given time for a given organization.

The concept for *president* in the ‘person’ reading is derived from the frame in Figure 4 (represented using predicate logic in (21)) by adding the attribute INC to node *p* and shifting the central and referential node to its value node *i*. This extension comes for free as this attribute is defined for all office-entities provided the office is not vacant.

$$(21) \quad \textit{president}_{\textit{person}} = \lambda o \lambda t \lambda i [i = \text{INC}(\text{HEAD}(\iota e. \mathbf{preside}(e) \wedge \tau(e) = t \wedge \text{ORG}(e) = o))]$$

Figure 5: *presidential*Figure 6: *presidency*

4.3. *Presidential*

The frame for *presidential* is essentially the same frame as for *president_{office}*, its co-noun. The *presidential* frame is represented in Figure 5. This frame has no referential node, as it fits an adjective (and not noun) frame. It also has no argument nodes either, as *presidentially* cannot have its temporal or relational arguments syntactically specified. This feature implements the property of LA that they do not predicate.

4.4. *Presidency*

We use the same basic frame to model the meaning of *presidency*. This is a relational noun referring to the event of a presidency for an incumbent possessor argument. The result is depicted in Figure 6. The four frames developed for *president_{office}*, *president_{person}*, *presidential*, and *presidency* represent four variants of the same conceptual structure. Defining the central element invests the structure with a perspective concerning what element it is primarily related to. Investing certain elements with argument status concerns the way in which the structure is to be linked within the proposition frame for the whole sentence, while referential status amounts to a particular role the element plays when the proposition frame is related to the world.

5. Compositional analysis

5.1. Predication at a level

Some modifiers seem to be able to distinguish between official and personal senses, further supporting our claim that these levels are distinguished ontologically. As *president* is able to force a predication to be interpreted as official-level, while *privately* or *as a private citizen* forces a predication to be interpreted as personal-level. Both modifiers are acceptable if the sentence can be interpreted as either official-level or personal-level.

- (22)
- a. As president/#Privately, the president vetoed the bill.
 - b. Privately/#As president, the president combed their hair.
 - c. As president/Privately, the president visited Canada.

- (23) The King, visiting as a private citizen, was reticent about his political ambitions, saying only that he wanted to help Romania. (BNC HLJ 2180)

We suppose that action at a level (e.g., action at the official-level or personal-level) requires event participants at that same level of the ontology. An event at the official-level, for instance, will require that both Agent and Theme of that event are also construed as being official-level entities. But then what are we to make of cases where entities seem to be mismatched in levels?

5.2. The official level and elaboration

When a DP with a role noun is the subject of the verb *visit*, it is possible to interpret the Theme as an individual at the official level of the social ontology (rather than the personal level). When the DP corresponding to the Theme inherently denotes at the official level, it's quite clear what the Theme attribute of the visiting event should have as its value. However, a difficulty arises when the DP doesn't inherently denote at the official level (e.g., that there is a mismatch of levels). For an illustration of this, consider (24). The name *Trudeau* naturally denotes the personal-level individual Justin Trudeau, but the sentence is most naturally interpreted as being an official visit between two heads of state (official-level individuals).

- (24) The president visited Trudeau. (official)

How is it that *Trudeau* comes to denote the head-of-state-Trudeau rather than the private-citizen-Trudeau? Our solution is that the semantics of a term can be elaborated using a combination of world knowledge and the IMPL and INC mappings between levels. The example is fleshed out here in prose; the resulting frame is represented in Figure 7.

First, the Agent of the visiting: as the sentence asserts about an official-level visiting event, the Agent role of 'visit_o' must unify with an official-level agent. The value *p* of the HEAD attribute of the *preside* frame, the president, is suitable here. However, an official level Theme is also required. But, the name *Trudeau* denotes an entity at the personal level, not the official level. In order to have a Theme at the appropriate level, world knowledge and contextual knowledge is used to infer an individual at the official-level, such that the personal-level individual 'Trudeau' stands in an incumbency relation (via INC) with that individual (e.g., Justin Trudeau in the role of head of state). This is illustrated in the rightmost part of Figure 7. Finally, an official-level visit must be appropriately implemented by personal-level action (see section 3); we therefore need to project down from the 'visit_o' node to a corresponding personal-level action node 'visit_p'. The Theme argument at this level is the personal-level 'Trudeau.' Note that 'visit_p' does not simply stand for a visit at the personal level. Being the implementation of an official visit, it stands for what the office incumbents do when one is paying an official visit to the other: they stage an official visit rather than visiting as private persons.

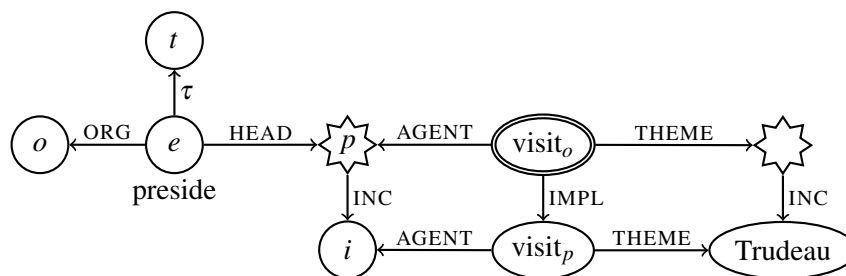


Figure 7: Frame for (24) ('official' level reading)

5.3. The personal level

Predications with *president* can also be situated at the personal level of the ontology, giving us a reading where something not necessarily official has occurred. For instance, if the internal argument of *visit* denotes an individual who does not have a (relevant) official-level role available for them, then the predication will be interpreted as applying at the personal level. An example of this is as in (25), where, because mothers do not normally have a relevant official role, the sentence is interpreted as it being a personal and not official visit. Of course, persons who are the incumbents of offices can also be visited as private citizens as well.

- (25) a. The president visited his mother. (personal)
 b. (As a private citizen,) the president visited Trudeau. (personal)

In contrast to the analysis in the previous section, no elaboration of the official-level is necessary for *visit* in this case; the reason, to put it simply, is that an official-level visit did not occur. Predication at the personal-level can occur with *president* using *INC* to map from the office of the president to the incumbent. The frame in Figure 8 shows this.

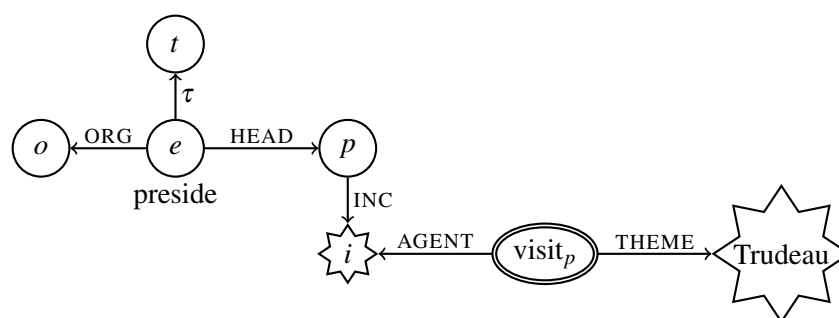


Figure 8: Frame for (25b) ('personal' level reading)

5.4. Unification and *presidential visit*

Recall that the relational adjective *presidential* requires an official-level reading: for example, *presidential visit* only allows for an interpretation where the visit is part of the official sphere of duties related to the president. We model this by supposing that the concept for *presidential* only provides nodes at the official level—that is, no nodes related to the personal level of visit, such

as the incumbent, are provided by *presidential*. The consequence of this move is that unification of the *visit* concept with the concept for *president* can only happen at the official-level of our social ontology. While the DP *the president* provides for the possibility of reference at multiple levels, *presidential* only provides for reference at the official level. This means that *presidential* cannot be ambiguous with regard to which level is selected for predication.

This does not rule out other sources of ambiguity, however. One source of potential ambiguity is the event nominal *visit* itself. The concept for *visit* encodes (at least) two thematic roles, that of an Agent (the one doing the visiting) and that of a Theme (the one being visited). If neither role is saturated, with either syntactically explicit or contextually implicit arguments, we should expect *presidential visit* to be ambiguous, due to the possibility of the official-level president node being able to unify with either the Agent or the Theme thematic role. These possibilities are illustrated in (26) and (27). To explicate a bit, (26) shows the result of unifying the Agent node of the *visit* frame with the president (HEAD) node.

$$(26) \quad \textit{presidential visit} = \lambda e \exists x \left[\begin{array}{l} \mathbf{visit}(e) \wedge \text{THEME}(e) = x \wedge \\ \text{AGENT}(e) = \text{HEAD}(1e'.\mathbf{preside}(e')) \end{array} \right]$$

Example (28) shows the result of unifying the Theme node of the *visit* frame with president.

$$(27) \quad \textit{presidential visit} = \lambda e \exists x \left[\begin{array}{l} \mathbf{visit}(e) \wedge \text{AGENT}(e) = x \wedge \\ \text{THEME}(e) = \text{HEAD}(1e'.\mathbf{preside}(e')) \end{array} \right]$$

These multiple possibilities for unification predict that an ambiguity should manifest itself in examples like *presidential visit*, where the semantic representations include both an individual-denoting node and multiple thematic arguments. This seems to be borne out; corpus and search engine findings show speakers do seem to use *presidential visit* in a way that would be consistent with the analysis above, where the president can be the Agent (visitor) or Theme (visitee) of a visit. While uses of the Agent-related variant are abundant, (28) provides an attestation of the Theme-related use.¹⁸ Other role-denoting LAs also have non-Agent uses, such as in (29), where *papal meeting* can mean a meeting with the pope rather than by the pope.

(28) Will NBA champions continue to visit the White House under Donald Trump? One of the first players to make **the presidential visit** gives his opinion.¹⁹

(29) Abuse survivor disputes removal from Vatican commission, seeks **papal meeting**.²⁰

Some accounts of RAs, such as Alexiadou and Stavrou (2011), treat them as essentially nominals, and argue that classificatory RAs syntactically saturate an external argument position. But, patterns such as those exemplified above are difficult to account for in those types of accounts, as the RA would need to be able to saturate both internal and external arguments (as the Theme

¹⁸ For readers unacquainted with the tradition, members of the winning team of the NBA finals championship game typically visit the White House and meet with the American president.

¹⁹ <http://www.golf.com/nba/2017/01/20/nba-white-house-visit-satch-sanders-celtics-jfk-donald-trump>

²⁰ <http://www.ncronline.org/news/accountability/abuse-survivor-disputes-removal-vatican-commission-seeks-papal-meeting>

argument is presumably an internal argument). In our analysis, the ability of RAs to be linked to either a Theme or an Agent role is a natural consequence of the machinery we use to analyze RAs. In this regard, we follow Arsenijevic et al. (2014), who also argue that the apparent argument-saturating behavior of RAs is only apparent and can be derived from the semantics of the construction (although our account does differ from theirs in crucial ways).

6. Conclusion

To conclude, we argue that the analysis of at least certain types of relational adjectives—our role-denoting relational adjectives or *presidential*-type adjectives—requires a richer semantic ontology than normally supposed. We develop an ontology that includes a social aspect to it, modeling a distinction between personal and social acts. Using this ontology we distinguish between levels of action that constitute or implement each other; our crucial example we develop is personal acts of visiting as implementations of official visitations. Roles are thus derived from the thematic roles available with events at different levels of the ontology.

The frame-based analysis we proposed differs from traditional approaches in formal semantics in a few relevant respects. First, frame representations allow for the type of decompositional strategy we pursued in our analysis, of mixing lexical, contextual, and world knowledge in a single representation. As the readings with *president* and *presidential* are driven in large part by context, modeling these different sources of knowledge in one place made stating their interaction relatively simple. Second, the use of unification as the basic mechanism of composition for frames allowed for a succinct way of capturing different meanings for *presidential visit* (e.g., a visit to or by a president), due to multiple possibilities for unification. And in a certain sense, our analysis is “intersective.” Unification of frames adds conditions to the single frames that are involved. In particular, unifying the noun frame with the LA frame adds conditions to be fulfilled by the referent of the noun. “Intersecting” the two frames in this way is more subtle and involved than plainly conjoining the two concepts.

Finally, this is a project very much in the spirit of “natural language metaphysics” as understood by Bach (1986) and Moltmann (2017). Our analysis is founded on a rich ontology, an ontology that includes social individuals and acts, and distinguishes between acts that implement or constitute each other, in the sense following Goldman (1970). From this ontology, we derive the notion of a social role; social roles are simply thematic roles of events at the official-level of our ontology, and linked to concrete persons on the personal-level via an incumbency relation. Official-level acts are similarly linked to concrete personal-level acts via an implementation relation. These levels in the ontology point towards natural language being sensitive towards acts of different levels of abstractness.

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Focus constraints on ellipsis — An Unalternatives account ¹

Muriel ASSMANN — *University of Vienna*

Daniel BÜRING — *University of Vienna*

Izabela JORDANOSKA — *University of Vienna*

Max PRÜLLER — *University of Vienna*

Abstract This paper presents a new account of the generalization that focused elements cannot be elided, framed within Unalternative Semantics, a framework that does away with syntactic F-marking. We propose the mirror image of the generalization: what is elided cannot introduce alternatives. We implement this as a focus restriction in UAS and then go on to show how to account for MAXELIDE effects using the same technique, without making reference to any transderivational constraints.

Keywords: focus, ellipsis, alternative semantics, unalternative semantics, MaxElide, secondary focus.

1. Introduction

In this paper we discuss the interaction of focus and ellipsis in English in the Unalternative Semantics framework (UAS, see Büring 2015, 2016a, b). Consider examples (1) and (2), which illustrate the Focus–Ellipsis Generalization in (3).

- (1) (Who was Kim going to kiss?) —
a. ALEX.
b. Kim was going to kiss ALEX.

- (2) (What was Kim going to do?)
a. Kim was going to kiss ALEX.
b. Kiss ALEX.
c. #ALEX.

- (3) The FOCUS–ELLIPSIS GENERALIZATION (FEG): Focal elements cannot be elided.

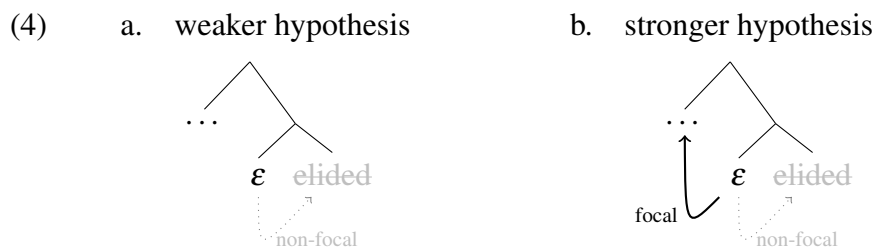
FEG at first sounds like a truism: If ellipsis is the most radical form of deaccenting, it seems trivial that a focus—the accent bearer *par excellence*—could not be elided. But (2) already shows that things aren't that simple: even though *kiss* need not bear a pitch accent in a VP focus answer like (2a)—and can in principle be elided, as in (1a)—such elision is impossible when the focus is a VP, as in (2c). Instead, only the non-focal subject and auxiliaries can be elided, as in (2b).

The straightforward move would seem to allude to a syntactic marking of focus. If VP were F-

¹We would like to thank James Gray, Nina Haslinger, the reviewers of SuB 22 and the people who came to our poster presentation. This work was supported by the Austrian Science Fund (FWF), project grant P29180-G23, 'Unalternative Constraints Crosslinguistically'.

marked in (2), but the object alone in (1), the ellipsis pattern would follow by equating ‘focal’ in (3) with ‘F-marked’. Note that on this view, the FEG provides an argument for *syntactic* focus marking: without F-markers or something like them, there is nothing in the structure for FEG (or the principles that account for it) to tell the difference between (1a) and (2c).

In this paper we argue against this. We show, in Section 2, how focusing and the FEG can be modelled without F-markers, based on the idea that ellipsis itself contributes to identifying (non-)focal material: what is elided cannot have (non-trivial) focus alternatives, as schematized in (4a) (where ϵ is a marker for elision of its sister à la Merchant 2004).



Starting in Section 3 we explore a stronger version of this hypothesis, namely that ellipsis furthermore marks its remnant as focal, (4b). This stronger hypothesis turns out to give us a direct implementation of some MAXELIDE effects.

In Section 4 we examine some apparent problems regarding MAXELIDE and extraction and propose a solution to it that invokes SECONDARY FOCUS (SF), while Sections 5 and 6 elaborate on the further predictions we make regarding SF. Section 7 concludes. Data are either taken from previous literature, the Corpus of Contemporary American English (COCA, Davies 2008) or constructed by ourselves and judged by a native speaker of English.

2. Background

In this section we present the Unalternative Semantics framework. We show how it relates to more standard versions of focus semantics, and how the FEG can be captured in it without recourse to syntactic F-markers.

2.1. Unalternative Semantics

Unalternative Semantics (UAS) takes a syntactic tree annotated with metrical weights and directly derives the set of focus alternatives for each node. As such it rolls into one what is done by the rules for stress/accent-to-F, F-projection, and F-interpretation in frameworks that base Roothian alternative semantics on syntactic F-marking.

Crucially, UAS restricts focal alternatives at branching nodes only, in one of two ways. If the metrical weights among sisters are *reversed from the default*—where the default, for the time being, would be *weak–strong*—STRONG RESTRICTION applies.

introducing alternatives—1. must be replaced by alternatives (strong sister in reversed structure, SR) 2. must be unchanged in all alternatives (weak sister in reversed structure, SR), 3. may or may not be changed in the alternatives (strong sister in default structure, WR), and 4. may not be changed, unless its sister is changed, too (weak sister in default, WR)—as opposed to standard alternative semantics’ two (F or not), our final proposal for ellipsis merely requires 1. and 2., the classical ‘focal’ and ‘non-focal’. This means that the gist of our proposal should be understandable even without the details of UAS. The crucial theorems of UAS on which the proposal relies, though, require those details and are explicated in the appendix.

2.2. The Focus-Ellipsis Generalization within UAS

To make things more perspicuous, we assume a syntactic element ε which marks the deletion/non-spell out of its sister constituent. ε is borrowed from Merchant (2001), and assumed to be subject to contextual restrictions, roughly that the denotation of its sister must be contextually given (‘ellipsis under identity’), the exact formulation being irrelevant here.

Crucially, we put an additional restriction on ε , to the effect that its sister must not contain focal material (i.e. constituents that introduce non-trivial alternatives). In standard alternative semantics this would amount to requiring that in $[\varepsilon B]$, B only has the trivial alternative, its literal meaning; indirectly this ensures that B does not (bear or) dominate any F markers. We get the same effect in UAS requiring that the only alternative allowed for $[\varepsilon B]$ is (the literal meaning of) B, written as \bar{B} . Take the term answer *ALEX* from (1a) and (2) above, which we assume to be represented as in (9).

(9) *ALEX* ε ~~Kim was going to kiss~~ t_{Alex}

By virtue of ε , *Kim was going to kiss* is marked as non-focal, so all focus alternatives at the sentence level will be built around that property, i.e. *Kim was going to kiss x*. This makes (9) a good answer to the question ‘Who was Kim going to kiss?’, but not ‘What was Kim going to do?’. So the FEG is turned around: We do not prohibit deleting something focal, but rather mark something that might otherwise contain focal material as *non-focal* in the process of ellipsis (i.e. as a condition on the presence of ε).⁵

It bears pointing out that the problem with the term answer *ALEX* to a VP-question as in (2c) is

⁵There is a complication here in that the question–answer condition (QAC) used with UAS in Büring (2015)—that A can answer Q if at least some answers in $[[Q]]$ are permitted as alternatives of A—actually fails to rule out an answer with only ‘Kim was going to kiss *x*’ alternatives as an answer to a VP question like ‘What was Kim going to do?’. The reason is that even an answer like *Kim was going to kiss ALEX* (‘VP focus’) does not have all propositions of the form ‘Kim was going to *Q*’ as possible focus alternatives; it lacks those in ‘Kim was going to Q^{kiss} Alex’ (for good reasons); therefore Büring (2015) relaxed the QAC so as to be content as long as *some* answers to the question are also permitted alternative of the answer, which, alas, is *also* the case if the permitted focus alternatives are just ‘Kim was going to kiss *x*’ or just ‘Kim was going to *R* Alex’. The correct version of QAC should be one that does not mind if, say, an answer to ‘What did Kim do?’ lacks *some* of the ‘Kim *Q*’ propositions as alternatives, but *does* mind if it *only* allows alternatives that are of the sort ‘Kim kiss *x*’ or ‘Kim *R* Alex’. But since QAC does not know about the ‘form’ of propositions, it is unclear to us at this point how to best state such a condition, so we leave this for another occasion.

not in general accounted for by demanding that the complement of ε is given (as is standardly assumed, e.g. in Merchant 2001). To see that, consider (10):

- (10) (Kim was going to call me, but then my phone went dead. What is Kim going to do now?) — *(call) ALEX

In (10) ‘Kim was going to call’ is made contextually salient, so the elided part of (9), *Kim is going to call*, is given. Yet, (10) is no better than (2c). We conclude that the oddness of (2c), like that of (10), is not attributable to eliding something non-given (*Kim called* in (2c)); rather, we submit, the problem is that in both cases *call* is marked as non-focal (by virtue of being elided), although it is part of the focus. The standard treatment of ε alone thus does not derive the FEG.

On the treatment just proposed, the restriction imposed by ε is different from both Weak and Strong Restriction; it is just the weak daughter condition of Strong Restriction (‘can’t be focal’), with out its relational counterpart (‘must be focal’). While this is certainly possible to do in UAS, it may be worth exploring the idea that ε does in fact impose a Strong Restriction: not only must the elided part be non-focal, its sister (or, counting ε itself: its aunt) must be focal, as schematized in (4b) above.

3. The remnant must be focal

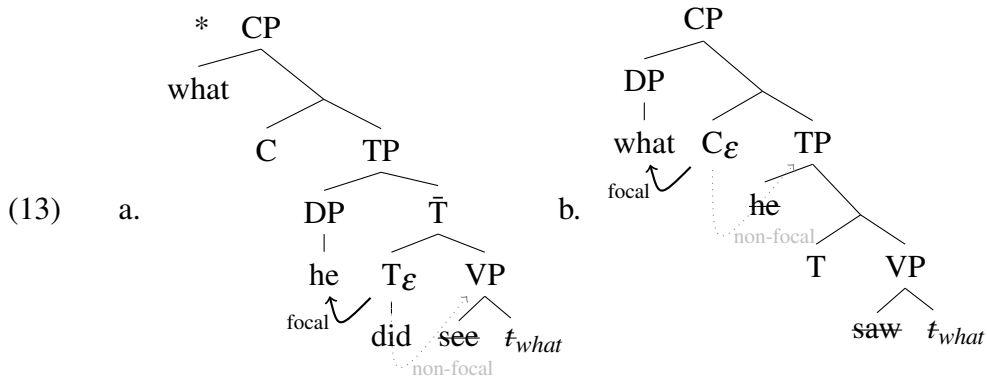
If ε imposes a SR, this means that the immediate remnant of an ellipsis must be focal. This seems generally on the right track, and in particular, it derives a number of so-called MAXELIDE effects, exemplified in (11).

- (11) a. *John saw something, but we don’t know WHAT he did.
b. John saw something, but we don’t know WHAT.

The definition of MaxElide, as stated originally in Merchant (2008) is given in (12).

- (12) MAXELIDE: Let XP be an elided constituent containing an A’-trace. Let YP be a possible target for ellipsis. YP must not properly contain XP. (Merchant 2008: p.141)

To a first approximation, MAXELIDE means that a smaller ellipsis like VP in (11a) is ungrammatical in a context where a bigger ellipsis, like TP in (11b), is possible. Using ε with a Strong Restriction, as suggested above, the two competing structures are given in (13).⁶



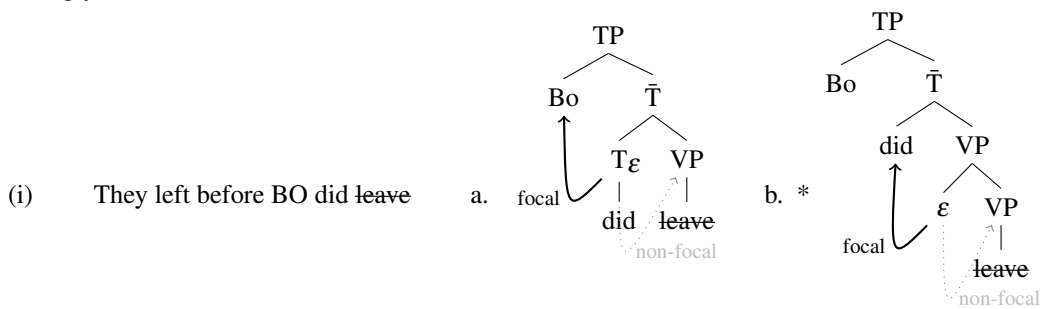
In (13a) *he* needs to be focal, by ϵ , and there should be a contrastive target of the form ‘somebody else saw something’, which there isn’t. Furthermore, *what* fails to be marked as focal in (13a), though it clearly is the element contrasting with *something*.

In (13b), on the other hand, *what* is marked as focal, and everything else as background, which exactly matches the context in (11). So using a strong restriction with ϵ not just makes sure that nothing focal is elided (which is the case in both (13a) and (13b)), but also that the final non-elided remnant is itself focal. This captures the basic MAXELIDE effect. What is more, it does so without invoking a transderivational constraint, which most other accounts of MAXELIDE effects we know of do.⁷

4. Apparent Problem: MAXELIDE and Extraction

What our story so far does not capture is that MAXELIDE effects appear to be restricted to cases in which the ellipsis site contains a trace. Thus in (14), which does not involve extraction, both small (lower VP) and maximal (higher VP) ellipsis are equally acceptable, apparently ignoring MAXELIDE.

⁶Note that unlike in our earlier trees, ϵ in (13) is sitting on preterminal nodes—T and C, respectively—rather than being adjoined; as a consequence, the SR does no longer regard sisters, but aunt–niece pairs (here: SpecT and VP/SpecC and TP). We believe that this is at least an option (though it wouldn’t make a difference in (13), since there ϵ could also just adjoin to \bar{C}/\bar{T}), as English in some cases allows for a non-focal head between the ellipsis site and the closest focus. This is shown in (i), where an ϵ adjoined right above the ellipsis site, as in (ib), would wrongly force *did* to be focal.

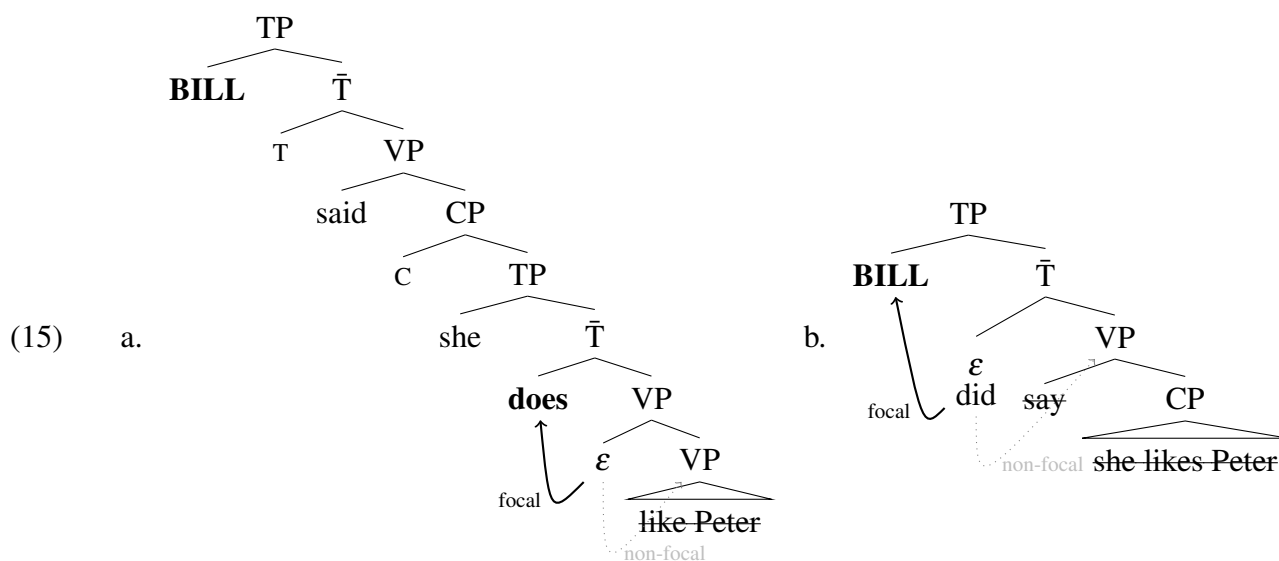


We are not concerned with what categories can and cannot be elided in English in general. See e.g. Miller and Pullum (2013) for further information.

⁷See Messick and Thoms (2016) and Griffiths (2017) for different accounts of deriving MAXELIDE effects.

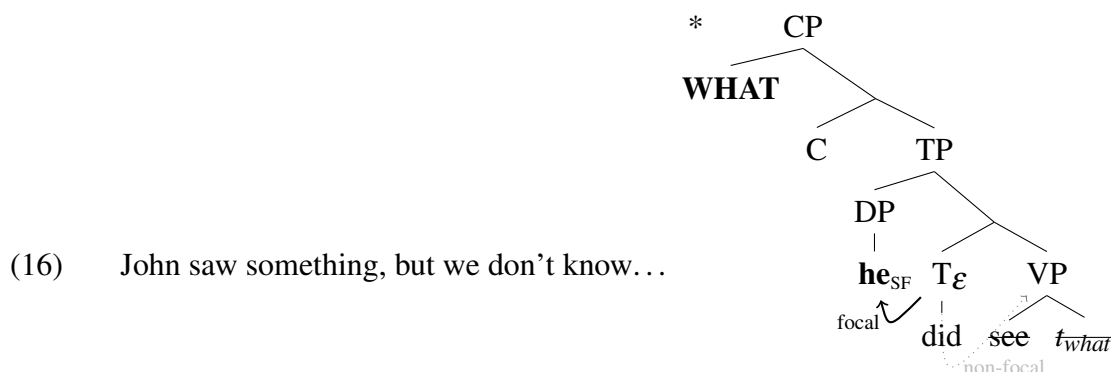
- (14) John said Mary likes Peter. a. No, **BILL** said she **does**. b. No, **BILL** did.

According to what we said so far, (14a) should only be possible if *does* (or *she*) were focal. But is it? Clearly it does not bear the nuclear pitch accent, which in both cases is on *Bill* (as one would expect). We submit, however, that *does* is a SECONDARY FOCUS (SF), i.e. a focus that is contained in the background of the main focus (*BILL*). As in (14a), we indicate a SF by boldface, reflecting that it is marked by stress, but not accented (which would be indicated by capitals). The structures for (14a) and (14b) are then as in (15a) and (15b), respectively.



Section 6 below provides independent evidence that, indeed, the final remnant before an ellipsis is always focused, even when not accented.

But for now we want to make sure that the introduction of SFi as a general possibility does not throw out the proverbial baby with the bathwater: If a SF can generally obscure the effect of MAXELIDE in this way, why are there unacceptable cases at all? That is to say, why can we not claim that (13a) also contains a SF on *did* or *he*, as in (16)?



Our answer to this question closely follows the one given in Takahashi and Fox (2005), who argue that if an ellipsis site, say VP, contains an unbound variable, its antecedent cannot be

just a VP; rather one has to find an antecedent matching a PARALLELISM DOMAIN, which includes, in addition to the ellipsis site, the binders for the variable. For example, while $[_{VP}likes Peter]$ in (14a)/(15a) can directly be licensed by $[_{VP}likes Peter]$ in the first sentence (their semantic identity can be established at the VP level), $[_{VP}see t_{what}]$ in (16) cannot, because it contains an unbound trace (roughly, we do not know its denotation, and hence cannot establish synonymy with any antecedent). Instead a parallelism domain that includes the antecedent, *what*, is required, i.e. the entire CP. In (15), on the other hand, any constituent containing the ellipsis site (and even the ellipsis site itself) is a potential PD (as there are no variables waiting to be bound).

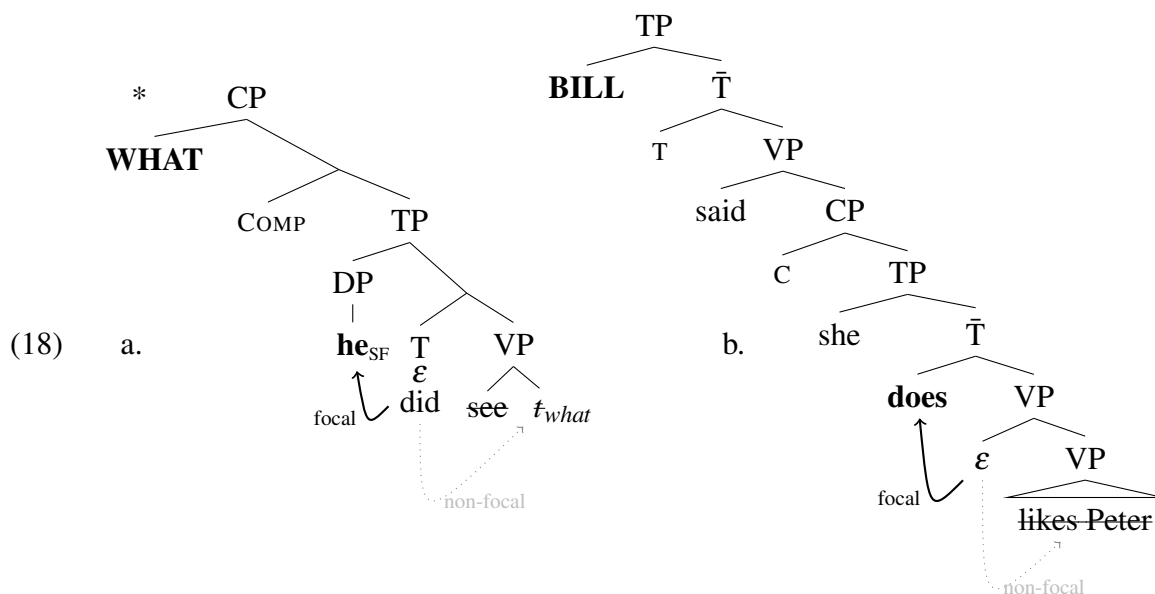
Takahashi and Fox (2005) then cash out MAXELIDE as ‘Delete the biggest deletable constituent within a PD’. For example, since the minimal PD in (16) is CP, ellipsis must delete TP, not just VP. The minimal PD in (15a), on the other hand, is the elided VP itself (since there are no unbound traces within it), within which, trivially, that VP is the biggest deletable constituent. If one picks the matrix VP or TP instead, the biggest deletable constituent within *that* is the matrix VP. So still, for any given PD, the ellipsis site is maximal, it’s just that there are various choices of PD. Where there is a trace involved, however, choices are effectively restricted to a domain containing at least the antecedent; (17) below illustrates again what rules out smaller PDs for such a case, here (16).

- (17) John saw something, but we don’t know
- | | |
|---|--|
| a. *what he did $[see t_{what}]_{PD}$. | PD contains trace, but not antecedent |
| b. *[what he did $see t_{what}]_{PD}$. | PD ok, ellipsis not maximal in PD |
| c. [what he did $see t_{what}]_{PD}$. | PD contains antecedent, ellipsis maximal |

In our proposal, the role of Takahashi & Fox’s PD is roughly played by the DOMAIN OF THE SECONDARY FOCUS, i.e. the domain that consists of the secondary focus and its background. Like Takahashi & Fox’s PD, the domain of a focus is in principle free (so long as it contains the focus, of course), provided it does not contain unbound variables. As a consequence, if the SF c-commands a trace, its domain must include the antecedent of that trace, again just like Takahashi & Fox’s PD.

Crucially, and unlike in the case of Takahashi & Fox’s PD, there is also an upper limit on the choice of the domain for a SF: it cannot include the main focus. This is a consequence of the UAS mechanism, as we demonstrate in the appendix. For now, we simply state that the choice of domain for the SF is limited: big enough to contain the antecedent of a trace (if there is one), but not including the main focus.

Importantly, these two conditions cannot possibly both be met in case the extractee is itself the main focus of a sentence. For example, in (16), repeated in (18a), the domain of the SF *he* has to include *what* so as to have the VP internal trace bound, and at the same time must *not* include *what*, since that is the main focus. This dilemma will present itself whenever the extractee is the main focus; in other words, there can be no SF in such cases, and hence no non-maximal ellipsis.



In a non-extraction case like (15a), repeated in (18b), no such problem arises: Since there is no trace waiting to be bound, the domain of the SF on *does* can be as small as (embedded) TP, CP or (higher) VP, which all exclude the main focus *Bill*. We thus predict that—other constraints on the choice of the focus domain notwithstanding—ellipsis size is flexible in these cases.

This concludes our derivation of MAXELIDE effects and their (apparent, see Section 6) absence in non-extraction contexts. In the next Section we will discuss in more detail the interaction between SF and extraction. But first, let us take stock: the basic MAXELIDE effect is written into the semantics of ellipsis itself, i.e. once ε /ellipsis is used, not only does the elided part need to be non-focal, but the nearest remnant must be focal. No transderivational constraints are needed (cf. ‘biggest deletable’), it’s just that any smaller ellipsis would wrongly mark something as focal that ought to be in the background. Furthermore there is now a reason why the size of what Takahashi and Fox (2005) call P(arallelim) D(omain) relates to the minimum ellipsis size: The minimal PD is the domain in which no S(econdary) F(oci) can occur. Lastly, our proposal directly answers the question why, unlike similar principles like Maximize Presuppositions (Heim 1991), MAXELIDE does not penalize the complete absence of ellipsis even where possible, that is, why the urge to elide as much as possible is only activated once *some* ellipsis has taken place: the alleged ‘principle’ MAXELIDE is just a consequence of the conditions that come with ε ; no ε —no MAXELIDE effect.

5. More Complex Interactions Between Ellipsis and Extraction

So far, we have paid attention only to configurations in which the phrase extracted from the elided VP was itself the primary focus. However, the generalization we have derived is a different one: that MAXELIDE effects will be observed *unless* the primary focus is higher than the extractee. This section will look at the two sides of this prediction that were not discussed so far: cases in which the primary focus is higher than the extractee, and cases in which it is lower.

5.1. Focus Below the Extractee

These cases have actually been discussed in the literature a lot: A focus below the extractee *forces* ellipsis to be smaller.⁸

- (19) a. I think YOU should ride the TALLEST camel, but I don't know which one PHIL should.
 b. I don't know which puppy you should agree to adopt, but I know which one you should NOT.

In existing accounts this is because a focus renders any constituent containing it undeletable. On our account, basically the same holds: As soon as a constituent is not given, it cannot be below ε . Another prediction we make for these cases is that ellipsis *does* have to be maximal below that focus. We share this prediction with Takahashi and Fox (2005), who contrast (19b) with the unacceptable (20), in which the ellipsis ends unnecessarily far below the focused *not*.

- (20) *I don't know which puppy you should agree to adopt, but I know which one you should NOT agree to.

In contradistinction to that, Griffiths (2017) claims that a focus underneath the extractee basically neutralizes MAXELIDE, providing examples such as those in (21) (his (13)).

- (21) a. I know who MARY thinks he'll kiss and also who SUE thinks he will.
 b. I know who BILL hopes to kiss and also who BOB hopes to.

Our account clearly predicts these to be ungrammatical, so to the extent that Griffiths' judgments are shared⁹, more needs to be said here. On the other hand, we correctly predict the contrast between (19b) and (20), which is surprising given Griffiths' account.

5.2. Focus above the Extractee

We assume that no MAXELIDE effects will be observed if there can be a (variable-free) focus domain below the main focus. So far we looked at cases in which the main focus was an element extracted from the ellipsis site, so that the *de facto* there could be no MAXELIDE obviation in structures with extraction.

But in principle, an extractee need not be focused, in which case we predict that MAXELIDE obviation is possible. A pertinent example is given in (22) ((33) from Merchant 2008):

- (22) ??Ben knows who she invited, but Charlie DOESN'T know who she did.

⁸Examples (48) from Schuyler (2001) and (32) from Takahashi and Fox (2005).

⁹Not all speakers accept these examples, so there seems to be a fair amount of inter-speaker variation. Furthermore, some speakers find (21b) worse than (21a), we leave this open for now.

According to our proposal, if *did* in (22) is a SF, it could take either the *who* clause or the VP headed by *know* (i.e. anything below the sentential focus *doesn't* and above the extractee) as its focus domain (FD). In either case, there shouldn't be a problem and the resulting sentence is predicted to be grammatical. (23) illustrates the case where the *who* clause is the FD of *did*:

- (23) DOESN'T know who she **did** invited t_{who} domain of SF *did*

The literature partly bears out this prediction in that Merchant (2008) judges (22) better than 'regular' MAXELIDE violations—i.e. ones in which the extractee is focused—such as (24) (his (30)).

- (24) *I know we invited SOMEone, but I cant remember WHO we did.

But (22) is still judged as degraded, which is not predicted by what we said so far. We are not sure what the cause of this degradation is; there are reasons to believe, though, that it is unrelated to the MAXELIDE effect. Observe that Merchant judges (22) on a par with (25), which, notably, involves extraction of an adjunct, *when*.

- (25) ??Abby knew when he had quit, but Beth DIDN'T know when he had.

Crucially, adjunct extraction generally does not lead to MAXELIDE effects at all (as they do not involve VP *internal* traces, cf. again (12)), as has been observed in the literature, (26) (ex. (16a) from Schuyler 2001), and indeed we found examples of this kind in the COCA corpus (Davies 2008), e.g. (27).¹⁰

- (26) I think you should adopt one of these puppies, but I don't know WHEN you should.
- (27) a. Sean: And the airline was not willing or forthcoming today, General McInerney, with any information about why he stopped his training back in 2009. That's somewhat of a puzzle, right?
b. General McInerney: It's very puzzling, Sean. **We have to do a deep dive into that to see why he did.** Did he suffer depression?

Likewise (25)'s counter-part in (28) seems impeccable.

- (28) Abby knew that he had quit, but not WHEN he had.

Based on this, it seems justified to assume that (22) and (25) are degraded for the same reason, and that, in the light of (25), that reason should crucially *not* be related to the explanation for MAXELIDE effects, but something independent. While of course we would like to know what that something is, we will have to leave that question for another occasion.¹¹ For now, our account

¹⁰The context is provided in (27a), while the relevant sentence is marked in bold in (27b).

¹¹The crucial difference between (28) and (25) appears to be that the main focus has 'moved' from the *wh*-word to something further to the left, so that the *wh*-word itself becomes part of the background, as schematized in (i).

(i) MAIN FOCUS... *wh*-phrase... aux ... t_{wh} ... / t_{wh} ...

predicts—correctly, as we just argued—that (22), like (25), does *not* show a MAXELIDE effect, and that both are of equal acceptability, which is significantly higher than ‘classic’ MAXELIDE violations.

6. Effects of SF

In this Section we motivate the assumption that cases of non-maximal ellipsis indeed involve a S(econdary) F(ocus). Or put differently, that ellipsis is really always maximal, once we consider SF, and as predicted by our claim that ellipsis itself marks its closest remnant as focal.

For this, we need to look at cases that do not involve extraction from the ellipsis site, such as those in (29) ((35) from Merchant 2008: with indication of accents added).

- (29) a. Ben knows that she invited Klaus, but her father DOESN’T
 b. Ben knows that she invited Klaus, but her father DOESN’T know that she did.

According to existing accounts of MAXELIDE effects, the choice between (29a) and (29b) is optional, as the choice of ellipsis size is in general where no extraction from within VP is involved. On the present proposal, (29b) must involve a SF on *did*, that is: it emphasizes that her father assumes that she *didn’t* invite Klaus. While this seems consistent with our intuition, it turns out difficult to really pinpoint these aspects of meanings. In particular, we would like to see cases in which a non-maximal ellipsis is unacceptable because its remnant cannot be focal for independent reasons.

To do so, we will concentrate on *associated* foci to demonstrate the connection between ellipsis size and focus interpretation. For an illustration consider (30).

- (30) A: Bob will only tell me WHERE he’s going (not when).
 B: (i) I wonder WHY.
 (ii) *I wonder WHY he will only tell you.
 (iii) I wonder WHY he will only tell you where.

By inserting *only* below the remnant of the higher sluice, we can quite reliably control the position of the SF in the small ellipsis cases, here on *where*. (30-ii) and (30-iii) set our baseline in that they show that, once *only* is overt, its associate must be, too, where both follow the sentential focus and are therefore deaccented, resulting in a rather small ellipsis.¹²

Note that the extraction in (30) is from the non-elided VP headed by (*only*) *tell*, so a proponent of the ‘classical’ MAXELIDE approaches could claim that (30-iii) is unsurprising, given that in non-extraction cases the choice of ellipsis size is free anyway. But our, stronger, claim is that in fact, the small ellipsis in (30-iii) is *only* possible if *where* is a SF. To bring home that point,

We suspect that the resulting configuration, then, involves two secondary foci, one on *had*, one on *when*, both embedded under the main focus *didn’t*, which might simply be too hard to contextualize.

¹²This generalization—that (secondary) foci may be deleted only if the element they associate with is deleted, too (see also Han and Romero 2004: note 15, p.199, and Büring, 2015:note 23)—is actually derived by our account: the focus sensitive element ‘retrieves’ the focus, i.e. allows the alternatives to be reset.

we need to look at (30)'s minimal cousin (31).

- (31) A: Bob will only tell ME where he's going.
 B: (i) I wonder WHY.
 (ii) I wonder WHY he will only tell you.
 (iii) *I wonder WHY he will only tell you where.

First off, note that (31-ii) is acceptable in this context (unlike (30-ii) in (30)), because *only* associates with the overt (and by hypothesis SF marked) *you*. More importantly, (31-iii) is *unacceptable* here (contrasting with (30-iii)); its only reading is one in which *only* associates with *where* ('where, but not when', just as in (30)), which is infelicitous in this context as it differs from the main focus in A's utterance in (31). This is exactly the evidence we are after: for the ellipsis to be non-maximal, the final remnant *must* be (secondarily) focal.

Additionally, (30) and (31) between them show that previous accounts of MAXELIDE-like effects are incomplete in several ways. First, (31-iii) should not fall under the purview of MAXELIDE to begin with, since it does not involve extraction from the ellipsis site at all. On our account, *all* ellipsis is subject to MAXELIDE—or more precisely: marks the final remnant as focal—, so effects like in (30)/(31) are predicted.

Second, this effect cannot be due to competition between ellipses of different sizes. The only *elliptical* competitor in (30) and (31) alike is (B-i); (31-ii) (like (30-ii)) does not involve ellipsis, but null-complement anaphora.¹³ But if (30-i) were to block (31-iii), it should do so in (30-iii) as well. On our account, (30-iii) is grammatical because *where* can be a SF in the context of (30), and (31-iii) is ungrammatical because it cannot—the SF must be *you*, not *where*. There is no competition involved.

In fact, (31-iii) actually *is* the maximal *ellipsis* structure that contains *only* and its associated focus *you*. So a version of MAXELIDE that claims (30-iii) to be grammatical because it is the biggest ellipsis excluding *where*—the focus associated with *only*—would have to do the same for (31-iii); the next bigger ellipsis, the VP headed by *tell*, would fatally include *you*.¹⁴ Again, the present account has no trouble with this since it does not invoke competition (of ellipses or otherwise) at all.

¹³Even if you think that null-complement anaphora is a form of ellipsis, it still should not compete, lest (ia) be blocked by (ib).

- (i) a. Mary has a hunch why Bob bailed, and Sue even KNOWS why.
 b. Mary has a hunch why Bob bailed, and Sue even KNOWS.

¹⁴Throughout this Section we have ignored the option of deleting the middle VP, i.e. a reply like *I wonder why he will* in (30)/(31). These sound bad in either context, as predicted. However, it seems generally hard to elide a VP with initial *only*; that is to say, (i) seems to mean that Steve will tell me where he (Steve) is going, not that he will *only* tell me.

- (i) Bob will only tell ME where he's going, and Steve will, too.

Whatever the reason for this, it may explain independently why *I wonder WHY he will* sounds odd in our examples, so we did not consider it in the paradigms.

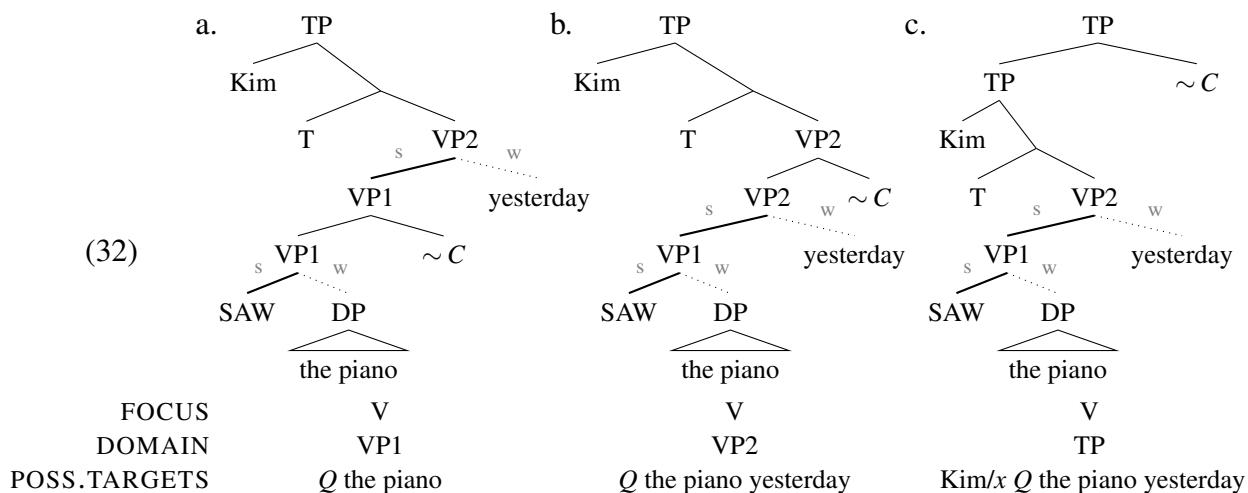
7. Conclusion

In this paper we have put forward an account of the generalization that focus cannot be elided, without making reference to syntactic F-markers. We propose that ellipsis itself imposes a restriction on the available (non-trivial) focus alternatives: Whenever ellipsis applies, the elided part cannot introduce alternatives. In a second step we proposed that ellipsis imposes an additional focus restriction to the effect that the final remnant is itself focal. This was shown to capture so-called *MAXELIDE* effects, and to do so without using transderivational constraints.

Crucially our proposal assumes that this marking occurs with any instance of ellipsis, not just those containing traces. Cases in which smaller ellipses are permitted are analyzed as involving a secondary focus on the final remnant as well. This assumption was motivated using examples with associated second occurrence foci in non-maximal ellipses. On the resulting picture there is no *MAXELIDE* principle, rather the effect follows, like the ban on deleting focal material, from our general modelling of ellipsis, without F-markers or any kind of competition-based principles.

Appendix: Secondary Focus in UAS

A SF results when a focal constituent, though locally strong, ends up within a weak branch higher up in the tree. To make this more perspicuous we follow Rooth (1992) and mark the domain of a focus by a *SQUIGGLE OPERATOR* \sim adjoined to that domain; some examples are given in (32).



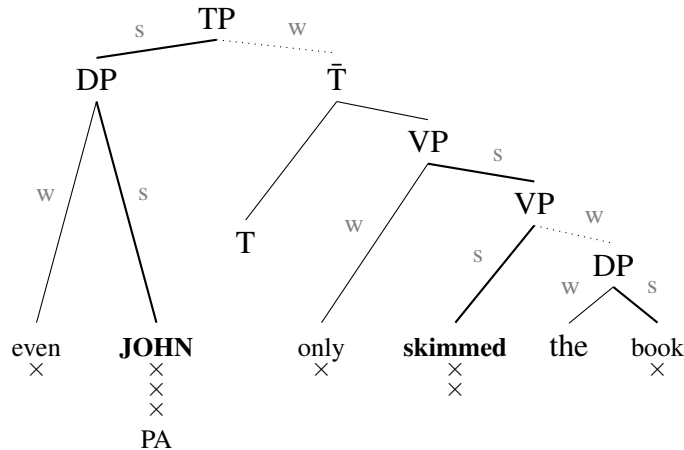
The squiggle operator *RETRIEVES* the focus, which—just like in Rooth (1992)—involves two things: First, it checks that the value of *C* (a covert pronoun, the focal target) is allowed as a focus alternative to the domain, i.e. compatible with the restrictions accumulated so far (otherwise the structure is undefined). If so, it, second, optionally *RESETS* the focus, i.e. sets the only possible alternative to the domain to be its literal meaning.

As detailed in Büring (2015), the resetting is crucial for the treatment of secondary foci. A typical SF configuration is *SECOND OCCURRENCE FOCUS*, where the domain of one focus

(the secondary) is included in the background of, and follows, the main, focus, as in (33a).¹⁵

(33) a. (The kids only skimmed the book.) Even **JOHN** only **skimmed** the book.

b.

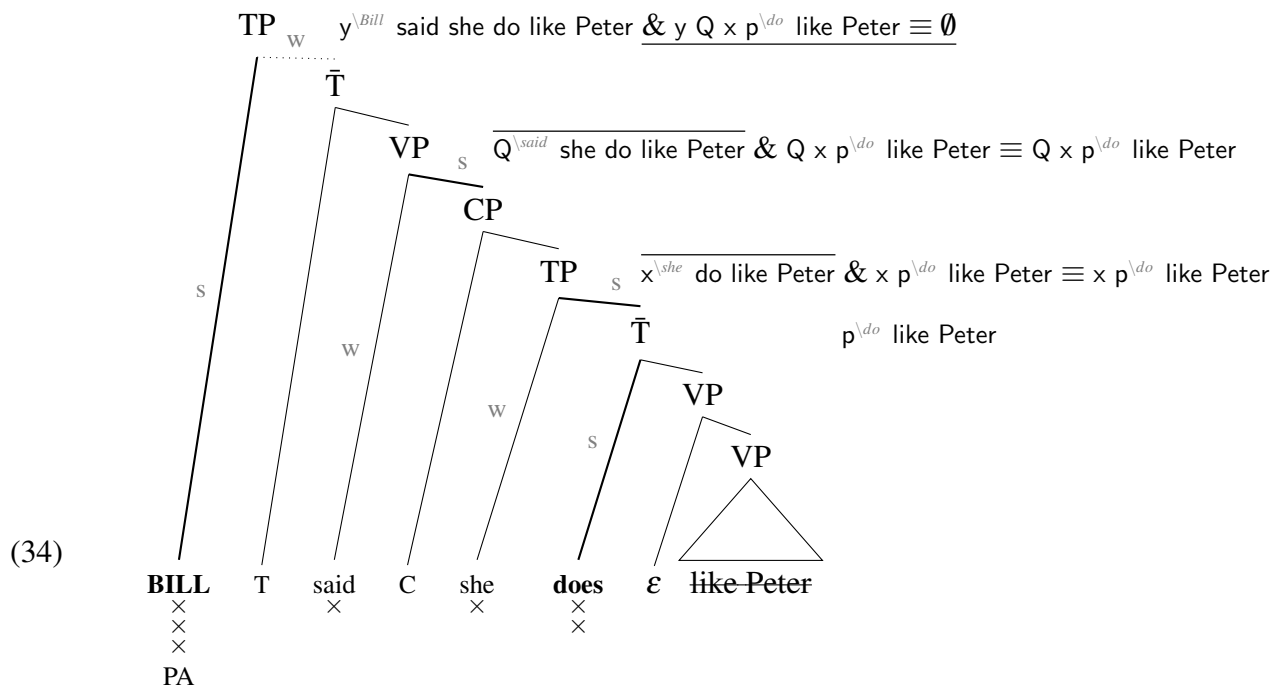


(33b) gives the full representation of the second clause, including a metrical grid compatible with the weights in the tree, and the resulting accent placement. *skimmed* is focal, as its mother node VP has undergone prosodic reversal, and the entire \bar{T} is in the background of the focal *even John*, whose mother TP likewise is reversed.

The crucial generalization that follows in such a configuration is that the focus on the SF *skimmed* has to be retrieved *below* the higher focus; put differently, the domain of the focal *skimmed* may be at most as big as \bar{T} . As Büring (2015), following Büring (2015), shows, this generalization is born out by the facts around second occurrence focus.

The ellipsis configurations we argued for in this paper are structurally parallel to SOF, see for example (34): *does* is a SF, marked in this case not by prosodic reversal, but by ellipsis/ ϵ , whose domain is in the background of the main focus on *Bill* (marked by prosodic reversal on TP).

¹⁵Every Second Occurrence Focus is a Secondary Focus, but not necessarily *vice versa*. The domain of a SOF, as the name suggests, needs to have a more or less *verbatim* antecedent, such as the first clause in (33a). A Secondary Focus is simply a focus whose domain is in the background of another focus. If there can be non-anaphoric focus domains, as we assume there can be, a SF need not have an antecedent.

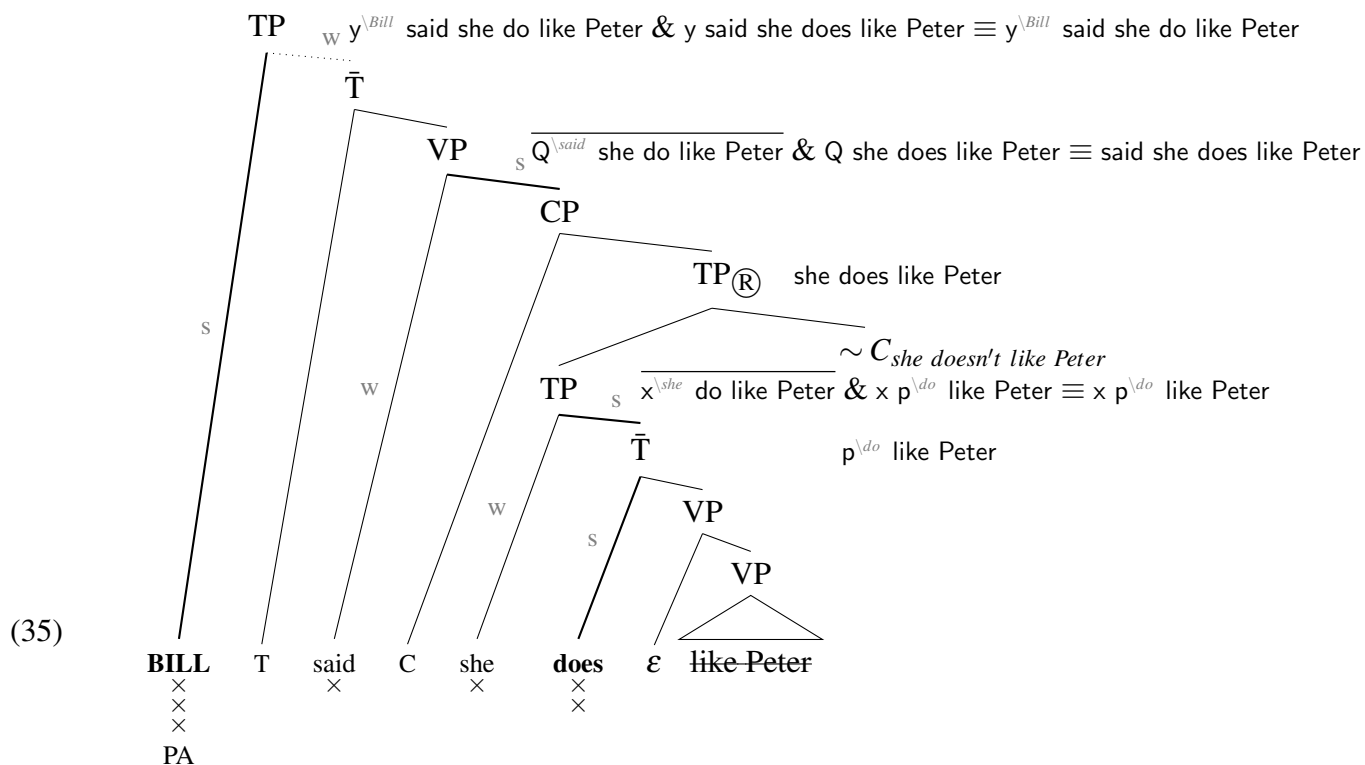


In (34) we also indicated the restrictions on focus alternatives imposed on the various nodes. Using those, we can now show that the restriction that SF needs to be retrieved and reset ‘before’ the main focus, indeed just follows from the general UAS system.

The lower \bar{T} marks *does* as focal (by ellipsis), a restriction that is propagated up. All nodes above \bar{T} and below the root have default weak–strong patterns and add rather trivial weak restrictions: they may or may not be focal. The only alternative to *do(es)*, we assume, is ‘does not’, so \bar{T} , TP and higher VP all require the focus alternatives to be about not liking Peter.

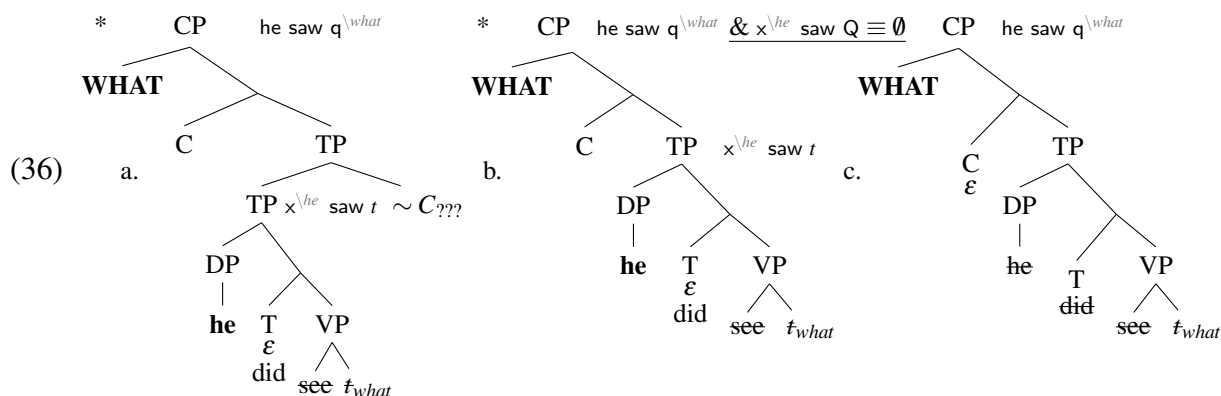
Fatally, the restriction originating with ϵ —that alternatives must involve *not* liking Peter—clashes with the strong restriction imposed by the prosodic reversal of the root TP, which requires ‘said she likes Peter’ to be background, i.e. be constant in any alternative. As indicated in the underlined part on the top line, these two are incompatible (one wants ‘does’ one wants ‘doesn’t’).

In such a configuration the SF needs to be retrieved before the higher focus comes along. This is shown in (35), where \textcircled{R} marks the node at which the permitted focus alternatives are reset to the literal meaning.



When the focus is retrieved by $\sim C$ (by juxtaposing ‘she does like Peter’ with the value of C ‘she doesn’t like Peter’), it is reset, so TP only has the trivial alternative. That in turn is propagated in the usual way until it meets the SR at the root level. This time the local strong restriction at the root and the propagated y said she does like Peter are compatible (in fact, the former simply subsumes the latter).

Finally, and crucially, a focus cannot be retrieved in a domain that contains unbound variables, (36a) and, as we just saw, it *has* to be retrieved before the ‘next’ focus. So if the binder to a variable in the focus domain *is* the next focus up, retrieval is impossible, and the structure crashes, (36b). As a consequence, there can be no SF in such configurations and maximal ellipsis up to the main focus is obligatory, (36c).



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Factors licensing embedded present tense in speech reports¹

Corien BARY — *Radboud University Nijmegen*

Daniel ALTSHULER — *Hamspire College/UMass Amherst*

Kristen SYRETT — *Rutgers University - New Brunswick*

Peter DE SWART — *Radboud University Nijmegen*

Abstract. According to Ogihara (1995), the usage of the embedded present in a speech report such as *John said that Mary is in the room* is restricted by the cause of John's belief (the state that made John think that Mary is in the room): the present tense can be used only if this cause still holds at the time that *John said that Mary is in the room* is uttered. This paper presents experimental evidence demonstrating that this is only one of the factors that licenses a felicitous usage of the embedded present tense. In particular, we show that the cause of belief still holding is not a necessary condition, and identify two additional, sufficient (but not necessary) factors: in cases of false belief, who is aware of the falsity of the belief and duration of the reported state. While these factors are independent, they collectively support the idea that the present tense encodes 'current relevance', even in embedded contexts (e.g. Costa 1972; McGilvray 1974). This gives rise to the question of how we can derive 'current relevance' and, in particular, whether previous analyses of the embedded present tense are adequately equipped to do so.

Keywords: tense, speech reports, double access, experiments.

1. Introduction: present under past

The question this paper addresses is the following: when can we use a present tense in the complement of a past tense speech report? An example of such a construction is in (1):

- (1) John said that Mary is in the room.

Ogihara (1995) claimed that the truth of the complement at the actual utterance time n (the time when (1) is uttered) is not a prerequisite for the use of an embedded present tense. What matters instead is the cause of the belief (the state that made John think that Mary is in the room, e.g. the presence of someone who looks like Mary). More precisely, Ogihara's observation was that the present tense can only be used if this cause still holds at n . We refer to this as the KEY OBSERVATION since it has motivated various analyses of embedded tense (e.g. Abusch 1988, 1997; Ogihara 1995; Heim 1994). Recently, however, the KEY OBSERVATION has been called into question by Klecha (2015), who comes with the following scenario:

- (2) Mary puts a balloon under her shirt. John then observes her in this state, and then says to everyone: 'Mary is pregnant!' Later that day, Mary takes the balloon out from under her shirt and pops it. Bill, aware of everything that happened, says to Mary: '(Earlier today,) John told everyone that you're pregnant.'

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In this scenario, the cause of John's belief that Mary is pregnant, i.e. the state of the balloon under her shirt, is absent by the time of Bill's report. Nevertheless, the present tense is acceptable, suggesting that the KEY OBSERVATION is empirically inadequate.

This difference leads us to ask what exactly it is that licenses the embedded present tense and whether, if it turns out that more than one factor plays a role, this bundle of factors are unified by, and are the instantiation of, an underlying factor. To make headway in addressing these questions, we conducted two experiments (a rating task and a forced choice task) that manipulate such factors and aim to precisify the empirical basis for the use of the embedded present tense. Our starting point is in the comparison of the minimal differences between Ogihara's and Klecha's scenarios, which give rise to the factors we manipulate: (i) the choice of a particular embedding verb of reporting, (ii) in cases that involve false belief, who is aware of the falsity of the belief, and (iii) the duration of the reported state. Our experimental findings indicate that while (i) does not appear to have an influence, factors (ii) and (iii) do. We propose that—along with the KEY OBSERVATION—(ii) and (iii) collectively support the idea of 'current relevance' (Costa 1972; McGilvray 1974), thereby giving rise to the question of whether and how previous analyses of the embedded present tense are adequately equipped to derive 'current relevance'.

The structure of the paper is as follows: In section 2 we further outline the historical and theoretical background to our experiments. In particular, we discuss the scenarios that led Ogihara to his KEY OBSERVATION, as well as Klecha's example noted above. In comparing the data, we motivate two experiments, which we discuss in section 3. Finally, in section 4 we discuss the consequences of our experiments for previous analyses of the embedded present tense.

2. Background: Ogihara's key observation and Klecha's counterexample

Much research in the past decades has been devoted to providing adequate felicity conditions for the use of the present tense in past tense speech reports.² When comparing (1) with its past tense counterpart in (3), the idea has been since the 70s that the embedded present tense imports additional information (e.g. Smith 1978):

- (1) John said that Mary is in the room.
- (3) John said that Mary was in the room.

While both the present and past tense lead to an inference in which according to John, Mary was in the room at the time that John locates himself at the time of his utterance, only the embedded present tense imposes a requirement about the actual utterance time *n*. This additional requirement has led to the name *double access* (Enç 1987), describing an interpretation of (1) that involves reference to two times (the time John locates himself and the actual utterance time *n*).

²See Klecha, this volume for discussion.

In the nineties, Ogihara and Abusch independently tried to make clearer what exactly it is that has to hold at the actual utterance time for the present tense to be felicitous. Ogihara (1995) considers various contexts for (1):

- (4) John and Bill are looking into a room. Sue is in the room.
 John (near-sighted): ‘Look! Mary is in the room.’
 Bill: ‘What are you talking about? That’s Sue, not Mary.’
- a. John: ‘I’m sure that’s Mary.’
 One minute later, Kent joins them. Sue is still in the room.
 Bill (to Kent): ‘**John said that Mary is in the room.** But that’s not true. The one that is in the room is Sue.’
- b. John: ‘Yeah. You’re right. That’s Sue.’
 One minute later, Kent joins them. Sue is still in the room.
 Bill (to Kent): ‘**John said that Mary is in the room.**’
- c. John: ‘I’m sure that’s Mary.’
Sue leaves the room. One minute later, Kent joins them.
 Bill (to Kent): # ‘**John said that Mary is in the room.**’

On the basis of (4a), Ogihara concludes that the truth of the complement at the actual utterance time is not a prerequisite for the use of a present tense: Mary is not in the room, but still a present tense in the complement is acceptable. Moreover, based on (4b), Ogihara argues that it also doesn’t matter whether the reported speaker (John) has found out the truth of the complement at some point after his utterance. By the time of the report, John no longer believes that Mary is in the room, but again the present is still acceptable. Comparing (4a) and (4b) (where Sue is still in the room) with (4c) (where Sue has left), Ogihara concludes that if the state that made John think that Mary is in the room still holds at the actual utterance time n , then we can use the present tense. Otherwise, we cannot. As mentioned in section 1, we call this the KEY OBSERVATION.

Without going into too much detail, let us say a bit on the formal-semantic implementation of this observation, which we come back to in section 4. In Ogihara’s words, the truth conditions of (1) are as follows: (1) is true iff there exists a state s at the actual utterance time n such that John talks at the reported time in the past as if he ascribes to s the property of being a state of Mary’s being in the room (Ogihara, 1995: 205). Note that this state s has to hold at n . In (4a) and (4b), but not in (4c), there is such a state still holding, namely Sue’s being in the room. This predicts correctly that (4a) and (4b) are acceptable, in contrast to (4c).

Ogihara thus proposes that (4) is an example of *de re* reports about states: John makes an utterance about a state which happens to hold at the actual utterance time, without this moment (which is in the future for him) playing a role in his mind. Building on Cresswell and von Stechow’s (1982) analysis of *de re* reports about individuals, Ogihara then formalises such *de re* reports about states in terms of acquaintance relations: (1) is true iff there exists a state s at the utterance time n and a suitable acquaintance relation R such that: (i) s is the state to which John bears R in the actual world and time of his utterance; and (ii) John talks at this time as if in all belief alternatives, s has the property of Mary’s being in the room. In (4a) and (4b) there

is such a state that satisfies these requirements, namely the state of Sue's being in the room, to which John is acquainted via the relation "the situation that I am observing".³

Let us leave this theoretical implementation aside for the moment and return to the KEY OBSERVATION that has driven this implementation. Recall that the KEY OBSERVATION is as follows: as long as the cause of the belief is still present at the actual utterance time n , the present tense is felicitous; otherwise it isn't. As noted in the previous section, Klecha (2015) questions this KEY OBSERVATION with the example in (2), repeated below:

- (2) Mary puts a balloon under her shirt. John then observes her in this state, and then says to everyone: 'Mary is pregnant!' Later that day, Mary takes the balloon out from under her shirt and pops it. Bill, aware of everything that happened, says to Mary: '(Earlier today,) John told everyone that you're pregnant.'

In this scenario, the cause of John's belief that Mary is pregnant, i.e. the state of the balloon under her shirt, is absent by the time of Bill's report. Nevertheless, the present tense is acceptable, suggesting that the KEY OBSERVATION is empirically inadequate. The noted formal implementation of this observation, however, has some wiggle room. For example, Abusch (p.c.), who uses acquaintance relations to times rather than states, suggests that the acquaintance relation in (2) could pick out the day in which the attitude time (rather than the time of the balloon being under Mary's shirt) is included, and since this day still holds at the actual utterance time the present tense is acceptable.⁴ While this would allow us to account for (2), the question, then, is why we don't have this flexibility for the infelicitous (4c). To make headway in answering this question, we need to have a better understanding of the factors licensing a felicitous usage of the embedded present, something that is lacking at this moment. Only then will we know what a theoretical analysis should account for, and only then can we start to discuss whether analyses in terms of acquaintance relations are on the right track.

A direct comparison of (2) and (4c) reveals a key set of factors that might play a role in the acceptability of the embedded present tense: the use of *tell* in (2) versus *say* in (4c), the duration of the state in the complement, i.e. pregnancy in (2) versus being in a room in (4c), and whether or not the audience of the reported utterance still believes the complement at the time of the report (as is the natural interpretation in (2) but not in (4c)). In the next section we present two experiments that test these three factors. We return to the theoretical discussion in section 4.

3. Experiments

We conducted two complementary experiments to investigate the factors licensing the use of the embedded present tense, targeting precisely those types of cases of interest to Ogihara and later Klecha, where the target sentence reports a false belief. We further zoomed in on one those cases in which the cause of the belief no longer holds at the speech time. Both experiments used

³We find very similar insights in Abusch 1997 and Heim 1994 (a reformulation of Abusch 1994), with the difference that Abusch uses acquaintance relations to intervals rather than states, while Heim uses time concepts: the meaning of descriptions by which a speaker might represent a time to herself, technically a function from world time pairs to times.

⁴Note that it is less clear whether Ogihara's acquaintance relation that picks out states could be manipulated along these lines.

a similar design, differing primarily in the behavioral response requested of the participants.

3.1. Experiment 1: rating task

Participants Eighty-eight native English speakers, all undergraduates at Rutgers University - New Brunswick, participated. They were granted extra credit in a Linguistics or Cognitive Science course for participating. The age range of the participants was 17 to 32 years.

Design The experiment followed a fully-crossed 2 x 2 x 2 x 3 design (see Table 1 for an overview). There were two between-subject factors (TENSE OF EMBEDDED VERB (past vs. present) and MATRIX VERB (*say* vs. *tell*)), and two within-subject factors (DURATION OF THE REPORTED PROPERTY (short term vs. long term)) and WHO WAS AWARE of the fact that it was a false belief at the time of the report (A: the reporter alone; B: the reporter and the reported speaker; C: the reporter, the reported speaker, and the audience)).

Factor	Levels
EMBEDDED TENSE (between subjects, within items)	present, past
MATRIX VERB (between subjects, within items)	tell, say
DURATION OF THE REPORTED PROPERTY (within subjects, between items)	short-term, long-term
WHO IS AWARE OF THE FALSITY (within subjects, within items)	A: reporter B: reporter, reported speaker C: reporter, reported speaker, original audience

Table 1: Factors manipulated in Experiment 1

Stimuli We constructed 12 experimental scenarios for the test items. Among these 12, six items featured a short-term property (e.g. *being in a bar*), and six featured a long-term property (e.g. *being pregnant*). Within each of these there were two items each of the ‘who was aware’ factor levels, yielding four of each. Three versions of every test item were made reflecting the levels of the ‘who was aware’ factor. These were then fed into a Latin Square design.

Scenarios were structured in the following way: Each scenario began with the introduction of two key individuals (‘Ind-1’ and ‘Ind-2’) and some friends, the ‘Audience’. There were ultimately four individuals plus the audience in the scenario, whose designated roles were linked to the target sentence uttered at the end of the trial (Ind-1: Reporter; Ind-2: Reported Speaker;

Ind-3: Subject of the Belief; Ind-4: Friend who the target sentence is going to be told to). In order to facilitate comprehension, the characters were given names whose alphabetical order reflected their order of introduction (e.g., Janelle, Keisha, Latasha, Meghan; Alex, Bill, Cindy, Dana).

A scenario was setup as follows. Ind-2 remarks aloud to Ind-1 that an ‘Ind-3’ has a long or short term property *P*. This utterance is in fact false. Ind-1 knows this but the exclamation is acknowledged as true by the Audience at this point. The scenario then diverges based on who becomes aware of this falsity in three conditions, all three of which were seen by a single participant, across different scenarios:

- (A) Ind-1 remarks to Ind-2 out of earshot that the claim is false. Ind-2 holds fast to the original claim, and departs from the situation, leaving only the Reporter (Ind-1) to be aware of the falsity.
- (B) Ind-1 remarks to Ind-2 out of earshot that the claim is false. Ind-2 then realizes the falsity of the original claim, mentioning this to Ind-1, leaving both the Reporter (Ind-1) and the Reported Speaker (Ind-2) aware of the falsity.
- (C) Ind-1 remarks to Ind-2 in front of the Audience that the claim is false. Ind-2 then realizes the falsity of the original claim, mentioning this to Ind-1 in front of the Audience, leaving the Reporter (Ind-1), the Reported Speaker (Ind-2), and the Audience aware of the falsity.

Then in all experimental items, the state that was the cause of the false belief ceases to hold, but only those individuals who recognized the falsity of the belief above witness this change (Ind-1 in (A), Ind-1+2 in (B), and Ind-1+2 and Audience in (C)).

All scenarios were resolved in the same way: another individual (Ind-4, the Friend, not part of the original Audience) arrives a few minutes later. Ind-1 reports Ind-2’s original claim to Ind-4 (hence, the role of Reporter and Reporter Speaker), saying, “Ind-2 [said/told us] that [Ind-3 VP].” Participants were asked to respond to this target sentence, given the scenario they had just read.

Examples of two experimental items (one with a short-term property and one with a long-term property) are provided in (5) and (6), with the target sentence in bold face.

(5) **Short-term property**

Alex, Bill, and some other friends are hanging out. Alex and Bill both look into a room. Cindy is in the room. But Alex is near-sighted and can’t see that well. He turns to Bill, in earshot of the others, and says, “Look! Dana is in the room.” Everyone but Bill nods in agreement.

- (A) Bill pulls Alex off to the side, away from the others and replies, “What are you talking about? That’s Cindy, not Dana!” Alex says, “No, I’m sure that’s Dana.” Alex walks away. Bill remains standing there, apart from the others. Bill watches as Cindy leaves the room. No one else sees this.

(B) Bill turns to Alex in front of the others in the room and replies, “What are you talking about? That’s Cindy, not Dana.” Alex says, “Oh yeah, you’re right! That’s Cindy.” Alex and Bill remain standing there, apart from the others. Alex and Bill watch as Cindy leaves the room. The others in the room don’t see this.

(C) Bill turns to Alex in front of the others in the room and replies, “What are you talking about? That’s Cindy, not Dana.” Alex says, “Oh yeah, you’re right! That’s Cindy.” Alex, Bill, and all their friends have a good laugh about this. Everyone watches as Cindy leaves the room.

A few minutes later, Bill’s friend Edward arrives. Bill says to Edward, “You won’t believe this. **Alex [said/told us] that Dana [is/was] in the room.**”

(6) **Long-term property**

Marsha, Nadia, and some other girls are waiting for their gymnastics practice to start. They’ve been told that there’s a new girl on their gymnastics team named Olivia. Marsha spots her across the gym, by the uneven bars, but since Olivia is so far away, Marsha can’t see that she is standing on a stool. Marsha says in front of the other girls, “Wow, Olivia is really tall!” All the other girls, except Nadia, have a look and nod in agreement.

(A) Nadia brings Marsha over to stretch with her away from the others and says, “What are you talking about? Olivia is not tall! She’s standing on something.” Marsha says, “No way, I can see her from here, and Olivia’s really tall.” Marsha goes off to get her ankles and wrists wrapped before practice. Marsha stays there stretching on her own. Nadia watches as Olivia gets off the stool, and is the same height as the other girls around her. No one else sees this.

(B) Nadia brings Marsha over to stretch with her away from the others and says, “What are you talking about? Olivia is not tall! She’s standing on something.” Marsha moves to get a better angle, and says, “Oh my gosh, you’re right! She is standing on something! She’s not really tall!” Marsha and Nadia remain stretching, and wait to re-join the others. Marsha and Nadia watch as Olivia gets off the stool, and is the same height as the other girls around her. No one else sees this.

(C) Nadia turns to Marsha in front of the others and says, “What are you talking about? Olivia is not tall! She’s standing on something.” Marsha moves to get a better angle, and says, “Oh my gosh, you’re right! She is standing on something! She’s not really tall!” All of the girls giggle about Marsha’s mistake. All the girls watch as Olivia gets off the stool, and is the same height as the other girls around her.

A few minutes later, Nadia’s friend Patricia arrives at gymnastics practice. Nadia says to Patricia, “You won’t believe this. **Marsha [said/told us] that Olivia [is/was] really tall.**”

The test items were pseudorandomized along with six control items, which shared a similar structure. The control items (three long-term and three short-term properties) had the cause of the belief present.

In addition, three practice scenarios were constructed and eight filler items were included that followed a similar make up as the experimental scenarios but contained other types of target

sentences (adverbial and embedded clauses), including clear unacceptable ones.

Materials were divided over 12 stimuli lists, following a Latin square design.

Procedure Participants were tested in a laboratory at individual stations. The entire experimental session lasted approximately 25-30 minutes. The experiment began with a brief 3-item training session to acclimate participants to the task.

Stimuli were presented on an iMac using Superlab 4.5 software, in randomized order. Each subsequent aspect of the scenario (introduction of the scenario, exchange between the individuals, etc.) was presented sequentially on the screen, with participants pressing buttons to advance through the scenario at their own pace.

After the target sentence was shown on screen, participants were asked to rate the acceptability of the target sentence on a 5-point scale, ranging from 1 to 5 with: 1: not acceptable at all, 2: hardly acceptable, 3: moderately acceptable, 4: acceptable, 5: definitely acceptable. ‘Acceptability’ was defined as whether or not a native speaker of English would express the sentence in the way presented. Participants were told that, “A native speaker of English is someone who has known English since childhood. This person may not actually have been born in this country. This person’s parents may not speak English. However, this person is considered to be a fluent speaker of English, and could provide judgments about English sentences as a fluent speaker if asked to do so.” Participants were also explicitly told that the person who delivered the target statement was always speaking truthfully, and so this sentence is always true, but the participants were asked to focus on whether or not it was ok for the speaker to say it in this way and rate acceptability.

Results Acceptability ratings were converted to z-scores to control for variability in scale use. The resulting scores were analyzed with generalized linear mixed models using the `lmerTest` package in R (Kuznetsova et al., 2015). Models were fitted the maximal random effects structure justified by the data. Factors were entered into the model using sum coding. Due to the complexity of the design and small numbers of items per condition, we only report effects of individual factors and their interaction with the factor TENSE OF EMBEDDED VERB.

EMBEDDED TENSE: Figure 1 shows the overall scores for target sentences in the present tense ($M = .13$, $SD = .82$) and in the past ($M = .21$, $SD = .79$). A model with EMBEDDED TENSE as a fixed factor and a random intercept for PARTICIPANT and a random intercept with random slope for ITEM revealed no significant difference. Note that, when looking at the raw scores, both types of sentences seem to be rated as acceptable (PRS: $M = 3.82$, $SD = 1.43$; PST: $M = 4.02$, $SD = 1.34$).

MATRIX VERB: The results for MATRIX VERB are shown in Figure 2. A model with the interaction between MATRIX VERB and EMBEDDED TENSE as fixed factors and a random intercept for PARTICIPANT and a random intercept with random slopes for the two fixed factors for ITEM

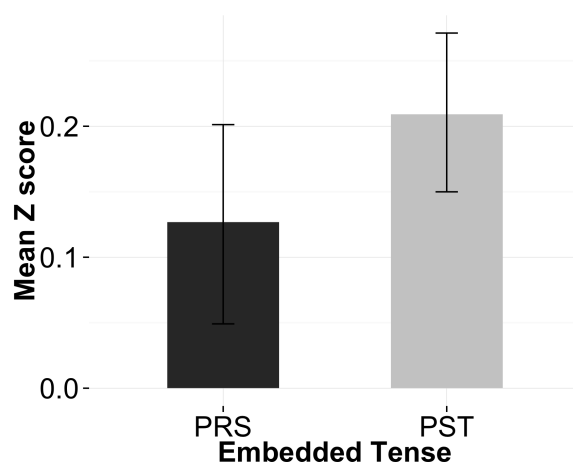


Figure 1: Mean z-scores of acceptability ratings from Experiment 1 for EMBEDDED TENSE, error bars show 95% CI.

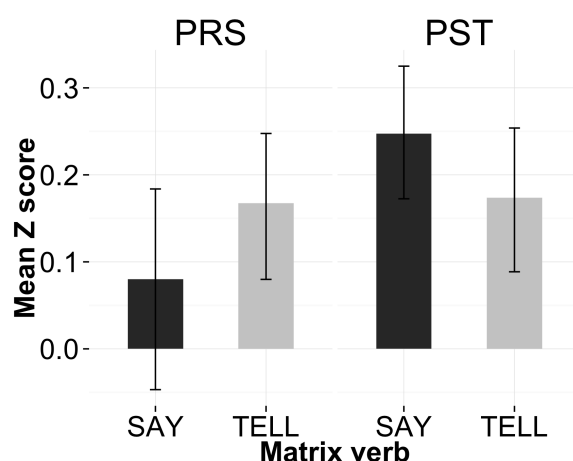


Figure 2: Mean z-scores of acceptability ratings from Experiment 1 for MATRIX VERB, error bars show 95% CI.

revealed no significant effects.

DURATION OF THE REPORTED PROPERTY: The results for this factor are shown in Figure 3. The findings suggest that the effect of this factor is different in target sentences with present tense compared to those with past tense. A model with the interaction between DURATION OF THE REPORTED PROPERTY and EMBEDDED TENSE as fixed factors and random intercept and random slope of DURATION for PARTICIPANT and a random intercept with a random slope of EMBEDDED TENSE for ITEM revealed a significant interaction ($\beta = .115$, $SE = .04$, $t = 2.93$, $p = .009$). A follow-up analysis of simple effects revealed a significant effect of EMBEDDED TENSE on the rating of short-term properties. Short-term properties were rated significantly lower in sentences with embedded present tense ($M = .01$, $SD = .84$) than in those with past tense ($M = .33$, $SD = .75$; $\beta = -.156$, $SE = .05$, $t = -3.47$, $p = .004$).

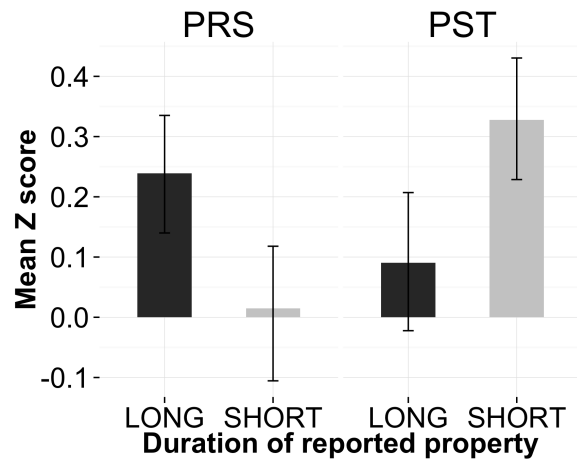


Figure 3: Mean z-scores of acceptability ratings from Experiment 1 for DURATION OF REPORTED PROPERTY, error bars show 95% CI.

WHO IS AWARE OF THE FALSITY: Figure 4 shows the scores for WHO IS AWARE OF THE FALSITY. The judgments show a lot of variation. The maximally converging model with the interaction between WHO IS AWARE OF THE FALSITY and EMBEDDED TENSE as fixed factors and random intercept and random slope of WHO IS AWARE OF THE FALSITY for PARTICIPANT and a random intercept with a random slope of WHO IS AWARE OF THE FALSITY and EMBEDDED TENSE for ITEM revealed a significant interaction effect ($\beta = .087$, $SE = .04$, $t = 2.24$, $p = .028$). A follow up analysis of simple effects revealed a significant effect of EMBEDDED TENSE on the rating of sentences in which the reporter, the reported speaker and audience are all aware of the falsity (level C) in a model with the maximal random structure. These sentences were rated significantly lower with embedded present tense ($M = .004$, $SD = .87$) than with past tense ($M = .31$, $SD = .76$; $\beta = -.137$, $SE = .006$, $t = -2.27$, $p = .04$).

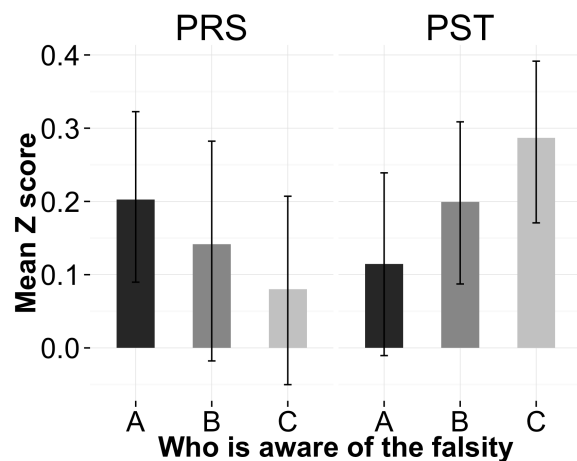


Figure 4: Mean z-scores of acceptability ratings from Experiment 1 for WHO IS AWARE OF THE FALSITY (A: the reporter alone; B: the reporter and the reported speaker; C: the reporter, the reported speaker, and the audience), error bars show 95% CI.

CONTROL: Finally, we compared the overall scores on the test items with control items in which the cause of the false belief remained present. Figure 5 shows a numeric trend towards a higher acceptability of control items in the present tense, but this was not substantiated by the statistical analysis in which ITEM TYPE (test, control) was included. A model with ITEM TYPE as a fixed factor and a random intercept and random slope of ITEM TYPE for PARTICIPANT and a random intercept for ITEM revealed no significant effect.

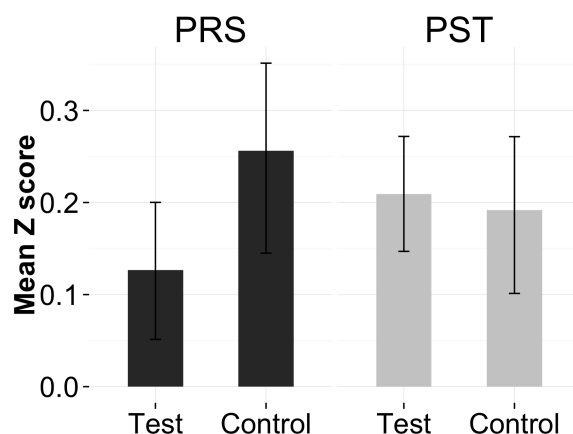


Figure 5: Mean z-scores of acceptability ratings from Experiment 1 for control items vs. test items, error bars show 95% CI.

The acceptability ratings from Experiment 1 were revealing of the acceptability of the present tense in the embedded clause. However, one might wonder if participants were inclined to inflate the acceptability of the present tense because they did not know the past tense was an explicit option within the same session. We wondered if participants would allow the present tense even when they were made aware that the past tense was available. We therefore conducted Experiment 2, using highly similar stimuli, but with a forced-choice behavioral measure, in which participants were asked to choose between present and past tense for the embedded clause. We reasoned that if participants chose the present tense even in such a task, when the past tense was a viable option, then this would be empirical evidence that the present tense was licensed. Moreover, if the preference was correlated with the manipulation of the target factors (duration of the property and who is aware of the false belief), then this would be evidence that such factors influence the felicity of present tense in the embedded clause.

3.2. Experiment 2: forced choice task

Participants 41 English speakers, all undergraduates at Rutgers University - New Brunswick, participated. As in Experiment 1, they were granted extra credit in a Linguistics or Cognitive Science course for participating. The age range of the participants was also 17 to 32 years.

Stimuli The stimuli had the same structure as in Experiment 1. However, there were two minimal changes. First, since the matrix verb did not produce a significant main effect in Experiment 1, the matrix verb was always *tell*. Second, participants were asked to choose between one of two target sentences at the end of the scenario: one with embedded present and the other with embedded past tense. Thus, the experiment had two within-subject factors (DURATION OF THE REPORTED PROPERTY (short-term vs. long-term)) and WHO WAS AWARE OF THE FALSITY (A: the reporter alone; B: the reporter and the reported speaker; C: the reporter, the reported speaker, and the audience)).

Procedure As before, the experiment began with a brief training session of three items to acclimate participants to the task. This time, data were presented on the Qualtrics platform online. Each subsequent aspect of the scenario was presented sequentially on the screen (see (5), yielding five windows of presentation). Participants pressed a 'next' button to advance through the scenario at their own pace. When presented with the target sentence, participants were asked to select the form of the embedded verb by choosing between a present and past tense form. The experimental session lasted approximately 25 minutes.

Results The binary data were analyzed using binomial generalized mixed effect models using the `lmerTest` package in R (Kuznetsova et al., 2015). Models were fitted with the maximal random effects structure justified by the data. Factors were entered into the model using sum coding. Figures show mean percentages of choice for the present tense. As for experiment 1, we only report effects of individual factors, due to the complexity of the design and small numbers of items per condition.

DURATION OF THE REPORTED PROPERTY: This factor also turned out to have an effect on the choice for present tense in Experiment 2. Figure 6 shows a higher percentage of present tense for long-term properties ($M = 62\%$) in comparison for short-term properties ($M = 22\%$). This effect was significant in a model with DURATION as a fixed factor and random intercept and slopes for both PARTICIPANTS and ITEMS ($\beta = 1.10$, $SE = .18$, $Z = 6.2$, $p < .001$).

WHO IS AWARE OF THE FALSITY: Figure 7 shows the results for this factor. There seems to be a numeric trend for a preference of present tense when only the reporter is aware of the falsity of the belief (Condition A). A statistical model with WHO IS AWARE OF THE FALSITY as a fixed effect and as a random slope for PARTICIPANT and ITEM only showed a trend towards significance ($p = .09$). The same was obtained in a model using treatment coding. Even though condition C was significantly different from condition A ($p = .041$) within the model, model comparison showed that the addition of the factor to a baseline model was only marginally so ($p = .07$). This may reflect a power issue.

CONTROL: Finally, we compared the choice for present tense on the test items with that on control items in which the cause of the false belief remained present. Figure 8 shows no difference between the items and this was confirmed by the statistical analysis in which ITEM TYPE (test, control) was included. A model with ITEM TYPE as a fixed factor and a random intercept

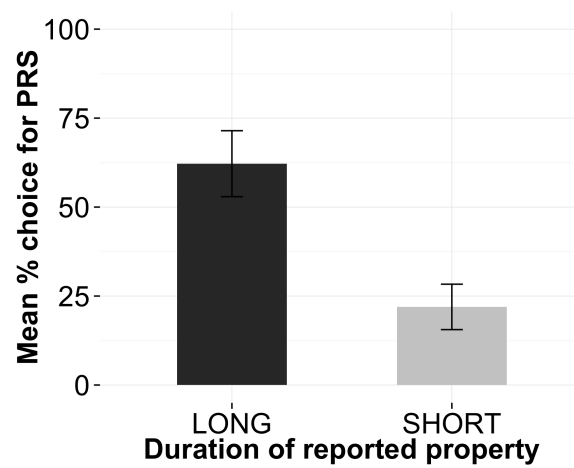


Figure 6: Mean percentage of choice for present tense in Experiment 2 for DURATION OF REPORTED PROPERTY, error bars show 95% CI.

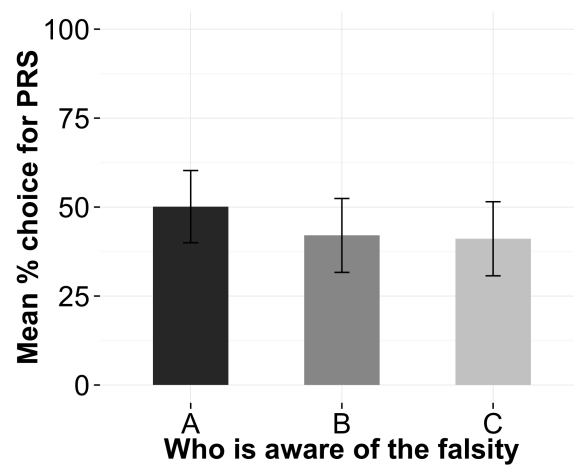


Figure 7: Mean percentage of choice for present tense in Experiment 2 for WHO IS AWARE OF THE FALSITY (A: the reporter alone; B: the reporter and the reported speaker; C: the reporter, the reported speaker, and the audience), error bars show 95% CI.

and random slope of ITEM TYPE for PARTICIPANT and a random intercept for ITEM revealed no significant effect.

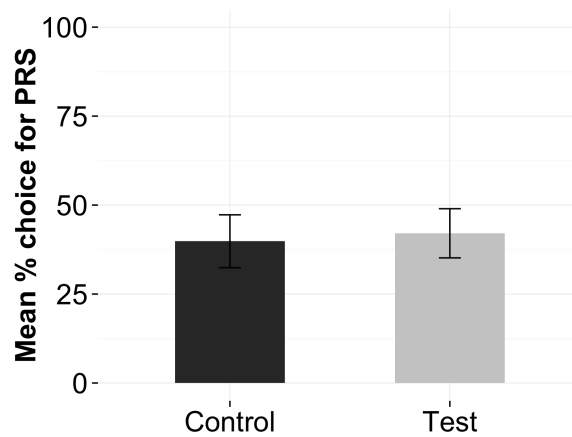


Figure 8: Mean percentage of choice for present tense in Experiment 2 for control items vs. test items, error bars show 95% CI.

4. Discussion

In the two experiments we have seen that when the cause of belief no longer holds, as in the Klecha-type example: (i) short term properties disfavor present tense and (ii) belief state of others seem to effect present tense use: present tense is better when people still entertain a false belief. (ii) is particularly interesting since it means that tracking other people's beliefs affects our choice of grammatical morphemes, even in the case of people who are not participating in the actual conversation. More research is needed to corroborate the effects of this factor.

Surprisingly, whether the cause of the false belief still holds—the key factor according to Ogihara—did not make a difference.

Why should this be? And how can we generalize over the various factors? For Costa (1972) and McGilvray (1974), the answer has to do with *current relevance*, an appealing notion since, after all, we are interested in the meaning of the present tense.

It seems possible to rephrase our findings as having to do with current relevance. The cause of the belief still holding at the actual utterance time (Ogihara's KEY OBSERVATION) is then just one of the ways in which the proposition expressed by the complement can still be relevant to the conversation the reporter is engaged in. Another way in which this proposition can be relevant at the time of the report is if the original audience still (falsely) believes it (factor (ii)). Yet another way could be cases where we do not expect changes to happen in the truth value of the proposition expressed by the complement between the reported time and the time of the report (i.e. the actual utterance time, *n*) (in line with in the category of eternal statements, a category mentioned in many textbooks of English, see Eckhardt 2001: p. 44 for an overview). This corresponds to factor (i), the duration of the reported property: for long-term properties (in

our items usually individual-level properties) such a change is implausible: had the complement been true at the reported time it would still be true at the actual utterance time.

The challenge for *de re* analyses of tense noted in section 2 is to show how the determination of particular acquaintance relations—which concerns how an attitude holder became acquainted with a time/state—is sensitive to these factors. This is a challenge because it's unclear how the latter two factors above would matter for acquaintance: the second factor involves an audience whose beliefs may be independent of the attitude holder's beliefs, while the third factor involves counterfactual reasoning. While it is not out of the question that a richer, pragmatic theory of acquaintance relations could derive the factors above, it is not clear to us what such a theory would be like.

Another possibility is to provide an analysis of the embedded present tense that does not depend on acquaintance relations. While this would be a move away from the orthodoxy,⁵ we note that Klecha (in this volume) provides a glimpse of what such a move may be like. He proposes that semantically speaking, the use of the embedded present tense leads to ill-formedness when it is embedded under past, requiring pragmatic intervention to be rescued. According to Klecha, a double access interpretation is *non-literal*, a special kind of loose talk. While presenting the details of this analysis would take us too far a field, several comments are in order. Klecha's key idea is that present-under-past sentences can be felicitously used when “the temporal resolution in the discourse is sufficiently coarse so as to conflate the event time of the attitude verb with speech time; in other words, in discourses where the interlocutors don't care to make the distinction between event and speech time for the purposes of discussing what they're discussing.” When the discourse is not sufficiently coarse, pragmatic enrichment via conflation of the speech time and the event time will not be triggered and infelicity will arise due to the Upper Limit Constraint (Abusch 1997).

This conflation between the event and the speech time could be an intriguing way to make sense of our factor (i) and perhaps even of the idea of current relevance in general. While more work is required to make sense of how exactly Klecha's proposed pragmatic enrichment is sensitive to the factors noted above, this task seems, on the face of it, promising. We leave this task open for further research. Our contribution here is a demonstration of how the applications of experimental methods may lead to important contributions to a theory of embedded tense, which must involve a sufficient pragmatic theory that complements the semantics.⁶

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⁵Though in line with Hawthorne and Manley 2012, who argue that semantic theorizing should not involve acquaintance relations. See also Altshuler and Schwarzschild 2013; Bary and Altshuler 2014; Altshuler 2016, where an analysis of embedded tense is proposed without invoking *de re* mechanisms, though the analysis does invoke time concepts, viz. Heim 1994.

⁶See also Altshuler et al. 2015 for a corpus study that reaches the same conclusion by independent means.

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Equational-intensional relative clauses with syntactic reconstruction¹

Itai Bassi – *Massachusetts Institute of Technology*

Ezer Rasin – *Massachusetts Institute of Technology*

Abstract. Analyses of scope reconstruction typically fall into two competing approaches: ‘semantic reconstruction’, which derives non-surface scope using semantic mechanisms, and ‘syntactic reconstruction’, which derives it by positing additional syntactic representations at the level of Logical Form. Grosu and Krifka (2007) proposed a semantic-reconstruction analysis for relative clauses like *the gifted mathematician that Dan claims he is*, in which the relative head NP can be interpreted in the scope of a lower intensional quantifier. Their analysis relies on type-shifting the relative head into a predicate of functions. We develop an alternative analysis for such relative clauses that replaces type-shifting with syntactic reconstruction. The competing analyses diverge in their predictions regarding scope possibilities in head-external relative clauses. We use Hebrew resumptive pronouns, which disambiguate a relative clause in favor of the head-external structure, to show that the prediction of syntactic reconstruction is correct. This result suggests that certain type-shifting operations are not made available by Universal Grammar.

Keywords: relative clauses, scope, reconstruction, type-shifting, *de dicto*, intensional quantifiers, binding, resumptive pronouns.

1. Introduction

Our focus in this paper is on one kind of relative clauses (RCs) with an embedded intensional quantifier and a copular clause, analyzed in Grosu and Krifka (2007) and illustrated in (1). Following Grosu and Krifka (2007), we refer to such RCs as ‘equational-intensional RCs’.

(1) The gifted mathematician that Dan claims he is should be able to solve this problem

The sentence in (1) has two readings which we will refer to as *de dicto* and *de re*. According to the *de dicto* reading, given Dan’s claim that he is mathematically gifted, he should be able to solve this problem. On the less salient *de re* reading, there is a certain gifted mathematician, say Hilbert, who should be able to solve this problem; Dan claims that he is Hilbert.

The *de dicto* reading presents an apparent mismatch between the syntax and the semantics of (1). On the semantic side, the *de dicto* reading does not imply the existence of a gifted mathematician, but rather only that Dan claims to be one. This suggests that the world variable of the relative head *gifted mathematician* should be bound by the intensional quantifier *claim* in the logical representation of the *de dicto* reading of (1), as schematized in (2). On the syntactic side, on the other hand, the relative head *gifted mathematician* is not c-commanded by the intensional quantifier *claim* in the surface structure of (1). The challenge, then, is that

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the relative head *gifted mathematician* seems to be interpreted in a pre-movement position—a scope-reconstruction effect.

$$(2) \quad \forall w \in \text{CLAIM}_{\text{Dan},@} [\dots \text{gifted-math}'(w) \dots]$$

where $\text{CLAIM}_{\text{Dan},@}$ stands for the set of worlds compatible with Dan's claims in the utterance world

The literature offers two main approaches to scope reconstruction. The first approach places the burden of explanation on the syntax by interpreting the higher NP in a low ('reconstructed') position at the level of 'Logical Form' (LF) (Chomsky 1993; Romero 1998; Sauerland 1998, 2004; Fox 1999; Heim 2012, among others). We label this approach SYN R (for syntactic reconstruction). The second approach accounts for the mismatch by complicating the semantics using semantic operations such as type-shifting, which often take the surface syntactic structure as their input (Jacobson 1994; Cresti 1995; Rullmann 1995; Lechner 1998; Sharvit 1999; Ruys 2011, among others). We label this second approach SEM R (for semantic reconstruction).² The present paper compares the two main approaches to scope reconstruction—SYN R and SEM R—with respect to equational-intensional RCs like (1).

An analysis of the *de dicto* reading of equational-intensional RCs within SEM R was developed by Grosu and Krifka (2007) (henceforth G&K). Here is a sketch of their analysis. G&K take the matrix subject to denote an individual concept, a function from worlds to individuals. In particular, the subject denotes the function that maps each world compatible with Dan's claims to Dan, who is a gifted mathematician in that world (3).

$$(3) \quad \text{Individual-concept denotation of the subject} \\ \llbracket \text{the gifted mathematician Dan claims he is} \rrbracket = \\ \iota f_{\langle s,e \rangle} [\text{dom}(f) = \text{CLAIM}_{\text{Dan},@} \wedge \forall w \in \text{CLAIM}_{\text{Dan},@} [\text{DAN}(w) = f(w) \wedge \text{gifted-math}'(w)(f(w))]]$$

The main ingredient of G&K's compositional derivation of (3) is a semantic mechanism that has two functions: it type-lifts the relative head *gifted mathematician* from a predicate of individuals to a predicate of individual concepts, and it binds the world of evaluation of the relative head. The basic meaning of the relative head on this analysis is given in (4) and the type-shifted meaning is given in (5). The RC *that Dan claims he is* is assumed to involve abstraction over an individual-concept variable and has the denotation in (6).

$$(4) \quad \llbracket \text{gifted-mathematician} \rrbracket^@ = \lambda x. x \text{ is a gifted-math}' \text{ in } @$$

$$(5) \quad \text{TS}(\llbracket \text{gifted-mathematician} \rrbracket) = \lambda f_{\langle s,e \rangle}. \forall w \in \text{dom}(f) [\llbracket \text{gifted-mathematician} \rrbracket^w(f(w))]$$

$$(6) \quad \llbracket \text{that Dan claims he is} \rrbracket^@ = \lambda f_{\langle s,e \rangle}. \forall w \in \text{CLAIM}_{\text{Dan},@} [\text{DAN} = f(w)]$$

The RC and the type-shifted head are of the same type and can combine intersectively (7a) to derive the meaning in (7b).

²The labels SYN R and SEM R are borrowed from Keine and Poole (2017).

- (7) a. $\underbrace{\text{TS}[\text{gifted-mathematician}]}_{\text{type } \langle se,t \rangle} \underbrace{[\text{that Dan claims he is}]}_{\text{type } \langle se,t \rangle}$
- b. $\lambda f_{\langle s,e \rangle} \cdot \forall w \in \text{CLAIM}_{\text{Dan},@} [\text{DAN} = f(w)] \wedge \forall w \in \text{dom}(f) [\text{gifted-mathematician}]^w(f(w))]$

In (7b), the world parameter of *gifted mathematician* is bound by $\forall w \in \text{dom}(f)$. On the assumption that *the* can pick up the smallest function in (7b) (for details see G&K as well as the appendix), we get the meaning of the entire subject in (3), in which the domain of the function f is $\text{CLAIM}_{\text{Dan},@}$. The result is that the world parameter of *gifted mathematician* ends up being bound by *claim* without interpreting the relative head NP (or any other constituent) in a non-surface position.³

An alternative theory of the *de dicto* reading of (1) within SYN R will be developed in detail in section 2. The main ingredient of the proposed theory, assuming the Copy Theory of Movement (Chomsky 1993), is a syntactic representation where only the low (unpronounced) copy of the relative head is semantically interpreted, as schematized in (8). As for the semantics, the theory draws on the semantics of syntactic reconstruction in Heim (2012).

- (8) LF: The ~~gifted-mathematician~~ that ... claim ... gifted-mathematician

As mentioned above, our goal is to compare the two competing approaches to scope reconstruction—SEMR and SYN R—with respect to equational-intensional RCs like (1). We do so in three steps. First, we develop the theory of the *de dicto* reading in equational-intensional RCs within SYN R (section 2). After developing the theory in section 2, we discuss a point of divergence in predictions between SEMR and SYN R with respect to equational-intensional RCs (section 3). The divergence concerns the availability of *de dicto* readings in head-external RCs. As we show in section 3, SEMR generates *de dicto* readings in head-external RCs, but SYN R without type-shifting does not. Finally, in section 4 we use Hebrew resumptive pronouns as a case study to test the divergent prediction presented in section 3. Hebrew resumptive pronouns are suitable for this task since they can disambiguate an RC in favor of the head-external structure, where the two approaches diverge. Extending an observation by Doron (1982), we show that *de dicto* readings are absent in the presence of resumptive pronouns. The absence of *de dicto* readings with resumptive pronouns is exactly what SYN R predicts, but it is surprising if type-shifting operations like (5) are made available by Universal Grammar.

³G&K's analysis is related to SEMR accounts of *functional readings* in questions and RCs, illustrated in (i), where a variable of type $\langle e \rangle$ (underlined) appears to be bound by a non-c-commanding quantifier (in bold).

- (i) a. Which [picture of herself_i] did **every girl_i** submit? (Engdahl 1986)
 b. The [relative of his_i] that **every man_i** likes best is his_i mother (Geach 1964; Jacobson 1994, 2002)

Engdahl (1986) (for questions) and Sharvit (1999) and Jacobson (2002) (for RCs) posit a type-shifting operation along the lines of G&K's (5) that binds individual variables (rather than world variables) and shifts an NP into a predicate of functions of type $\langle e, e \rangle$ (rather than type- $\langle s, e \rangle$ functions). See Heim (2012) for an analysis of functional readings that uses syntactic reconstruction and forgoes type-shifting.

2. Syntactic Reconstruction

2.1. Preliminaries

In this section we develop the SYNRR theory of the *de dicto* reading of (1), repeated in (9), focusing on the denotation of the matrix subject.

(9) [The gifted mathematician that Dan claims he is] should be able to solve this problem

Here are some of the differences between the SYNRR theory we propose in this paper and G&K's SEMR theory. The first difference, which is not our focus in this paper, is the following. While SEMR is committed to an individual-concept denotation for the subject as in (3), SYNRR can generate the *de dicto* reading both with an individual-concept denotation for the subject as in (3) and with the individual denotation in (10).

(10) Individual denotation of the subject⁴
 $\iota x_e [\forall w \in \text{CLAIM}_{\text{Dan},@} [x \text{ is a gifted-math' in } w \wedge x = \text{Dan}]]$
 = Dan, who is a gifted math' in all worlds compatible with his claims

We bring up the compatibility of SYNRR with (10) to simplify the presentation of the approach. It turns out that the compositional details of the individual denotation in (10) are simpler than those of the individual-concept denotation in (3), so we will present SYNRR using (10) in what follows. For completeness, we provide the derivation of the individual-concept denotation in (3) under SYNRR in the appendix, and we will show that the main prediction of SYNRR we discuss in this paper is made with both denotations.

Our focus in this paper is on the differences between SEMR and SYNRR that have to do with the mechanism responsible for scope reconstruction: first, the SYNRR theory we propose assumes that the moved NP *gifted mathematician* is interpreted in a low (reconstructed) position at LF, as schematized above in (8); second, the proposed theory relies on the unavailability of the type-shifting operation posited by G&K. We stipulate that G&K's type-shifter in (5), repeated in (11) in its general form, is not made available by Universal Grammar.⁵ In the present paper, we assume the stipulation in (11) without discussion and do not try to derive the absence of the type-shifter from deeper principles.

⁴The uniqueness requirement of the iota operator in (10) is met assuming that individuals are the same across worlds (Kripke 1980). Note that (10) is an oversimplified representation which ignores issues such as binding of individual variables into intensional contexts (Quine, 1956). We will stick to this oversimplified representation since, as far as we can tell, those issues can be resolved in ways that do not bear on the mechanism responsible for scope reconstruction (see, e.g., Percus and Sauerland 2003).

⁵G&K's SEMR analysis derives the *de dicto* reading through a combination of abstraction over individual-concept variables and type-shifting. Since both ingredients can be dispensed with under SYNRR, excluding the SEMR derivation of the *de dicto* reading could also be achieved by banning abstraction over individual-concept variables (as an alternative to banning type-shifting). Defending that alternative seems to us like a non-trivial challenge given that traces can be arguments of predicates that arguably take individual-concept arguments (like *rise*), as in *the number of residents in this city is 250,000, a number that rose significantly in the past decade*, so we do not pursue that alternative here (see Montague, 1973 and later literature for discussion of predicates of individual concepts). In addition, to our knowledge G&K's type-shifter has not been used elsewhere in the literature.

(11) STIPULATION REGARDING TYPE-SHIFTING

Universal Grammar does not make available the following type-shifter:

$$\text{TS}(P_{\langle s,et \rangle}) = \lambda f_{\langle s,e \rangle}. \forall w \in \text{dom}(f) [P(w)(f(w))]$$

Assuming (11), we proceed to develop the theory behind (10) under SYN_R by first presenting our assumptions about the syntax in 2.2. Then, in 2.3, we present the semantic composition of the subject, followed by the combination of the subject with the rest of the sentence in 2.4.

2.2. Syntax

Our proposal for the LF of the subject is given in (12). We assume a ‘head-raising’ derivation of the RC, where the relative head NP is generated inside the RC and undergoes movement to its surface position (Schachter 1973; Vergnaud 1974; Bhatt 2002, among others). The high (pronounced) copy of the head NP is deleted and its low copy is converted into a definite description using the mechanism of Trace Conversion (Fox 2002, Sauerland 2004, Heim 2012).

(12) The GM λx_e Dan claims_@ λw [he is $\underbrace{\text{THE [GM}_w \text{ [IDENT } x_e \text{]]}}_{\text{Converted trace}}$]

The syntactic derivation of (12) proceeds as in (13). First, the RC *Dan claims that he is a gifted mathematician* is constructed by repeated application of external merge.⁶ Then, the NP *gifted mathematician* is copied through internal merge, which we take to insert a binder below the copied NP (Heim and Kratzer 1998). Next, the definite article is externally merged. Trace Conversion converts the lower copy into a definite description and the lower determiner is deleted (cf. Heim 2012). Then, the higher NP is deleted. Finally, two world variables, which we assume to be represented in the syntax (see, e.g., Cresswell 1990), are inserted and saturate the world argument of the predicates *claims* and *gifted mathematician*.

(13) LF derivation (cf. Heim 2012):

Construct TP:	Dan claims λw [he is a GM]
Internal-merge NP:	<u>GM</u> λx_e Dan claims λw [he is a GM]
External-merge <i>the</i> :	<u>the</u> GM λx_e Dan claims λw [he is a GM]
Trace conversion + $\text{\textcircled{D}et}$:	the GM λx_e Dan claims λw [he is a <u>THE</u> [GM <u>IDENT</u> x_e]]
Delete higher NP:	the GM λx_e Dan claims λw [he is THE [GM IDENT x_e]]
Insert world pronouns:	the λx_e Dan claims _@ λw [he is THE [GM _{w} IDENT x_e]]

⁶Our choice of the indefinite article as the lower determiner is arbitrary. Since that determiner eventually gets deleted, other choices would not have made a difference.

2.3. Semantics

We now show that the LF in (12) results in the desired individual denotation of the subject in (10), repeated here:

$$(14) \quad \iota x [\forall w \in \text{CLAIM}_{\text{Dan},@} [x \text{ is a gifted-math' in } w \wedge x = \text{Dan}]] \\ = \text{Dan, who is a gifted math' in all worlds compatible with his claims}$$

The interpretation procedure makes important use of the mechanism of presupposition projection, following Heim (2012). We present the central steps of the interpretation of the LF in (15) going bottom-up.

$$(15) \quad \text{The } \lambda x_e \text{ Dan}_2 \text{ claims}_@ \lambda w [\text{he}_2 \text{ is THE } [\text{GM}_w \text{ IDENT } x_e]]$$

For the first step, THE and IDENT are defined as in (16) and (17). The converted trace has the interpretation in (18).

$$(16) \quad \llbracket \text{THE} \rrbracket = \lambda P_{\langle e,t \rangle} : \exists! x [P(x)]. \iota x [P(x)]$$

$$(17) \quad \llbracket \text{IDENT} \rrbracket = \lambda x. \lambda y. x = y$$

$$(18) \quad \llbracket \text{THE } [\text{GM}_w \text{ IDENT } x] \rrbracket^g \text{ is defined only if} \\ g(x) \text{ is a gifted-math' in } g(w); \\ \text{where defined, } \llbracket \text{THE } [\text{GM}_w \text{ IDENT } x] \rrbracket = g(x)$$

Our entries for the copula and *claim* are given in (19) and (20). *claim* projects the presuppositions of its complement universally, as indicated by the statement that immediately follows the colon in (20). Thus, the presupposition introduced in (18) projects universally as in (21).

$$(19) \quad \llbracket \text{be} \rrbracket = \llbracket \text{IDENT} \rrbracket = \lambda x. \lambda y. x = y$$

$$(20) \quad \llbracket \text{claim} \rrbracket = \lambda w. \lambda p_{\langle s,t \rangle}. \lambda x : \forall w' \in \text{CLAIM}_{x,w} [w' \in \text{dom}(p)]. \forall w' \in \text{CLAIM}_{x,w} [p(w') = 1] \\ \text{where } \text{CLAIM}_{x,w} \text{ is the set of worlds compatible with } x\text{'s claims in } w$$

$$(21) \quad \llbracket \text{Dan}_2 \text{ claims}_@ \lambda w \text{ he}_2 \text{ is } [\text{THE } [\text{GM}_w \text{ IDENT } x]] \rrbracket^g \text{ is defined only if} \\ \forall w \in \text{CLAIM}_{\text{Dan},@} [g(x) \text{ is a gifted-math' in } w]; \\ \text{where defined, it equals 1 iff } \forall w \in \text{CLAIM}_{\text{Dan},@} [\text{Dan} = g(x)]$$

The next step, in (22), is abstraction over the variable x . For this step, notice that we can simplify the assertive component of (21) and replace $\forall w \in \text{CLAIM}_{\text{Dan},@} [\text{Dan} = g(x)]$ with the equivalent statement $[\text{Dan} = g(x)]$ (assuming that $\text{CLAIM}_{\text{Dan},@}$ is not empty). The presupposition in (21) continues to project, this time by making the result of the abstraction a partial function defined only for individuals that satisfy the presupposition. (22) denotes the characteristic function of the singleton containing Dan, who is (presupposed to be) a gifted mathematician in each of his CLAIM worlds.

$$(22) \quad \begin{aligned} & \llbracket \lambda x_e \text{ Dan}_2 \text{ claims}_@ \lambda w \text{ he}_2 \text{ is [THE [GM}_w \text{ IDENT } x]] \rrbracket = \\ & \lambda x_e : \forall w \in \text{CLAIM}_{\text{Dan},@} [x \text{ is a gifted-math' in } w] \\ & \quad \cdot \text{Dan} = x \end{aligned}$$

The combination of (22) with the definite article yields the denotation of the subject in (23), as desired.

$$(23) \quad \begin{aligned} & \llbracket \text{The } \lambda x_e \text{ Dan}_2 \text{ claims}_@ \lambda w [\text{he}_2 \text{ is THE [GM}_w \text{ IDENT } x_e]] \rrbracket \\ & = \iota x [x = \text{Dan} \wedge \forall w \in \text{CLAIM}_{\text{Dan},@} [x \text{ is a gifted-math' in } w]] \\ & = \text{Dan, who is a gifted math' in all worlds compatible with his claims} \end{aligned}$$

Since *gifted mathematician* is interpreted in the scope of *claim*, the reconstruction effect is achieved using syntactic reconstruction and without the type-shifter in (11).

2.4. Combination of the subject with the rest of the sentence

The combination of the subject with the rest of the sentence proceeds in the usual way, as in (24). For concreteness, we assume that the subject reconstructs below *should* at LF as in (24a). The structure in (24a) results in the denotation in (24b).⁷

$$(24) \quad \begin{aligned} & \text{The gifted mathematician Dan claims he is should be able to solve this problem} \\ & \text{a. LF: Should}_@ \lambda w [[\text{the } \lambda x \dots \text{GM} \dots] [\text{be-able}_w \text{ to solve this problem}]] \\ & \text{b. } \forall w' \in \text{SHOULD}_@ [\iota x [x = \text{Dan} \wedge \forall w \in \text{CLAIM}_{\text{Dan},@} [x \text{ is a gifted-math' in } w]] \\ & \quad \text{is able to solve this problem in } w'] \end{aligned}$$

3. A divergent prediction

In this section, we show that SYN_R ties the availability of the *de dicto* reading in equational-intensional RCs to the syntactic structure of the RC, whereas SEM_R does not. Importantly, SYN_R and SEM_R diverge in their predictions regarding the availability of the *de dicto* reading with *head-external* derivations of the RC, where the relative head is generated outside of the RC. Such derivations include the classical derivation where a null operator undergoes \bar{A} -movement (Chomsky, 1977), the so-called ‘matching’ derivation where an NP undergoes \bar{A} -movement and gets deleted (Chomsky 1965; Sauerland 1998), and, as we will see later, derivations with no \bar{A} -movement inside the RC whatsoever. In particular, as we now show, SYN_R but not SEM_R makes the prediction in (25).

$$(25) \quad \textbf{Prediction of SYN}_R: \text{ the } de \text{ dicto} \text{ reading in an equational-intensional RC will be blocked when the RC is unambiguously head-external}$$

⁷On the most salient interpretation of (24), Dan would be able to solve the problem under normal circumstances that would arise assuming that his claims are true. That is, the domain of *should* seems to be restricted to a subset of the worlds compatible with Dan’s claims. See Kratzer (2012) for a theory of modality that can derive this restriction contextually by appealing to the contextually-available set $\text{CLAIM}_{\text{Dan},@}$. We leave out the details for reasons of space.

To see why SYN_R does not generate the *de dicto* reading with head-external RCs, consider first the situation of an RC that denotes a predicate of individuals—in fact, an intensionalized predicate of individuals (as in our analysis in section 2). Since the relative head has not undergone movement, it must be interpreted in its surface position, above the intensional quantifier. The *de dicto* reading is not derived because the world argument of the head is not bound by the quantifier. This scenario is schematized in (26), where the world argument @ and the binder are given in bold.

$$(26) \quad \underbrace{\llbracket \text{gifted-math}'_{@} \rrbracket}_{\text{type } \langle s, et \rangle} \underbrace{\llbracket \lambda x \text{ Dan claims } \lambda w \dots \rrbracket}_{\text{type } \langle s, et \rangle} \quad (\textit{de dicto} \text{ not generated})$$

Consider now the alternative situation of an RC that denotes a predicate of individual concepts (as in the SYN_R analysis of the *de dicto* reading in the appendix). Given the assumption of SYN_R in (11)—namely, given that predicates of individuals cannot be type-shifted into predicates of individual concepts, interpreting the relative head outside of the RC would result in a type-mismatch between the relative head and the RC. On this scenario, which is schematized in (27), the structure would be uninterpretable.

$$(27) \quad \underbrace{\llbracket \text{gifted-math}'_{@} \rrbracket}_{\text{type } \langle s, et \rangle} \underbrace{\llbracket \lambda f \text{ Dan claims } \lambda w \dots \rrbracket}_{\text{type } \langle se, t \rangle} = ?? \quad (\text{type-mismatch; nothing generated})$$

In contrast to SYN_R, SEM_R does not make the prediction in (25). Whether the relative head has moved from an RC-internal position or not, it can be type-shifted into a predicate of functions and get interpreted in the scope of the embedded intensional quantifier.

Our observations regarding the predicted dependency between scope and RC structure under SYN_R are not new. They have been explored in various works including Sauerland (1998), Bhatt (2002), Fox (2002), Heycock (2005), and Hulsey and Sauerland (2006). Previous research has also offered diagnostics for head-external RCs such as Condition C and extraposition that might be used to test the prediction in (25) (see especially Hulsey and Sauerland 2006). In the next section, we use resumption in Hebrew—a diagnostic for head-external RCs that allows us to test the prediction in (25) using sentences that differ only minimally from the RCs discussed by G&K, and where the judgments regarding the availability of the *de dicto* reading are clear.

4. Case study: Hebrew resumptive pronouns

In this section we present resumptive pronouns (RPs) in Hebrew as a diagnostic for head-external RCs, and show, using that diagnostic, that the prediction of SYN_R for equational-intensional RCs in Hebrew is correct. We start, in 4.1, by providing background on the distribution and interpretation of RPs in Hebrew. Then, in 4.2, we present a theory of RPs that derives their distribution and interpretation from the assumption that RPs inhabit head-external RCs. Finally, in 4.3, we use Hebrew RPs to test the divergent prediction of SYN_R and SEM_R regarding equational-intensional RCs in Hebrew. (Readers who are familiar with resumption as a diagnostic for head-external structure may wish to proceed directly to 4.3.)

4.1. Background: the distribution and interpretation of Hebrew resumptive pronouns

RPs are pronouns that appear in unbounded dependency constructions such as RCs, questions, and clefts, in positions where we would otherwise expect a gap. The Hebrew RC in (28) illustrates: a pronoun optionally occurs in direct object position, where other languages, like English, must use a gap.⁸ We focus here on Hebrew RPs in RCs which, in simple RCs, alternate with a gap.⁹

- (28) ze ha-sefer še-karati \emptyset /**oto** etmol
 this the-book that-I.read \emptyset /**it** yesterday
 ‘This is the book that I read yesterday’

The literature on RPs has argued that RPs like the one in (28) are incompatible with movement (Chomsky 1977, McCloskey 1979, McCloskey 1990, Borer 1984, Shlonsky 1992, among others). Evidence that movement is not involved includes the insensitivity of RPs to islands, as well as environments where RPs are not interpreted like gaps, which suggests they are not merely phonological spell-outs of gaps (Doron 1982, Sichel 2014).

The examples in (29) illustrate that Hebrew RPs are obligatory in island contexts, using a complex NP island in (29a) and an adjunct island in (29b).

- (29) *Evidence for non-movement #1: insensitivity to islands*
- a. *Direct object RP, complex NP island*
 ze ha-sefer še-ani makir et ha-iša še-kar’a **oto**/*** \emptyset**
 this the-book that-I know ACC the-woman that-read **it**/*** \emptyset**
 ‘This is the book that I know the woman who read it’
- b. *Direct object RP, adjunct island*
 ze ha-sefer še-ani sameax biglal še-karat **oto**/*** \emptyset**
 this the-book that-I happy because that-you-read **it**/*** \emptyset**
 ‘This is the book that I’m happy because you read it’

To demonstrate that RPs are not interpreted like gaps, consider the following Hebrew idiom:

- (30) litfor tik le-X
 to.sew briefcase for-X
 ‘to frame X for a crime’ (lit. ‘to sew a briefcase for X’)

⁸Resumption is considered to be part of the grammar of Hebrew. Theories of resumption distinguish grammatical RPs from ‘intrusive RPs’ in languages like English, which have a different behavior. As opposed to grammatical RPs, intrusive RPs only occur in island contexts or deeply-embedded contexts, and there is evidence suggesting that they do not bring island structures to full acceptability (Alexopoulou and Keller 2007).

⁹Hebrew also has RPs that never alternate with a gap (e.g., following a preposition) which behave differently (Sichel 2014). Since such RPs will not help us distinguish between SYN and SEM, we ignore them here, and they should be taken to be excluded whenever RPs are referred to in the main text.

An RC can be formed with the noun *tik* ‘briefcase’ as its head. In RCs headed by ‘briefcase’, the idiomatic interpretation is unavailable precisely in the presence of an RP, as shown in (31): in (31a), where an RP is optional, a gap but not an RP is consistent with the idiomatic interpretation, as observed by Sichel (2014); in (31b), an RP is obligatory and the idiomatic interpretation is unavailable.

(31) *Evidence for non-movement #2: RPs are not interpreted like gaps*

a. *RP blocks idiomatic interpretation, non-island context* (Sichel, 2014)

ha-tik še-tafru #oto/∅ la-sar haya kašur le-nadlan
the-briefcase that-they.sewed #it/∅ for-the-minister was related to-real.estate
‘The crime that they framed the minister for was related to real estate.’

b. *RP blocks idiomatic interpretation, island context*

ha-tik še-ani sameax biglal še-tafru oto/*∅ la-sar
the-briefcase that-I happy because that-they.sewed it/*∅ for-the-minister
haya kašur le-nadlan
was related to-real.estate
Intended: ‘I’m happy because they framed the minister for a crime related to real estate.’

Next, we show how the distributional and interpretive properties of RPs discussed in this section follow from a theory of resumption on which RPs inhabit head-external RCs.

4.2. Theory of the distribution and interpretation of resumptive pronouns

Rasin (2017), following McCloskey (2002) and Adger and Ramchand (2005) (cf. Sichel 2014), proposed an account of the distributional and interpretive properties of Hebrew RPs according to which RPs unambiguously inhabit head-external RCs that are formed without movement.

On this account, the derivation of a non-movement head-external RC proceeds as in (32). First, a TP is constructed with an ordinary pronoun. Then, a λ -binder is externally merged from the lexicon and the pronoun is abstracted over without movement. (On this view, the existence of a λ -binder in the lexicon of Hebrew is what distinguishes Hebrew from languages like English, where similar resumed relatives are unavailable.) Finally, the relative head NP is externally merged.

(32) Derivation of a head-external structure for [book that Miri read it]

Construct TP: [_{TP} Miri read it₁]

External-merge λ -binder: [_{CP} λ_1 Miri read it₁]

External-merge *book*: [_{NP} book λ_1 Miri read it₁]

On Rasin’s 2017 account, head-raising and head-external (non-movement) RCs co-exist in Hebrew. Head-raising RCs are formed with movement which leaves a gap, whereas head-external

RCs, which are derived as in (32), have an ordinary pronoun. The co-existence of these two RC structures in Hebrew accounts for the distribution of RPs as follows: in non-island contexts, RPs are optional because both structures are available; in island contexts, movement (hence head-raising) is unavailable, so the RP is obligatory. The interpretive effects of RPs follow as well. Consider again the blocking of idiomatic interpretations in (31). Assume, following the literature on the syntax of idioms, that a syntactic locality restriction requires a low copy of the relative head in order to achieve the idiomatic interpretation (e.g., Marantz 1997 and references cited there). The presence of an RP indicates that movement of the relative head has not taken place. This means that there is no low copy of the relative head, and thus, on the assumption regarding syntactic locality, that the idiomatic interpretation is unavailable when an RP is present. Now that we have an independently-supported theory of RPs as a diagnostic for head-external RCs, we can proceed to test the prediction presented in section 3.

4.3. Resumptive pronouns block the *de dicto* reading

Doron (1982) discovered that Hebrew RPs block *de dicto* readings in RCs with intensional transitive verbs like *seek*. Here we show that her discovery extends to equational-intensional RCs, as predicted by SYN_R but not by SEM_R.

The Hebrew counterpart of G&K's example with a gap is compatible with both the *de dicto* and the *de re* interpretations, as in English:¹⁰

- (33) *A gap allows the de dicto reading, non-island context*
 ha-matematikai ha-mexunan_i še-ata toen še-ata *t_i* amur lehacliax liftor
 the-mathematician the-gifted_i that-you claim that-you *t_i* should be.able to.solve
 et ha-baaya be-kalut
 ACC the-problem in-easiness
 'The gifted math' that you claim you are should be able to solve the problem easily'
(*de re, de dicto*)

An RP is optional in the position of the gap. Crucially, when it is present, the *de dicto* reading is blocked (34).

- (34) *An RP blocks the de dicto reading, non-island context*
 ha-matematikai ha-mexunan_i še-ata toen še-ata **hu_i** amur lehacliax
 the-mathematician the-gifted_i that-you claim that-you **him_i** should be.able
 liftor et ha-baaya be-kalut
 to.solve ACC the-problem in-easiness
 'The gifted math' that you claim you are should be able to solve the problem easily'
(*de re, *de dicto*)

¹⁰For our Hebrew sentences we use a second-person pronoun as the subject of the embedded copular sentence. For some reason, a proper name sounds unnatural in this construction and the third-person pronoun is degraded when followed by an RP, so we were not able to use them.

We tested (34) with two contexts, one that is compatible with the *de re* reading and one that is not (35). Speakers reported a contrast between the contexts: (34) sounded more natural to them in the *de-re-compatible* context (35a) than in the *de-re-incompatible* context (35b)¹¹, suggesting that (34) is only true given the *de-re-compatible* context.¹²

(35) Contexts for (34)

- a. *de-re-compatible* context: Rina is a participant in a trivia game show. In each stage of the game, a person hiding behind a curtain claims to be a historically famous mathematician. Rina's task is to guess the mathematician's identity by presenting the person with statements to which the person responds 'True' or 'False'. In one stage of the game, Leibniz is the mathematician whose identity Rina is supposed to guess. She writes on a piece of paper: "Problem: Prove that the real numbers are uncountable". She knows that only mathematicians born after 1874, the year in which the first such proof was provided, would be able to solve the problem easily. She presents the paper and says: "True or False?." She then says (34).
- b. *de-re-incompatible* context: Rina is a recruiter for a high-tech company which is looking for a new mathematician. She interviews Dan for the job. During the interview, Dan tells Rina that he is mathematically gifted. To test his claim, Rina presents him with a problem that only truly gifted mathematicians can solve. She then says (34).

Similarly, an RP in an island construction blocks the *de dicto* reading (the sentence in (36) is unacceptable in a *de-re-incompatible* context, a variant of (35b) where Dan claims that he is mathematically gifted prior to being invited for an interview and his claim is the reason for the invitation):

(36) *An RP blocks the de dicto reading, island context*

ha-matematikai ha-mexunan_i še-hizmanu otxa [biglal še-ata toen
 the-mathematician the-gifted_i that-we.invited you [because that-you claim
 še-ata **hu**_i/**t*_i] amur lehacliax liftor et ha-baaya be-kalut
 that-you **him**_i/**t*_i] should be.able to.solve ACC the-problem in-easiness

Intended *de dicto*: 'We invited you because you claim that you are mathematically gifted' (de re, *de dicto)

¹¹We presented the sentences in (34) and (36) by reading them out loud with intonational prominence on the RP. Shifting the prominence to *toen* 'claim' improved the acceptability of (34) in the *de-re-incompatible* context but did not improve the acceptability of (36) in the same context. At present, we are not sure how to make sense of the effect of prominence-shift on the judgments regarding (34). As far as we can tell, however, that effect does not undermine our argument: a contrast between *de re* and *de dicto* is still found in (34) with prominence on the RP and in (36) regardless of the intonational pattern.

¹²The Hebrew copula is phonologically identical to a pronoun. One might wonder whether *hu* 'him' in our examples can be analyzed as a copula followed by a trace. We note that such an analysis would not account for the *de re/de dicto* asymmetry on either theory and that it is impossible as an analysis of *hu* 'him' in (36) to begin with, since a trace is unavailable in an island construction. Furthermore, to our own judgment the *de re/de dicto* asymmetry in (34) and (36) remains the same if we change the equational sentence to the past tense (*ata hayita hu* '(that) you used.to.be **him**'), where the third-person pronoun is no longer identical to the copula.

Given that the RPs above inhabit head-external relatives, and given the reasoning described in section 3, the distribution of *de dicto* readings in (33)-(36) falls out under SYNRR without any special assumptions. SEMR over-generates *de dicto* readings in (34) and (36) since it is not sensitive to the structure of the RC. Minimally, SEMR would require additional constraints to block those readings. At present, we have not been able to formulate constraints (including constraints on the semantic type of pronouns) that would block the *de dicto* readings in (34) and (36) without under-generating elsewhere, though we leave a more detailed review of possible responses within SEMR to a separate occasion.

5. Conclusion

We have shown that SYNRR (but not SEMR) predicts that the *de dicto* reading in equational-intensional RCs should be unavailable with unambiguously head-external RCs. We have also shown that Hebrew RPs, which disambiguate an RC in favor of the head-external structure, block the *de dicto* reading. This result is predicted by SYNRR, but it is surprising under theories that allow for the type-shifter proposed by G&K.

Our result raises a few questions that we have not answered in this paper. As mentioned in section 3, other diagnostics for head-external RCs have been proposed in the literature, such as Condition C and extraposition. SYNRR predicts the *de dicto* reading to disappear in those cases as well, and that prediction remains to be tested. Another question concerns intensional RCs that are not equational, such as *the dog that Mary seeks*, with the intensional operator *seek* and without an embedded copular sentence. The present paper focused on equational-intensional RCs, whose semantics—if our analysis is correct—we understand. We leave open the question of whether the proposed analysis can extend to intensional RCs that are not equational.

Our claim that SYNRR but not SEMR derives the *de dicto* reading in equational-intensional RCs is consistent with hybrid approaches to scope reconstruction according to which some semantic-reconstruction mechanisms are available alongside syntactic reconstruction (Lechner 1998, Sharvit 1998, Keine and Poole 2017). The literature on SEMR has proposed various semantic mechanisms for scope reconstruction; if our claim is correct, it merely suggests that one such mechanism is unavailable: type-shifting from predicates of individuals to predicates of individual concepts. In the present paper, we made the stipulation—repeated below in (37)—that this type-shifting operation is not made available by Universal Grammar. Our result raises the question of whether this unavailability can be derived from deeper principles, a question that at present we leave open.

- (37) STIPULATION REGARDING TYPE-SHIFTING
Universal Grammar does not make available the following type-shifter:

$$TS(P_{\langle s,et \rangle}) = \lambda f_{\langle s,e \rangle}. \forall w \in dom(f) [P(w)(f(w))]$$

A. Appendix: An individual-concept analysis

A.1. Analysis of the subject

In section 2 we mentioned that G&K's individual-concept denotation of the subject, repeated in (38), can be generated with syntactic reconstruction and without type-shifting. This appendix provides the relevant details.

$$(38) \quad \text{Individual-concept denotation of the subject (repeated from (3))} \\ \llbracket \text{the gifted mathematician Dan claims he is} \rrbracket = \\ \iota f_{\langle s,e \rangle} [\text{dom}(f) = \text{CLAIM}_{\text{Dan},@} \wedge \forall w \in \text{CLAIM}_{\text{Dan},@} [\text{DAN}(w) = f(w) \wedge \text{gifted-math}'(w)(f(w))]]$$

The main difference between the individual-concept version of SYNRR presented here and the individual version presented in section 2 is that the semantics here involves abstraction over individual-concept variables as opposed to individual variables.

The LF we assume for the subject is given in (39). The functional variable f of type $\langle s, e \rangle$ is abstracted over and applies to a world variable w which is itself bound by λw .

$$(39) \quad \text{The } \lambda f_{\langle s,e \rangle} \text{ Dan}_2 \text{ claims}_@ \lambda w [\text{he}_2 \text{ is THE } [\text{GM}_w \text{ IDENT } f(w)]]$$

As in section 2, we focus on the central steps of the interpretation procedure going bottom up.

The node $[f(w)]$ denotes the individual that f returns for w , and is defined only if f is defined for w (40). The converted trace in (41) introduces the additional presupposition that $f(w)$ is a gifted mathematician in w .

$$(40) \quad \llbracket f(w) \rrbracket^g \text{ is defined only if} \\ g(w) \in \text{dom}(g(f)); \\ \text{where defined, } \llbracket f(w) \rrbracket^g = g(f)(g(w))$$

$$(41) \quad \llbracket \text{THE } [\text{GM}_w \text{ IDENT } f(w)] \rrbracket^g \text{ is defined only if} \\ g(w) \in \text{dom}(g(f)) \text{ and } g(f)(g(w)) \text{ is a gifted mathematician in } g(w); \\ \text{where defined, } \llbracket \text{THE } [\text{GM}_w \text{ IDENT } f(w)] \rrbracket^g = g(f)(g(w))$$

The next steps of the derivation before abstracting over f proceed along the same reasoning as in section 2 and need not be repeated here. After abstraction, the denotation of the RC is as follows:

$$(42) \quad \llbracket \lambda f_{\langle s,e \rangle} \text{ Dan}_2 \text{ claims}_@ \lambda w [\text{he}_2 \text{ is THE } [\text{GM}_w \text{ IDENT } f(w)]] \rrbracket = \\ \lambda f_{\langle s,e \rangle} : \forall w \in \text{CLAIM}_{\text{Dan},@} [w \in \text{dom}(f) \text{ and } f(w) \text{ is a gifted-math}' \text{ in } w]. \\ \forall w \in \text{CLAIM}_{\text{Dan},@} [\text{Dan} = f(w)]$$

(42) denotes the set of functions of type $\langle s, e \rangle$ which are defined at least for all of Dan's CLAIM worlds and which map each of Dan's CLAIM worlds to Dan, who is (presupposed to be) a gifted

mathematician in those worlds. One function in that set is (43), the function that satisfies the condition in (42) whose domain is equal to $\text{CLAIM}_{\text{Dan},@}$. This function is the desired denotation of the subject (38).

$$(43) \quad \iota f [\text{dom}(f) = \text{CLAIM}_{\text{Dan},@} \wedge \forall w \in \text{CLAIM}_{\text{Dan},@} [f(w) = \text{Dan} \wedge f(w) \text{ is a gifted-math' in } w]]$$

In addition to (43), the set in (42) includes any other function that satisfies the condition in (42) whose domain properly contains $\text{CLAIM}_{\text{Dan},@}$. Since the definite article requires a singleton set as its argument and (42) includes multiple functions, it cannot apply to (42). The rest of the composition follows G&K, who propose to restrict the set in (42) to a singleton set that only contains (43). They define the minimization operation in (44) which picks up the smallest function from a set of functions.

$$(44) \quad \text{Let } S \text{ be a set of functions. Then } \min(S) = \{f \in S : \forall g \in S [g \subseteq f \rightarrow g=f]\}$$

Applying minimization to (42) picks up the right singleton set:

$$(45) \quad \begin{aligned} \min((42)) &= \{f \in (42) : \forall g \in (42) [g \subseteq f \rightarrow g=f]\} \\ &= \{f \in (42) : \text{dom}(f) = \text{CLAIM}_{\text{Dan},@}\} \\ &= \{(43)\} \end{aligned}$$

Now the definite article can apply to $\min((42))$ to derive the desired denotation:

$$(46) \quad \begin{aligned} \llbracket \text{the} \rrbracket (\min(42)) &= \\ \iota f [\text{dom}(f) = \text{CLAIM}_{\text{Dan},@} \wedge \forall w \in \text{CLAIM}_{\text{Dan},@} [f(w) = \text{Dan} \wedge f(w) \text{ is a gifted-math' in } w]] \end{aligned}$$

In words, this function is the unique function from Dan's CLAIM worlds to Dan, who is a gifted mathematician in those worlds. This is the same meaning G&K derive for *the gifted mathematician that Dan claims he is*, but using different compositional techniques.

A.2. Combination with the rest of the sentence

For the combination of the subject with the rest of the sentence, we assume that the subject is reconstructed below *should* at LF, and that it takes as an argument a world variable bound by *should*, in (47a). The final denotation is in (47b).

$$(47) \quad \begin{aligned} &\text{The gifted mathematician Dan claims he is should be able to solve this problem} \\ \text{a. } &\underline{\text{LF}}: \text{Should}_@ \lambda w [\llbracket \text{the } \lambda f \dots \text{GM} \dots \rrbracket_w [\text{be-able}_w \text{ to solve this problem}]] \\ \text{b. } &\forall w \in \text{SHOULD}_@ [f(w) \text{ is able to do solve the problem in } w], \\ &\text{where } f \text{ is the denotation of the subject (given in (46)),} \\ &\text{and } \text{SHOULD}_@ \text{ is the set of worlds quantified over by } \textit{should} \end{aligned}$$

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Subjective assertions are Weak: exploring the illocutionary profile of perspective-dependent predicates.¹

Andrea BELTRAMA — *University of Konstanz*

Abstract. Sentences containing subjective predicates – e.g., “The movie was *awesome*” – are intuitively anchored to a particular perspective; this makes them different from sentences describing objective facts – e.g., “The movie was set *in 1995*”. While authors have long debated on whether this intuition tracks a lexical distinction between subjective and factual predicates, much remains to be explored on whether, and how, the difference between these two assertions is reflected at the illocutionary level. Relying on evidence from two experiments, we show that assertions containing subjective predicates display different discourse behavior from objective assertions. We take these findings to support the idea that SAs should be assigned a special illocutionary profile, unveiling a genuine empirical difference between subjective and factual speech.

Keywords: subjectivity, discourse, assertion, Common Ground.

1. Introduction: Subjectivity and Discourse

Sentences containing subjective predicates – e.g., *awesome* in (1) – are intuitively anchored to a particular perspective, contrary to sentences describing objective facts (as in (2)).

(1) The movie was awesome. Subjective Assertion

(2) The movie was set in 1995. Factual Assertion

A lively debate in linguistics and philosophy revolves around the best way to model the distinction between subjective and factual predicates at the lexical level. Among extant proposals, it has been suggested that subjective predicates are interpreted relative to a judge (Lasersohn 2005; Stephenson 2007; Stojanovic 2007; Sæbø 2009; for a judge-free account, see Pearson 2013; Umbach 2016); that they involve “first person genericity” (Moltmann 2010); that they share a common semantic core with other subjective expressions like evidentials and epistemic modals (Korotkova 2016); and that, at the same time, they do not constitute a homogeneous class (McNally and Stojanovic 2017).² Less explored, however, is whether, and how, the distinction between subjective and objective predicates is reflected in the dynamics of the conversation. In the current paper, we take a step forward towards investigating this issue by asking the following question: How do assertions with and without subjective predicates differ in shaping the Common Ground between two conversation partners? Relying on two experiments, we show that assertions with subjective predicates (henceforth **SAs**) display different discourse behavior from objective assertions (henceforth, **OAs**): **(i)** they do not lead to up-

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²For space constraints, providing an exhaustive review of the literature on the semantics of subjectivity goes beyond the scope of this paper. But see van Wijnbergen-Huitink (2016) for an overview.

dating the Common Ground when followed by silent responses; (ii) they do not engender a conversational crisis when targeted by a denial. We take these findings to highlight a genuine empirical difference between subjective and factual speech, suggesting that SAs should be assigned a special illocutionary profile. The paper is structured as follows: Section 2 summarizes the standard view of how OAs and questions shape the Common Ground; Section 3 reviews current proposals of the illocutionary profile of SAs; Section 4 and 5 present the two experiments comparing SAs to OAs with respect to two crucial properties of assertions: the effect of silence responses and the aftermath of denials; Section 6 provides a general discussion of the experimental findings; Section 7 concludes.

2. Preliminaries: Assertions, Questions, Common Ground

Conversation is central to human cognition. As we engage in dialogues with other speakers, we constantly pool our epistemic resources with those of our interlocutors; by doing so, we inch closer to a correct representation of the current world, the ultimate goal along our quest for knowledge. For the purpose of the current paper, I follow two standard ideas concerning the dynamics of this activity. First, we increase our stock of mutual knowledge by constantly establishing and updating the Common Ground (henceforth, **CG**), the set of worlds compatible with what all conversational participants believe (Stalnaker 1978). Second, different types of speech acts place different constraints on how the conversation evolves and the CG is updated (Farkas and Bruce 2010). A particularly important distinction, in this respect, is the one between assertions and questions, which I now turn to review.

On the one hand, assertions are *informative* moves; that is, they aim at directly increasing the CG. This idea is captured by modeling assertions as *proposals* to add the anchor proposition to the CG, which the listener can either accept or reject. Let us consider (2) above again in (3).

(3) The movie was set in 1995. Assertion

In this view, this assertion has three effects. First, the speaker publicly commits to the proposition “The movie was set in 1995”. Second, the speaker proposes to add p to the Common Ground of the conversation. Third, the interlocutor has the power to either accept the proposal, which effectively amounts to enriching the CG with p ; or to reject it, which prevents the CG from being modified. Concerning this last effect, it is important to observe that, from a pragmatic perspective, acceptance and rejections are not on a par. While acceptance is the default outcome of an assertion, rejection is a highly marked response, as shown by a crucial piece of evidence: besides affirmative responses, absence of an explicit response on the part of the interlocutor is normally taken to indicate acceptance; by contrast, rejection needs to be overtly signaled by a denial.

(4) A: The move is set in 1995.

- | | | |
|----|-----------------------|--|
| a. | B: Yes, that’s right! | Affirmative response $\rightarrow p$ added to CG |
| b. | B: [silence] | No response $\rightarrow p$ added to CG |
| c. | B: No, it isn’t! | Denial $\rightarrow p$ not added to CG |

On the other hand, polar questions are *inquisitive* moves; they do not aim at directly increasing the CG, but they request for information, calling on the interlocutor to enrich the CG in the next conversational turn. Once again, let us examine this with an example:

(5) Was the movie set in 1995? Polar Question

On the standard view, asking $?p$ has three effects. First, the speaker publicly commits to raising an issue about whether the movie is set in 1995. Second, the speaker proposes to add either p or $\neg p$ to the Common Ground. Third, the interlocutor is ultimately requested to decide to shape how the CG will be updated with their response. Contrary to assertions, however, we do not observe the same asymmetry between positive and negative responses: since two alternative proposals have been put forward by the speaker, the interlocutor has to actively choose one of them; failure to do so, i.e., remaining silent, will *not* lead to an update in either direction.

(6) A: Is the movie set in 1995?

- | | | |
|----|-----------------------|--|
| a. | B: Yes, that's right! | Affirmative response $\rightarrow p$ added to CG |
| b. | B: [silence] | \rightarrow neither p nor $\neg p$ is <i>not</i> added to CG |
| c. | B: No, it isn't! | Denial $\rightarrow \neg p$ is added to CG |

Building on this distinction, I ask the following: how do SAs shape the procedure whereby the CG is updated? More specifically: How does the perspective-dependent nature of the predicate shape the illocutionary force of the assertions that contain them? I first turn to review three proposals, each of which makes different testable predictions with respect to the discourse effects of these moves.

3. The illocutionary profile of SAs: current proposals

In light of the substantive amount of work concerned with subjectivity in language, the discourse status of assertions like (1) remains surprisingly underexplored. When it comes to the pragmatic correlates of subjectivity, in particular, most of the literature has focused on cases in which these forms are embedded under attitude verbs such as “I find that”, or come with an overt argument specifying the anchor of the judgment. The crucial observation is that in such cases, contrary to regular assertions, these predicates cannot be challenged, even in case the interlocutor has a different view/experience on the matter. (7) reports an example from Stephenson (2007).

(7) Mary: How is the cake?
 Sue: It tastes good to me.
 Sam: # No, it doesn't! It tastes terrible.

A common view is that, in such contexts, subjective predicates are simply *presentative*: they merely express an opinion, but effectively fail to make an actual proposal to increase the Common Ground. This idea is cashed out in different ways: Dechaine et al. (2017) suggest that these constructions merely update the *Origo Ground*, a discourse space where perspective-dependent

content is represented, and which is distinct from the Common Ground; Umbach (2016) and Stephenson (2007) propose that these moves are simply not made available to the interlocutor for acceptance or rejection.

Less consensus, however, surrounds uses of subjective predicates as in (1), where no anchor is specified. Three accounts, in particular, have been proposed. According to Dechaine et al. (2017), subjective predicates “lexicalize presentative force” independently of whether the anchor is specified or not: as such, both (7) and (1) should be treated as inert with respect to the goal of increasing the Common Ground. According to Umbach (2016), SAs with no explicit anchor or no embedding attitude verb are interpreted as assessments *tout court*: similar to regular assertions, they do aim at increasing the CG and, once asserted, wait for confirmation or denial, in the same way in which an objective statement would. Finally, Stephenson (2007) suggests that assertions like those in (1) are associated with an *autocentric* norm of assertion: p can be asserted as long as the speaker judges it to be true; however, it is only added to the CG if *all* participants in the conversation judge it as true (see Coppock 2018 for a variant couched within the framework of outlook semantics). On this view, the norm of assertion of SAs is distinctively *weak*: a speaker can legitimately make these without having any expectation that the interlocutor will share the same view, and thus that the proposition will end up being added to the Common Ground. This contrasts with OAs, which, barring exceptional circumstances, normally require that the speaker expects that the asserted proposition will be accepted. At the same time, SAs are still proposals that are aimed at enriching the CG, and that can be either accepted or rejected by the interlocutor. The emerging picture is one in which the view that SAs rely an autocentric norm of assertion occupies a middle ground between the other two views presented above: they do not encode acceptance of p as their default outcome, similar to what is predicted by the view that they are presentative moves; but they are nevertheless inscribed in the participants’ project of enriching the CG, similar to the view that they are assessment *tout court*. I now proceed to test the predictions of these proposals experimentally, comparing the behavior of SAs, OAs and PQs with respect to two distinctive parameters of assertions: the effects of silent responses, and the aftermath of denials.

4. Experiment 1: the effect of silent responses

In this study, I explore the behavior of SAs with respect to silent responses. As can be recalled from the discussion in Section 2, adding p to the CG represents the unmarked outcome of an assertion (see e.g., Stalnaker 1978, Farkas and Bruce 2010). As such, while rejection needs to be overtly signaled with a denial, silence typically leads accepting the proposal, on a par with an explicit affirmative reply. By contrast, because Polar Questions do not make a univocal proposal, they require an explicit response from the interlocutor for the CG to be updated. Concerning Subjective Assertions, each of the three accounts above make different predictions. If SAs work like regular assertions, they should put forward a proposal in the same way in which OAs do: on this view, silent responses should likewise lead to updating the CG with p . If SAs are merely presentational, no proposal is made at all: this predicts that silent responses should not lead to update the CG. Finally, if SAs rely on a weak norm of assertion, an explicit response should be required from all participants before an update is made: this, again, predicts that silence should not be interpreted as a sign of acceptance of the proposition.

4.1. Methods

4.1.1. Design

Two factors were crossed in a 3x3 design. Each trial consisted of a written dialogue in which Greg makes one of three possible moves – OA, SA or Polar Question (PQ) – and Mary provides one of three possible responses – Confirmation, Denial or Silence. Following each dialogue, participants were asked to assess whether, according to what they had just read, the proposition was part of the participants' Common Ground. The assessment was operationalized on a 1-7 Likert scale (7="totally agree"; 1="totally disagree") response to the statement "It is now part of Greg and Mary's mutual knowledge that p ". The higher the score, the higher the likelihood that the update went through according to the participant. (8) illustrates a sample dialogue.

- (8) *Greg: OA:* The movie was awesome.
Greg: SA: The movie was set in 1995.
Greg: PQ: Was the movie set in 1995?
Mary: Confirm: Yes, indeed!
Mary: Denial: No, not really!
Mary: Silence: [Keeps listening, says nothing.]
Statement to assess: "It is now part of G and M's mutual knowledge that {The movie was awesome/the movie was set in 1995}."

4.1.2. Procedure and Statistical analysis

27 items, each with a different set of predicates, were distributed in 9 lists with a Latin Square Design. Each list was completed by 26 fillers. All fillers consisted of dialogues between Greg and Mary, where Greg would ask a Wh-Question, and Mary would provide a response. 54 self-declared native speakers of American English were recruited on MTurk and paid \$1.50 for participation. 3 subjects were excluded due to missing responses. For statistical analysis, a mixed-effects model was run with the responses as the dependent variable, fixed effects for Move and Response and random slopes for Subjects and Items. The models were run with the *lmer* test in R (Kuznetsova et al. 2016). Given the theoretical motivation of the study, a crucial comparison is the one between OAs, SAs and PQs in silent responses. No difference should be observed for these moves with the other responses: while all confirmations should lead to adding p to the CG, all denials should not lead to updating the CG with the proposition. OAs and Confirmation were entered as reference levels in the model.

4.2. Results

The results are plotted in Figure 1 below.

Table 1 reports the results of the model.

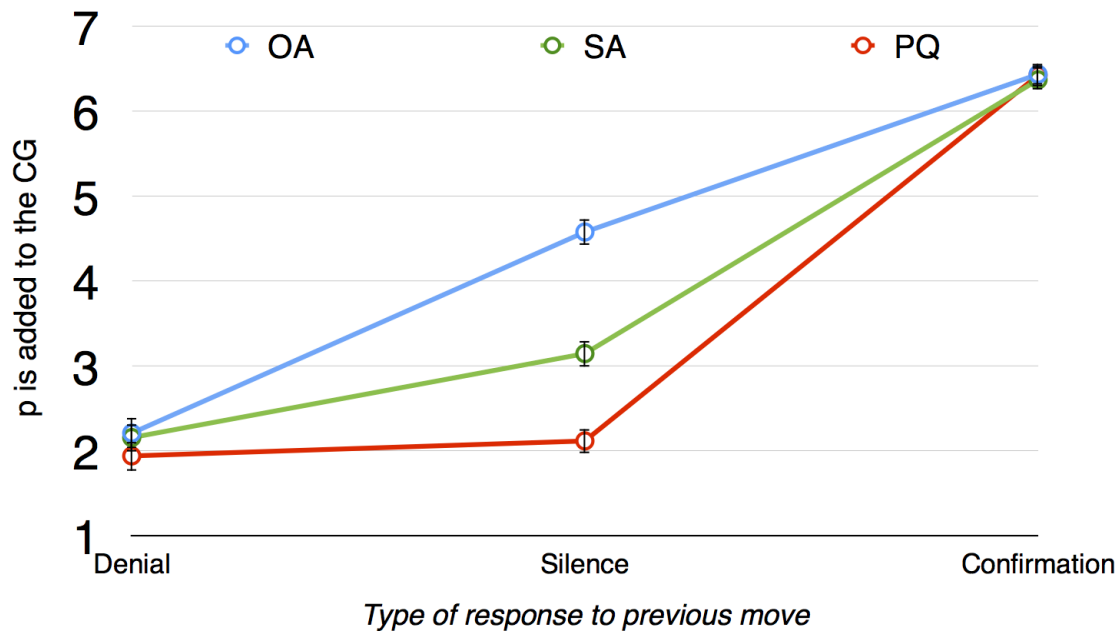


Figure 1: Average ratings for Experiment 1

Table 1: Mixed effect model summary for positive attributes. Intercept: OA & Confirmation

Factor	Coefficient	Standard Error	t-value	<i>p</i>
Intercept	6.44	0.17	37.8	<.0001
PQ	-0.02	0.15	-0.14	0.88
SA	-0.07	0.13	-0.52	0.60
Denial	-4.22	0.30	-13.61	<.0001
Silence	-1.84	0.25	-7.33	<.0001
PQ:Den	-0.24	0.16	-1.51	0.12
SA:Den	0.01	0.16	0.08	0.929
PQ:Sil	-2.45	0.16	-15.14	<.0001
SA:Sil	-0.77	0.16	-4.79	<.0001

The model reveals two main effects of Response, as well as two interaction effects Move:Response. To better understand these results, we carried post-hoc comparisons with the application of a Tukey correction for multiple comparisons. We are especially interested in comparing the ratings associated with PQs, SAs and OAs in the presence of silent responses. The analysis reveals that SAs significantly differ from both OAs ($t(22.57)=5.4, p < .001$) and PQs ($t(22.57)=5.4, p < .001$). No significant difference is found between these three moves following either confirmations or denials.

4.3. Discussion

In Experiment 1, we explored how different responses to PQs, SAs, and OAs affect CG updates. As predicted, confirmations lead to adding the proposition to the CG across moves, while denials blocked CG updates across moves. The three moves, however, behave differently when followed by silent responses. In particular, following OAs, silence leads to updating the CGs to a considerably greater extent than for SAs, suggesting that, in the presence of subjective predicates, adding p to the CG is less of a default outcome than it is for assertions containing factual predicates. At the same time, the CG-acceptance rating for silence following SAs is higher than for PQs, suggesting that SAs still retain some kind of assertive force with respect to plain questions.

5. Experiment 2: the aftermath of denials

In Experiment 2, we compare SAs and OAs with respect to another distinctive property of assertions: the aftermath of disagreement. Let us consider these two examples.

- (9) a. A: The movie was set in 1995.
B: No, it wasn't!
- b. A: The movie was awesome.
B: No, it wasn't!

On the one hand, there is consensus that disagreement following an objective statement tends to be highly disruptive for the conversation. First, it undermines the felicity of the assertion itself, implying that the speaker is not using language in a congruous way. Second, it creates a situation of *conversational crisis*, where the two interlocutors have incompatible commitments, and the CG ends up being an absurd belief state. As a result, this situation needs work to be solved: it can be sorted out via retraction, for example, or via a mutual negotiation to leave the issue unsettled and “agree to disagree” (Farkas and Bruce 2010). This experiment directly compares SAs and OAs on this basis by operationalizing and measuring the actual degree of disruptiveness of disagreement following each of these moves. Specifically, the study compares the perceived naturalness of two types of reactions to a denial: “Aha, interesting to hear!”, which signals a welcoming disposition towards disagreement; and “No way! That can't be true”, which signals willingness to react to the denial. Following the idea that denying assertions leads to a conversational crisis, insisting responses should be rated as more natural than welcoming reactions to denials following OAs. By contrast, for a “No” answer directed at a question, a welcoming response should be more natural than an insisting one to be inappropriate, since questions do not put forward proposals in the first place. Concerning subjective predicates, different theories make divergent predictions. If SAs have mere presentational force, no proposal for the CG is put forward: as such, insisting responses on the part of the speaker should be rated as unnatural as insisting responses following denials to questions; by contrast, welcoming responses should be rated as natural as welcoming responses following denials to questions. If SAs behave like regular assertions, insisting responses should be as natural as they are for OAs, while welcoming responses should be as unnatural. Finally, if SAs are linked to a weak norm of assertion, both types of responses should have intermediate naturalness:

welcoming responses should be more natural than they are for OAs, since disagreement does not undermine the felicity of the assertion that it targets; at the same time insisting responses should also be natural than they are for question, since a proposal for the CG is still put forward, motivating the speaker's effort to push the assertion further.

5.1. Methods

2 factors were crossed in a 3x2 design. Each trial consisted of a written dialogue in which Greg makes one of three moves (OA, SA or a PQ); Mary responds with a denial; and Greg follows up with one of the two reactions above. Subjects provided a 1-7 naturalness judgment (1="totally unnatural"; 7="perfectly natural") on the final reaction. An example is below.

- (10) *Greg: SA:* The movie was awesome.
Greg: OA: The movie was set in 1995.
Greg: PQ: Was the movie set in 1995?
Mary: No, it was not!
Greg: Welcoming: Aha, interesting to hear!
Greg: Insisting: No way! That can't be true!

How natural does the underlined part sound? "1.....7"

5.2. Procedure and statistical analysis

18 items were distributed in 6 lists with a Latin Square Design, together with 20 fillers. 54 self-declared native speakers of American English were recruited on MTurk and paid \$1.50 for participation. 1 subject was excluded due to missing responses. To ensure that welcoming and insisting replies were perceived as such, subjects were explicitly instructed to assume that Greg was *not* being sarcastic. For statistical analysis, a mixed-effects model was ran with the responses as the dependent variable, fixed effects for Move and Response and random slopes for Subjects and Items. The models were ran with the *lmer* test in R (Kuznetsova et al. 2016). OAs and Insisting were entered as reference levels in the model.

5.3. Results

The results for Experiment 2 are plotted in Figure 2 below.

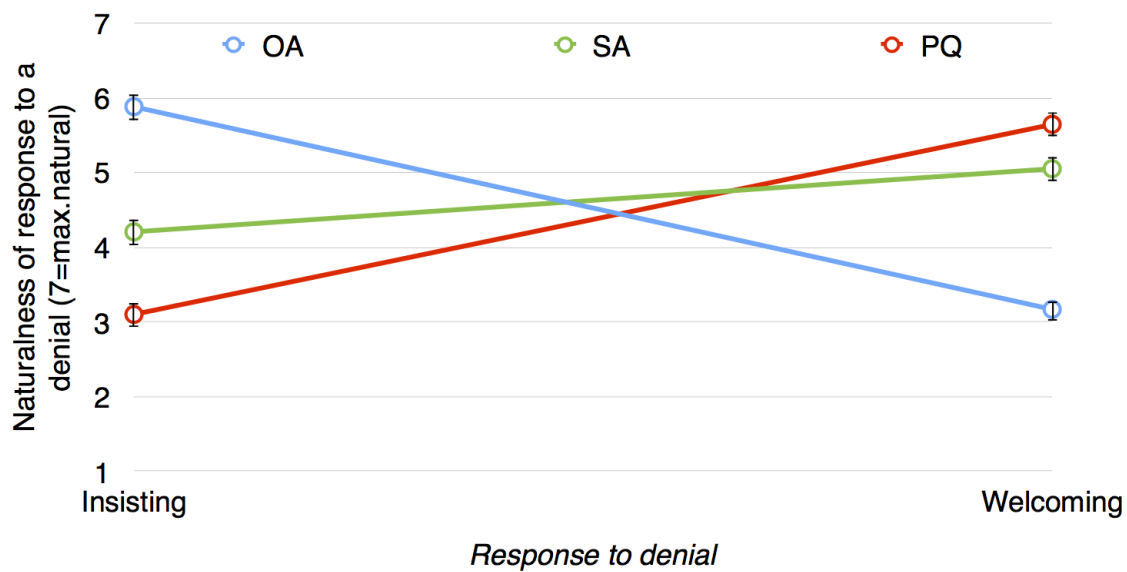


Figure 2: Average ratings for Experiment 2

The results from the mixed-effects model for Experiment 2 are reported in Table 2 below.

Table 2: Mixed effect model summary for positive attributes. Intercept: OA & Insisting

Factor	Coefficient	Standard Error	t-value	<i>p</i>
Intercept	5.87	0.18	31.1	<.0001
PQ	-1.72	0.21	-8.3	<.001
SA	-1.91	0.20	-9.4	<.001
Welc	-2.71	0.23	-11.6	<.0001
PQ:Welc	4.25	0.23	17.8	<.0001
SA:Welc	3.80	0.13	15.9	<.0001

All main effects and interactions are significant. To better understand the interactions, post-hoc comparisons with the application of a Tukey correction for multiple comparisons were carried out. As far as the contrast between welcoming and insisting responses, insisting responses were rated higher than welcoming ones for OAs ($t(32.3) = 11.6, p < .0001$); for SAs and PQs, instead, welcoming responses were rated higher (For SAs, $t(32.3) = 4.6, p < .001$; For PQs, $t(32.3) = 4.5, p < .001$). As far as the contrast between different types of moves, welcoming responses were rated higher for SAs than for OAs ($t(20.0) = 9.2, p < .0001$), and were rated higher for PQs than for either SAs or OAs (PQs vs SAs: $t(20.0) = 3.1, p < .05$; PQs vs OAs: $t(20.0) = 11.2, p < .0001$). Conversely, insisting responses were rated higher following SAs than following PQs ($t(27.5) = 4.2, p < .01$), and were rated higher following OAs than following either SAs or PQs (OAs vs SAs: $t(20.0) = 9.4, p < .0001$; OAs vs PQs: $t(34.2) = 8.3, p < .0001$).

5.4. Discussion

These findings suggest that disagreement targeting SAs behaves differently than disagreement aimed at OAs. Insisting responses and welcoming responses are rated respectively higher and lower for SAs than for OAs; in addition, within SAs, welcoming responses are rated higher than insisting ones, while the reverse is the case for OAs. The emerging picture is one in which denials targeting SAs come with a degree of disruption that is lower than the one associated with OAs, and yet higher than the one associated with PQs. This suggests once again that assertions containing subjective predicates occupy a middle ground between polar questions and regular assertions.

6. General Discussion

The findings from these two studies suggest that, from an empirical perspective, the illocutionary behavior of SAs is different from the one of OAs. Two differences are supported by the experimental results. First, as shown in Experiment 1, SAs do not lead to an update of the CG with p in the absence of an overt response. Second, as shown by Experiment 2, denials following SAs are less disruptive – i.e., more likely to be accepted and less likely to be resisted – than denials following OAs. With respect to both these properties, the behavior of SAs is remarkably similar to that of questions. In particular, both PQs and SAs appear to require some sort of explicit response before a proposition is added to the CG; and both SAs and PQs do not engender a conversational crisis when followed by denials. At the same time, the profile of SAs remains different from the one of questions: when followed by a silent response, SAs still lead to update the CG to a higher extent than PQs; and in the aftermath of denials, it is still more natural for authors of SAs to defend the proposition than it is for authors of PQs. Taken together, these observations suggest that OAs and SAs are empirically distinct moves from the perspective of discourse. In particular, with respect to both properties that were tested the behavior of SAs is consistent with the idea that SAs rely on a weaker norm of assertion, where a speaker utters the proposition as long as they judge it to be true, but the proposition is added to the CG only if all discourse participants share the same evaluation: this would explain the absence of default acceptance in case of silence, as well as the mild flavor of disagreement in case of denials.

Looking at the broader picture, two questions arise. First, how should SAs be modeled within a formal theory of speech acts and discourse moves? At the very least, the observed behavior of these statements suggests that SAs present significant overlap both with OAs and PQs, two moves that are located at opposite ends of a spectrum (see Section 2). This intuition could be cashed out by suggesting that SAs are effectively a hybrid type of speech act. Similar to OAs, they are *informative*: they require the speaker's commitment to the anchor proposition, as they present a proposal that is supposed to directly enrich the CG. Similar to PQs, however, they are *inquisitive*: they raise the issue as to whether the interlocutor also judges the proposition as true, explicitly requesting for an explicit stance on this issue before the CG can be updated. This idea could be captured by positing that SAs obtain the two following effects whenever they are uttered by a Speaker A in a conversation with Speaker B. In the notation above, pA and pB refer to p as judged by Speaker A and Speaker B respectively.

- **Informative part:** A publicly commits to p_A (\approx OAs)
- **Inquisitive part:** A proposes to update the CG by raising the issue $?p_B$ (\approx PQs)
- **Update procedure:** the CG is updated with p_{AB} if and only if the interlocutor agrees

If this is the illocutionary profile of SAs, it becomes possible to explain why a response from the interlocutor is always needed, and why disagreement isn't disruptive. A negative response, under this account, is not a rejection of the speaker's proposal, but merely a way of choosing one of two available options, just like it normally happens with polar questions. As a further empirical observation, it can be noted that SAs, similar to PQs, license response particles like *totally* or *yes!*, suggesting that they indeed raise an issue that can be addressed by the interlocutor. The status of such responses appears to be degraded with OAs (Beltrama 2018).

(11) A: The movie was awesome.
B: Totally!

(12) A: The movie was set in 1995.
B: #Totally!

While I leave the proper formulation of this idea to further research (but see Beltrama 2018 for a preliminary attempt), it is important to point out that, if correct, this proposal highlights SAs as a further instance of speech act with declarative syntax and idiosyncratic discourse profile, on par with raising declaratives (Jeong, to appear; Rudin 2018) or declaratives modified by tags (Malamud and Stephenson 2014). As such, modeling the illocutionary profile of SAs could crucially contribute to enriching our understanding of the land in between assertions and questions, informativity and inquisitiveness, a territory that remains relatively uncharted in the study of discourse.

A second theoretically relevant question is the following: How do the properties of SAs highlighted in these studies shed light on the debate concerning the representation and interpretation of subjective predicates? A particularly contested notion in this literature revolves around the nature of disagreement following perspective-dependent expressions. According to some authors, subjective predicates give rise to the phenomenon commonly labeled as *faultless disagreement* (Kölbel 2002, Lasersohn 2005, Stephenson 2007). On this view, disagreement is seen as much less disruptive than with OAs: although the interlocutors are producing conflicting assertions, neither of them is saying something false, or making a pragmatically infelicitous move. Other authors, however, question the very existence of faultless disagreement altogether, suggesting that disagreement following subjective predicates is not distinct from genuine, factual disagreement (Stojanovic 2007; Umbach 2016); on this view, the intuition that no participant is blameworthy is a misconception arising from the fact that, when such predicates are used, a general perspective on the CG is not available to the speakers. While Experiment 2 was not designed to provide support in favor or against either view, it is worth observing that the non-disruptive flavor of disagreements following SAs can be accounted for rather straightforwardly under a view in which these are disputes are genuinely faultless, and thus distinct

from those about objective matters. By contrast, explaining this result in light of the competing view would instead require a more complex explanation – e.g., one that links the lack of disruptiveness of denials to more general pragmatic principles about reasoning with evaluative meanings, and not to their status as speech acts with distinctive properties. In sum, while the findings from the second study cannot provide conclusive evidence supporting either view of the nature of disagreement, they do highlight experimental methods as a potentially viable technique to cast light on this debate, as well as on other theoretical issues related to the encoding of subjectivity in language (see Solt 2018; Kaiser and Lee 2018 for recent approaches).

7. Conclusion

The two studies discussed in the paper suggest that the distinction between subjective and factual language is empirically reflected in the way in which different types of assertion shape discourse. As such, these findings raise a number of questions concerning the modeling of the pragmatic and discourse correlates of subjective language. While providing an answer to these issues would go beyond the scope of the current paper, it is my most sincere hope that these results, together with the discussion provided above, can be a useful starting point for further research on a seminal topic across linguistics and philosophy.

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Decomposing cornering effects: an experimental study¹

Andrea BELTRAMA — *University of Konstanz*

Erlinde MEERTENS — *University of Konstanz*

Maribel ROMERO — *University of Konstanz*

Abstract. Alternative Questions with “or not” (NAQ) convey a *cornering effect*, which is not found with their polar counterparts (PQ). This effect has been claimed to consist of two parts (Biezma 2009): NAQs (i) cannot be used discourse-initially and (ii) they do not license follow-up questions/subquestions. In this paper, we ask the following: Are both parts of cornering linked to the same property of NAQs? Or do they reflect distinct linguistic phenomena? We explore the issue by comparing the behavior of NAQs to Complement Alternative Questions (CAQ), a type of question that, like NAQs, presents logically opposite alternatives but, unlike NAQs, fully spells out the second one. Results from two experiments suggest that both parts of cornering can instead be explained in terms of independent semantic and pragmatic principles, which operate beyond the domain of alternative questions.

Keywords: Alternative Questions, cornering, discourse, focus, information structure.

1. Introduction: the Cornering Effect

Questions with seemingly similar semantic content have significantly different pragmatic properties. In particular, Bolinger (1978) observed that Polar Questions (henceforth, PQs) tend to have a broader distribution than Negative Alternative Questions, that is, their alternative counterparts with “or not” (henceforth, NAQs). For example, PQs have been reported to be more felicitous than NAQs in many non-canonical uses—e.g., when used to make invites, draw inferences, or pose rhetorical questions. In addition, Biezma (2009) observes that, in information-seeking uses, NAQs induce a *cornering effect*, whereby they put the discourse in a ‘cul de sac’ (Biezma 2009), pressing the hearer to provide an answer. According to Biezma, the cornering effect can be broken down into two distributional restrictions. First, NAQs are inappropriate discourse-initially, as shown in the following example.

(1) **Cornering, Part 1**

Scenario: You are in charge of coordinating the cooks for the colloquium dinner. John is one of the cooks. Dinner is tomorrow and you need to know what is happening with the pasta.

You: # Are you making pasta or not?

NAQ

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Second, NAQs are necessarily discourse-final, that is, they do not license followup questions/subquestions.

(2) **Cornering, Part 2**

Scenario: You are in charge of coordinating the cooks for the colloquium dinner. John is one of the cooks. Dinner is tomorrow and you need to know what is happening with the pasta.

You: Are you making pasta?

John: (Silence and dubitative faces)

You: ✓ Are you making pasta or not?

NAQ

John: (Silence and dubitative faces)

You: # Are you making pasta?

It follows from these restrictions that NAQS are only felicitous in a context in which a question has already been asked before, and no other question follows it. Note that in this exchange a PQ is used discourse initially, and is followed by another question; this shows that neither component of cornering applies to it. In this paper, we address two interrelated questions: What is the underlying source of each part of the cornering effect? And are the two components of cornering independent from one another? Relying on two experiments, we aim to tease apart the following two possibilities in particular. One possibility is that cornering is driven by certain distinctive properties of NAQs, as suggested by two separate accounts in the literature; the other possibility is that cornering is driven by more general pragmatic principles underlying information structure and discourse, which apply beyond NAQs. To cast light on the issue, we will compare the behavior of PQs and NAQs to Complement Alternative Questions (henceforth, **CAQs**), a variety of question that poses two logically opposite alternatives, but spells out the second disjunct with a complementary antonym, as opposed to via negation.

- (3) a. Is it a boy or a girl?
 b. Is it heads or tails?

Based on the results from our studies, we will suggest that Part 1 of cornering is linked to a particular focus structure which penalizes discourse-initial uses of questions in general; and that Part 2 is driven by a broader pragmatic principle that penalizes reusing a question that didn't previously work. The emerging picture is one in which each part of cornering is derived independently, and can be derived through constraints that apply beyond the narrow domain of NAQ.

The paper is organized as follows. In Section 2 we review two current accounts of the two components of the cornering effects: Biezma's (2009) exhaustivity/exclusivity-based analysis and Biezma and Rawlins (2014, 2018)' bundling-based analysis. In Section 3 we outline a third possibility to account for cornering. In Section 4 we introduce CAQs as a case study and outline our hypotheses. In Section 5 and 6 we describe the two experiments. In Section 7 we provide a general discussion of the findings from the study. In Section 7 we conclude.

2. Cornering and NAQs: hypothesis

2.1. Biezma 2009

Biezma (2009) argues that both parts of cornering track a semantic difference between the denotation of NAQs and PQs. Specifically, she argues that PQs denote an open list of alternatives, which contains p and other unmentioned alternatives salient in discourse; alternative questions at large, by contrast, denote two exhaustive, mutually exclusive alternatives $\{p, q\}$. What makes NAQs special, among alternative questions, is that they present *logically opposite* alternatives, that is $\{p, \neg p\}$. By virtue of this semantic property, NAQs necessarily exhaust the possibility space in discourse, presenting the hearer with no option other than picking one of the two proposed alternatives. These properties have two consequences for the distribution of these questions. On the one hand, they are an overly strong strategy to begin a conversation, explaining their infelicity in discourse-initial position. On the other hand, they can only be resolved with an answer, ruling out follow up questions or other inquisitive strategies. This explains their necessarily discourse-final position. By contrast, PQs, by virtue of denoting an open list, do not corner the addressee. Since they leave open plenty of options other than the mentioned one, they are adequate to start a conversation and they can be followed by further questions.

2.2. Biezma and Rawlins 2014, 2018

In subsequent work, Biezma and Rawlins (Biezma and Rawlins 2014, 2018) integrate Biezma's (2009) analysis of cornering by introducing the notion of *bundling*. In the authors' account, bundling refers to the particular strategy that a speaker adopts for "packaging" the available alternatives when asking a question. For example, in the following exchange, the speaker changes their inquisitive strategy turning a WH-Question into a PQ, bundling an open set of alternatives—i.e., "places for lunch"—into the category of "vegetarian places".

- | | | |
|-----|---|------|
| (4) | Question 1: Where should we go for lunch? | Wh-Q |
| | ... | |
| | Question 2: Should we go to a vegetarian place? | PQ |

The authors, specifically, argue that every bundling choice made by a speaker is subject to a *Qualitative Constraint*: there must be some reason to group alternatives together as a strategy in a particular way, distinct from prior discourse. Combined with NAQs' semantic properties, such a constraint is precisely what explains the two components of cornering. Let us consider the following example again.

- (5) **Scenario:** You are in charge of coordinating the cooks for the colloquium dinner. John is one of the cooks. Dinner is tomorrow and you need to know what is happening with the pasta.
You: Are you making pasta?

John: (Silence and dubitative faces)

You: ✓Are you making pasta or not?

Here, following the initial PQ, the use of a NAQ re-organizes the logical space around p , bundling any alternative to it under $\neg p$. Per the Quality Constraint, the only possible reason to re-organize the logical space of discourse in this way is the following: p must already be the prominent alternative in discourse. This requirement derives the two components of cornering. Concerning the ban in discourse-initial position, for p to be already prominent in discourse it must be the case that the interlocutors have accepted a bias for p —that is, that ? p has been asked before. Crucially, this constraint is not met in discourse-initial questions, explaining Part 1 of cornering. Concerning Part 2 of cornering, NAQs cannot be subject to further bundling; that is, no bundling strategy that is more informative is available to the speaker once a NAQ has been asked, making any further inquisitive strategy irrelevant. This explains NAQs' necessarily discourse-final status.

Note that, on this account as well, PQs are correctly not predicted to give rise to cornering. Since their denotation includes further, unmentioned propositions beyond the mentioned one, the use of this strategy does not induce a situation in which the entire logical space is organized around p . Because of this, PQs do not presuppose that p is already prominent in discourse, avoiding part 1 of cornering; and they can be followed by more informative bundling strategies, such as NAQs indeed, avoiding part 2.

The emerging picture is one in which the cornering effect can be explained via two alternative accounts: one based on exhaustivity/exclusivity, as per Biezma (2009); and one based on a combination of exhaustivity/exclusivity and bundling, as per Biezma and Rawlins (2014, 2018). Since they aim at explaining the same data, however, these proposals cannot be teased apart by merely looking at the behavior of NAQs in comparison to PQs. In the remainder of the paper, we thus aim to assess them by looking at Complement Alternative Questions, a type of question that, as we turn to explain shortly, presents itself as a suitable case study to compare the suitability of these two accounts. Before proceeding any further, however, we want to introduce a third possibility: Both Part 1 and Part 2 of cornering might be related to independent semantic/pragmatic principles, which apply besides the domain of NAQs, and just happen to coalesce in this particular construction. We now turn to discuss this hypothesis in greater detail.

2.3. A third hypothesis: Cornering as an effect of independent principles

Both accounts suggest that both Part 1 and Part 2 of cornering are linked to the same underlying phenomenon; that is, in both views, the two restrictions on the distribution of NAQs are seen as grounded in the properties that distinguish this type of inquisitive strategy from other ones. We suggest that, at least in principle, an alternative hypothesis ought to be entertained: each part of cornering could be the result of independent pragmatic principles, and thus explained independently from the other. In particular, we suggest that Part 1 could be grounded in the interaction between focus and information structure. Specifically, we observe that infelicity in

discourse-initial position is not found only with NAQs, but, more generally, with questions with focus on the polarity. The contrast below shows this for PQs with the focus on the auxiliary, as opposed to on the property (? , Lohnstein 2012).²

- (6) **Speaker A:** Jane had a baby!
 a. **Speaker B:** Is it a BOY_F? Focus on the property
 b. **Speaker B:** #IS_F it a boy? Focus on the polarity

Crucially, NAQs precisely present two opposite polar values as disjuncts. As such, following the generalization that all alternative questions mandatorily place main focal stress on the disjuncts (Bartels 1999, Truckenbrodt 2013), they necessarily have focus on the polarity, similar to (6b) above.

- (7) **Speaker A:** Jane had a baby!
Speaker B: Is it a boy (yes_F) or not_F? Focus on the polarity

As such, concerning Part 1 of cornering, the additional hypothesis that should be considered besides those outlined above is the following: to the extent that focus on the polarity blocks the use of an interrogative clause at the beginning of a conversation, this factor could stand behind NAQs' infelicitous in discourse-initial position.

Similarly, Part 2 of cornering—that is, the necessarily discourse-final status of NAQs—could also be explained via an independent principle. Let us consider the crucial piece of data again.

- (8) **Cornering, Part 2**
Scenario: You are in charge of coordinating the cooks for the colloquium dinner. John is one of the cooks. Dinner is tomorrow and you need to know what is happening with the pasta.
You: Are you making pasta?
John: (Silence and dubitative faces)
You: ✓ Are you making pasta or not?
John: (Silence and dubitative faces)
You: # Are you making pasta?

Our hypothesis is that the infelicitous status of the final PQ might be driven not by the preceding NAQ, but by the fact that a PQ had already been asked with no success beforehand. Specifically, following a standard view of discourse moves as strategic attempts to solve a salient Question

²Focus accent on a tense verb may express, among other things, focus-marking on the polarity as in (i), verum focus as in (ii) (Höhle 1992) or so-called 'dictum' focus as in (iii) (Creswell 2000). Since (6b) with focal stress on the tense verb is infelicitous in the given context, none of these three uses is licensed discourse-initially. In this paper, the polarity focus use will be most relevant.

- (i) John arrived. Bertha DIDn't.
 (ii) A: Rumor has it that Alan finished his dissertation.
 B: HE Finished his dissertation.
 (iii) A: Are we going to the party?
 B: Right! ARE we going?

Under Discussion (Roberts 2012 among others), we suggest that speakers should not resort to strategies that already proved unsuccessful to solving the QUD in the previous turns. Doing so would result in pragmatically irrational behavior, since it would amount to adopting a strategy that, in light of what happened in the previous stages of the conversation, is very likely to fail. We summarize this idea in the **Repeat* principle, a conversational constraint that applies to discourse moves across the board. On this view, Part 2 of cornering would be orthogonal to the properties of NAQs, resulting instead from this more general principle.

(9) ***Repeat:** Do not resort to a discourse move that already proved unsuccessful

2.4. Interim summary

In this section, we have entertained three different hypothesis concerning the source of the two parts of the Cornering Effect: two of them are drawn from the previous literature; the third one has been formulated as part of the current investigation.

- **Hypothesis 1:** Both parts of cornering derive from logical exhaustivity/exclusivity (Biezma 2009);
- **Hypothesis 2:** Both parts of cornering derive from bundling around p plus logical exhaustivity/exclusivity (Biezma and Rawlins 2014, 2018);
- **Hypothesis 3:** Each part of cornering derives from an independent pragmatic principle (additional hypothesis)

3. CAQs: a testbed to test the hypothesis

We suggest that a viable case study to adjudicate these possibilities is represented by Complement Alternative Questions (CAQ), a type of alternative question that, similarly to NAQs, pronounces two logically opposite alternatives; but, contrary to NAQs, spells out the second alternative in full, as opposed to with "or not". (10) reports two examples.

- (10) a. Is it a boy or a girl?
 b. Is it heads or tails?

Crucially, each of the hypotheses outlined above makes different predictions concerning the behavior of CAQs with respect to the two components of the Cornering Effect.

If, as Hypothesis 1 suggests, cornering is linked to the fact that the disjuncts exhaust the epistemic space of in discourse, CAQs should also feature both parts of the effect, since they likewise pose logically opposite alternatives. On this view, we predict that CAQs should behave exactly like NAQs with respect to both restrictions outlined above.

If, as Hypothesis 2 suggests, cornering is driven by the strategy to bundle the alternatives around

p , then CAQs should feature neither part of the effects. Since they spell out the second disjunct with a full proposition, they do not presuppose that the speakers already accepted a bias for p in discourse; and they can be followed by more informative bundling strategies in the continuation of the conversation. On this view, we predict that CAQs should diverge from NAQs with respect to both restrictions.

Finally, concerning Hypothesis 3, we predict that CAQs and NAQs should behave differently from NAQs with respect to Part 1, and that neither CAQa nor NAQs should be necessarily discourse-final, as long as the question that follows them has not been used yet in the previous discourse. Let us unpack both predictions made by this account before proceeding any further. Concerning Part 1, this hypothesis suggests that the ban of NAQs in discourse-initial position is linked to that fact that they necessarily have focus on the polarity, a constraint that typically makes interrogative clauses infelicitous in the beginning of a conversation. But CAQs, contrary to NAQs, spell out two fully distinct propositions, as opposed to a proposition and its negated counterpart. As such, following the generalizations that all alternative questions necessarily have focus on the disjuncts, they have focus on such two propositions, and not on polarity, as illustrated below. If focus on the polarity is what determines Part 1 of cornering, it follows that NAQs should not be felicitous discourse-initial, while CAQs should be immune to this restriction.

- | | | | |
|------|----|---|-----------------------|
| (11) | a. | Is it a boy _F or a girl _F ? | Focus on the property |
| | b. | Is it a boy (yes _F) or not _F ? | Focus on the polarity |

Concerning Part 2, Hypothesis 3 suggests that the infelicity of PQs as a follow up to a NAQs is not due to the preceding NAQ per se; rather, it stems from the infelicity of repeating the PQ again, after it had been used in the beginning of the exchange. On this view, we expect that, *independently* of what we see for Part 1, both NAQs and CAQs should fail to license a follow-up question that was previously unsuccessful; and they should both be able to be followed by follow-up questions that hadn't been used yet.

We now turn to test these hypotheses in two experiments. Experiment 1 compares these three hypotheses with respect to Part 1 of cornering; Experiment 2 is concerned with comparing these possibilities with respect to Part 2.

4. Experiment 1: CAQs and NAQs in discourse-initial position

In this study, we compared the distribution of NAQs, CAQs and PQs in discourse-initial position. Our goal is to assess the predictions of our three hypothesis concerning the source of Part 1 of the Cornering Effect, that is, the infelicitous status of NAQs at the beginning of a conversation. As can be recalled, the three possibilities outlined above make the following prediction with respect to this restriction: Hypothesis 1 predicts that both NAQs and CAQs, by virtue of exhausting the possibility space, should be infelicitous discourse-initially; Hypothesis 2 and 3 predict that only NAQs should be infelicitous in this context, while CAQs should sound natural.

4.1. Methods

4.1.1. Design

Two factors were crossed in a 2x3 design. Each trial consisted of a dialogue, at the end of which one participant would ask a question. The first factor manipulated the moment of the dialogue in which the question is asked, with two levels: ask for the first time, in which the question is asked discourse-initially; and ask-again, in which the question is asked for the third time, after the first two attempts failed to elicit a response. The second factor manipulated the type of question and came in three levels: PQ, NAQ, and CAQ.

(12) a. **Ask first-time**

Context: Mary runs into Greg on the street. It's been one year since they last saw each other, so they want to catch up:

Greg: Hey, what's new?

Mary: I just got a puppy!

Greg:

Oh, is it a male? PQ

Oh, is it a male or not? NAQ

Oh, is it a male or a female? CAQ

b. **Ask-again**

Context: Mark checks in at a hotel. After the receptionist hands him the keys, the following exchange ensues:

Receptionist: Sir, would you like to have breakfast directly served in your room?

Mark: Is there a charge for it?

Receptionist: It's a great service. Our customers love it.

Mark: Ok, but is there a charge for it?

Receptionist: You can also order food from the special menu.

Mark:

Is there a charge for it? PQ

Is there a charge for it or not? NAQ

Is there a charge for it or is it free? CAQ

4.1.2. Procedure and Statistical analysis

Each subject saw 24 experimental items, 12 for the ask-first-time context and 12 for the ask-again context, plus 24 fillers. The conditions were crossed in a Latin Square Design. 48 participants were recruited on Mechanical Turk and paid \$1.50 for participation. 2 participants were excluded as they failed to complete the task. At the end of each trial, participants were asked to answer the following question with a value between 1 and 7: "How natural does the question sound in light of the goal of the speaker? "1" indicated a completely unnatural

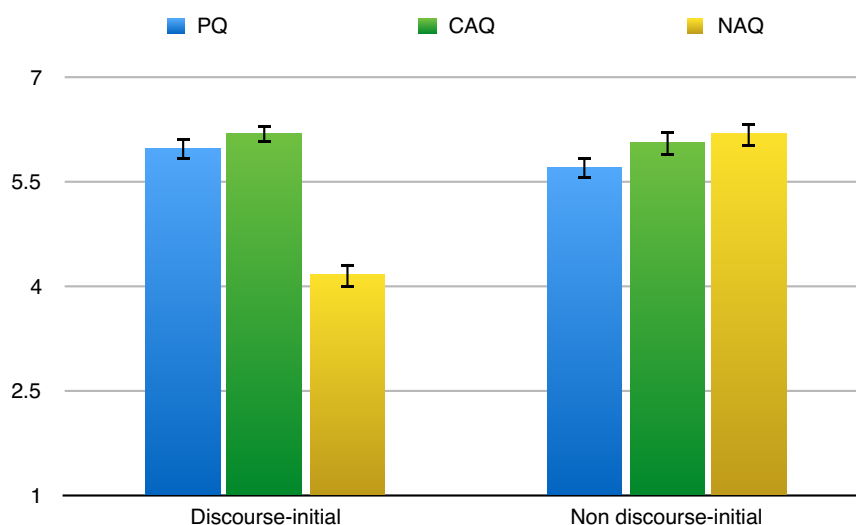


Figure 1: Average naturalness ratings for Experiment 2.

question; “7” indicated a perfectly natural question. All items were presented in written form on a screen. As in the first experiment, we ran separate mixed-effects models on the ratings of questions asked for the first time and asked again, with Question Type as the fixed effect and random intercepts for Subjects and Items. Again, the models were ran with the *lmerTest* package. Given the theoretical motivation of the study, we are especially interested in the comparison between NAQ and CAQ for each moment of the dialogue in which the question was asked. In light of this, we opted to establish NAQs as the reference level.

4.2. Results

The results are plotted in Figure 1 below.

As predicted, the control condition turned out to be highly infelicitous across the board. We therefore removed it from the analysis. Remarkably, CAQs and NAQs patterned differently across these two contexts. When the question was asked for the first time, CAQs were rated higher than NAQs ($\beta=2.01$, $SE=0.28$, $p<.0001$); when the question was asked again, instead, no difference emerged between NAQs and CAQs ($\beta=-.18$, $SE=0.14$, $p=.2$). Concerning the contrast between PQs and NAQs, we observe that PQs were significantly better than NAQs when the question was asked for the first time ($\beta=1.78$, $SE=0.32$, $p<.0001$); by contrast, NAQs were better than PQs when the question was being asked again ($\beta=.48$, $SE=0.17$, $p<.01$).

4.3. Discussion

In Experiment 1, we compared the distribution PQs, NAQs and CAQs discourse-initially. Replicating Biezma’s observations, NAQs appear to be felicitous only when used to ask a question again, while they are infelicitous discourse-initially. By contrast, CAQs show remarkable

flexibility across discourse-initial and non-discourse-initial uses, featuring equal naturalness in both contexts. Crucially, these findings do not support the predictions of Hypothesis 1—that is, that CAQs, by virtue of posing logically opposite alternatives, should also induce cornering. However, the questions remain open as to whether the observed restrictions on NAQs are tied to their distinctive bundling effects, as per Hypothesis 2; or by the combined effect of information structure in interrogative clauses and the *Repeat pragmatic principle, as per Hypothesis 3. To tease apart these two possibilities, we now proceed to compare NAQs and CAQs in discourse-final contexts.

5. Experiment 2

Hypothesis 2 predicted that NAQs, by bundling all discourse options around *p* or the negation thereof, should feature both parts of cornering, and thus have necessarily discourse-final status; CAQs, by adopting a completely different bundling strategy, should feature neither part of cornering, and thus be able to license follow up moves. By contrast, Hypothesis 3 predicted that the seemingly necessary discourse-final status of NAQs is an epiphenomenon of a pragmatic constraint penalizing repeated uses of a discourse strategy that didn't work. As such, NAQs and CAQs should pattern together with respect to Part 2 of cornering: both should be able to license follow up questions when the subsequent move has not been used before; but neither should be able to license follow up questions when the subsequent move has already been used in previous discourse. Experiment 2 aims to cast light on these two alternative possibilities.

5.1. Methods

5.1.1. Design

Two factors were crossed in a 2x2 design. Each trial consisted of a dialogue in which one of the speakers would ask three questions, the first of which was always Polar Question. Factor 1 manipulated the type of second question, with NAQ and CAQ as levels; Factor 2 manipulated the type of the third question, with two levels: a question identical to the first PQ (i.e., “match”, abbreviated “M”); and a question different from the first PQ (i.e., “non-match”, abbreviated “NM”). Specifically, we ran two different sub-experiments, which were identical, except for the way in which the non-matching question was constructed. In Expt2A the non-matching question was a PQ asked with emphatic tone (i.e., all caps); in Expt 2B the non-matching question was a Wh-Question. The item below illustrates the whole paradigm across the two sub-experiments. Moreover, in each sub-experiment we had a control sequence with a Wh-Question as the first question, a PQ as the second, and a NAQ as the third question. This sequence was predicted to be felicitous (see Biezma 2009).

(13) Expt2A

Herb and Kelly are about to play chess. There are only two possible colors: black or white. Herb: “I’m so excited!”

Kelly: “Do you want black?”

Herb: “Well, I can’t wait to play”

Q1: PQ

- Kelly: “Ok, but do you want black {or not? / or white?} **Q2: {NAQ/CAQ}**
Henry: “I want to win!”
Kelly: “{Do you want black?/DO YOU WANT BLACK?}” **Q3: {M/NM}**
- (14) **Expt2A**
Herb and Kelly are about to play chess. There are only two possible colors: black or white. Herb: “I’m so excited!”
Kelly: “Do you want black?” **Q1: PQ**
Herb: “Well, il can’t wait to play”
Kelly: “Ok, but do you want black {or not? / or white?} **Q2: {NAQ/CAQ}**
Henry: “I want to win!”
Kelly: “{Do you want black?/What color do you want?}” **Q3: {M/NM}**
- (15) **Control: same across Expt 2A and 2B**
Herb and Kelly are about to play chess. There are only two possible colors: black or white. Herb: “I’m so excited!”
Kelly: “What color do you want?” **Q1: WhQ**
Herb: “Well, il can’t wait to play”
Kelly: “Ok, but do you want black?” **Q2: {PQ}**
Henry: “I want to win!”
Kelly: “Do you want black or not?” **Q3: {NAQ}**

5.1.2. Procedure and Statistical analysis

Each subject saw 12 experimental items, 3 for each condition, plus 10 control items. The conditions were crossed in a Latin Square Design. 48 native speakers of English were recruited in each sub-experiment via Mechanical Turk and paid \$1.50 for participation. At the end of each trial, participants were asked to answer the following question with a value between 1 and 7: ”How natural does the last question of the conversation sound in light of the goal of the speaker? “1” indicated a completely unnatural question; “7” indicated a perfectly natural question. All items were presented in written form on a screen. As in the first experiment, we ran separate mixed-effects models on the ratings of questions, with Q2 type and Match as the main effects, and random slopes for Subjects and Items. Again, the models were ran with the *lmer*test package. To better understand the effects, we then followed up with posthoc comparisons, performing t-tests with a Bonferroni correction for multiple comparisons.

5.2. Results

The results for Expt2A and Expt2B are plotted in Figure 2 and 3 below.

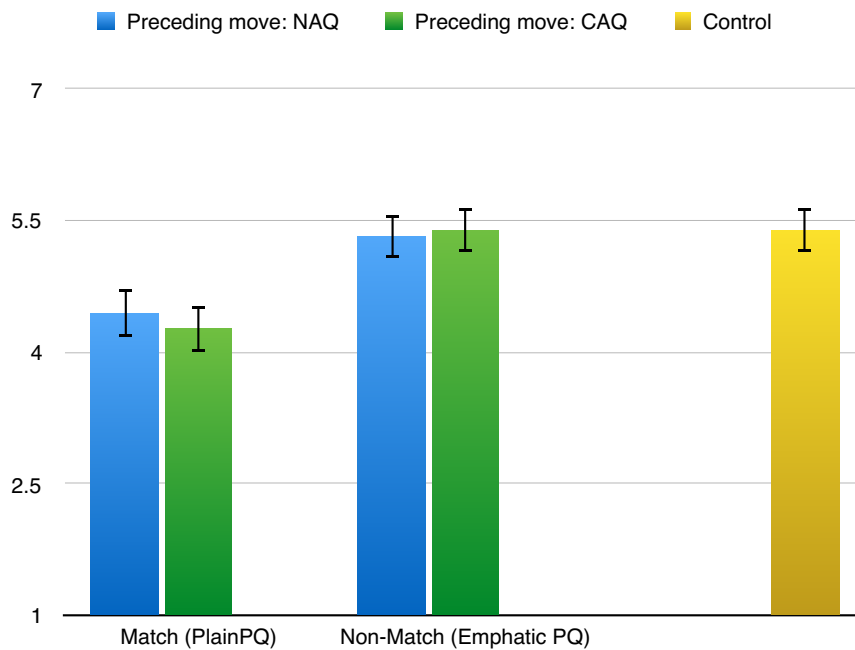


Figure 2: Average naturalness ratings for Experiment 2A.

As predicted, the control condition turned out to be felicitous in both studies, and was therefore removed from the analysis. Concerning the test conditions, we entered NAQs and Match as reference levels. The models showed a main effect of Match in both experiments (Expt 2A, Match: $\beta=.90$, $SE= 0.23$, $p <.001$; Expt 2B, Match: $\beta=1.20$, $SE= 0.13$, $p <.001$); no effect of Q2 Type in either experiment (Expt 2A, Q2 Type: $\beta=-.15$, $SE= 0.09$, $p =.09$; Expt 2B, Q2 Type: $\beta=-.12$, $SE= 0.16$, $p =.33$), and no interaction effect between Q2 Type and Match (Expt 2A, Q2 Type*Match: $\beta=.22$, $SE= 0.13$, $p=.09$; Expt 2B, Q2 Type*Match: $\beta=-.30$, $SE= 0.12$, $p =.12$). In particular, within each type of Q2, the last question was rated as more felicitous when it did not match the PQ asked in the beginning of the conversation than when it did (Expt 2A, Q2-NAQ: $p <.001$; Expt 2A, Q2-CAQ: $p <.001$; Expt 2B, Q2-NAQ: $p <.01$; Expt 2B, Q2-CAQ: $p <.001$). In addition, in both experiments, no difference between CAQ and NAQ was found within Match. (Expt 2A, Match: $p >.5$; Expt 2A, Non-Match: $p >.5$; Expt 2B, Match: $p >.5$; Expt 2B, Non-Match: $p >.5$).

5.3. Discussion

These findings suggest that what determines the status of the final question in a conversation is not whether the preceding move is a NAQ or a CAQ, but rather whether the same question had been asked before. We take this results as evidence supporting Hypothesis 3: the observed necessarily discourse-final status of NAQs is not driven by their features per se, but rather by the fact that follow-up PQs are not felicitous when they had already been used and did not accomplish the intended goal. If the follow-up question differs from the first question, either in terms of syntactic structure or intonation, neither NAQs nor CAQs need to be discourse final. The emerging picture is one in which also Part 2 of Cornering can be explained by appealing to general pragmatic principles that apply beyond the domain of alternative questions.

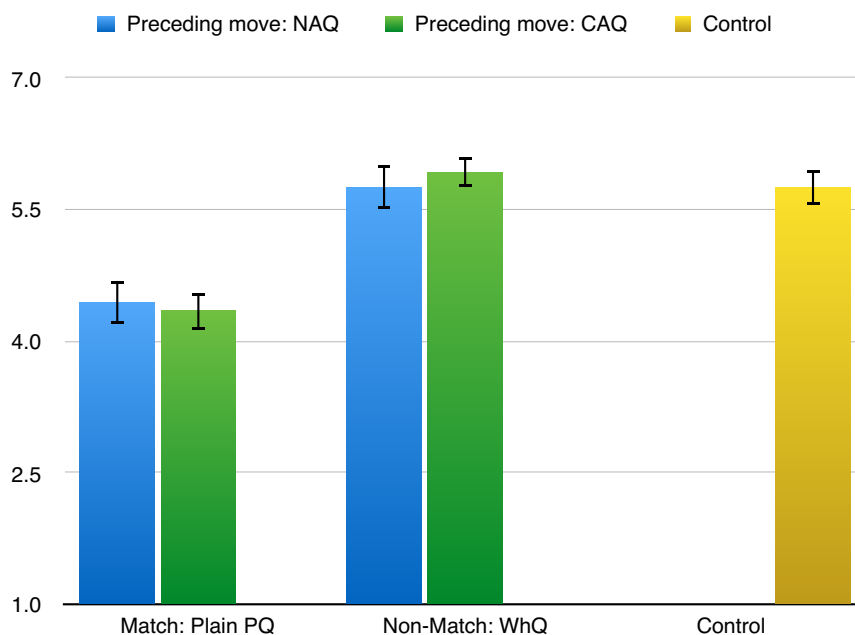


Figure 3: Average naturalness ratings for Experiment 2B.

6. General Discussion

We now turn to discuss in greater detail how these principles can be modeled for both components of the effect.

6.1. Explaining Part 1: Information Structure and Focus

We showed that NAQs' ban in discourse-initial position is not featured by CAQs, ruling out the possibility that this restriction be featured by the logical exhaustivity/exclusivity of the alternatives. Furthermore, based on the results of Experiment 2, we suggested that this restriction is likely not driven by bundling either; since bundling does not make the right predictions concerning Part 2 of cornering, requiring an independent explanation for it, it might be more appropriate to also explain Part 1 independently. In this regard, we observed earlier that NAQs are not the only type of question that is infelicitous discourse-initially; more generally, this restriction applies to all questions that have focus on the polarity (in (16)), whereas it doesn't apply to questions that have focus on the property, including CAQs (in (17)).

- (16) **Speaker A:** Jane had a baby!
 a. **Speaker B:** #IS_F it a boy? Focus on the polarity
 b. **Speaker B:** Is it a boy (yes_F) or not_F? Focus on the polarity
- (17) **Speaker A:** Jane had a baby!
 a. **Speaker B:** Is it a BOY_F? Focus on the property
 b. **Speaker B:** Is it a boy_F or a girl_F? Focus on the property

As for the reason that underlies this restriction, we follow Schwarzschild (1999) in proposing that to license narrow focus on BOY in (17) above, the proposition that there exists a property such that the baby has this property has to be given. To license narrow focus on the polarity, as in (16), the following proposition needs to be given: there is a polarity function (ranging over $\{\lambda p.p, \lambda p.\neg p\}$) that, applied to the proposition “that the baby is a boy”, yields a true proposition. The two propositions are reported below:

- (18) a. $\exists X_{\langle e, st \rangle}[\text{the baby is } X \text{ at } w]$
 b. $\lambda w. \exists X_{\langle st, st \rangle}[X(\lambda w'.\text{the baby is a boy at } w')(w)]$

We suggest that these two propositions differ with respect to the ease with which listeners can accommodate them. In particular, accommodating the existence of a property is a relatively routine task, which does not undermine the felicity of the question that presupposes this proposition; by contrast, accommodating the presence of a polarity function is a much harder task, which goes through smoothly only if the issue $\{p, \neg p\}$ has already been risen. While providing a detailed account of reason explaining this difference goes beyond the scope of the current paper, we observe that this constraint on polarity focus in discourse-initial position bears intuitive resemblance to a general Economy Principle that penalizes the use of meta-conversational moves out of the blue, when the issue has not been raised explicitly in the previous discourse (Romero and Han 2004).

- (19) *Principle of Economy*: Do not use a meta-conversational move unless necessary (to resolve epistemic conflict or to ensure Quality).

For example, the authors suggest that using an epistemic adverb like *really* to express commitment to adding a proposition to the Common Ground expresses a contribution that is already encoded in any assertion, hence potentially trivial; this contribution is felicitous only as long as the previous discourse explicitly called for the use of these expressions, for example raising the issue around *p*.

- (20) a. #I *really* am going to eat outside tonight. Out of the blue
 b. A: I don't believe you are going out tonight!
 B: Yes! I *really* am going to eat outside tonight! Issue already risen

While Polarity functions do not qualify as meta-conversational moves in the sense of *really*, they similarly run the risk of providing a redundant contribution. Since propositions inherently have a polarity value in their logical form, and since the alternative set of this value is trivially closed, focusing on such a value amounts to providing a redundant contribution, unless the development of the previous discourse calls for emphasis on it—for example, if the issue around the polarity of the proposition has already been raised. The same does not hold for property focus. While it is arguably true that “boy” only has another element in its alternative set (i.e., “girl”), the speaker could have chosen among many other types of properties to fill that slot; as such, focusing on the property is felicitous also in situations in which the issue had not been raised in previous discourse.

6.2. Explaining Part 2: *Repeat

Concerning NAQs' observed inability to license follow up questions, we suggested that it can be seen as an artifact of a general pragmatic principle that penalizes the felicity of inquisitive strategies that were previously unsuccessful in discourse; this naturally applies regardless of whether such strategies were preceded by a NAQ or a CAQ. Supporting this claim is the observation that multiple strategies are available for the speaker to follow up to a NAQ/CAQ with another question, such as placing special emphasis on the question, or switching to a different question form. We labeled this principle *Repeat.

- (21) *Repeat: When pursuing an issue, avoid re-using a strategy that previously didn't help solve the issue.

The upshot is that Part 2 of cornering is linked to the optimal strategies that the speaker should pursue to solve the QUD. As such, the infelicity of follow up PQs observed in the previous literature emerges as a side effect of NAQs' licensing conditions: since NAQs always need to come after a move that raised the issue—which in many cases happens to be a PQ, as in Experiment 1—a follow up move of the identical type—e.g., another PQ—will automatically cause a violation of *Repeat, leading to infelicity. Once again, we believe that this principle applies beyond the domain of alternative questions. While more research would be needed to explore its implications in other realms, we observe that it also appears to be at work with imperatives as well. In the following context, for example, it seems natural for the speaker to resort to a different strategy to express a command, once the previous attempts failed. To keep using the same command, by contrast, appears to be an example of irrational linguistic behavior.

- (22) A: Stop playing!
 B: [Keeps playing]
 A: Hey, can you stop playing?
 B: [Keeps playing]
- a. A: # Stop playing!
 b. A': I told you to stop playing

7. Conclusion

We have provided evidence supporting the following hypothesis: both effects of cornering are not linked to the distinctive properties of negative alternative questions, but rather stem from general pragmatic principles that govern communication across constructions. As we leave a more detailed modeling of how these principles interact with the compositional properties of different question types, we hope that these results will contribute to fueling further inquiry aimed at understanding how linguistic constructions with seemingly similar logical properties differentially shape the discourse space in interaction.

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Scalar diversity and negative strengthening¹

Anton BENZ — *Leibniz–Centre General Linguistics*

Carla BOMBI — *Potsdam University*

Nicole GOTZNER — *Leibniz–Centre General Linguistics*

Abstract. In recent years, experimental research has demonstrated great variability in the rates of scalar inferences across different triggering expressions (Doran et al. 2009, 2012, van Tiel et al. 2016). These studies have been taken as evidence against the so-called uniformity assumption, which posits that scalar implicature is triggered by a single mechanism and that the behaviour of one scale should generalize to the whole family of scales. In the following, we present an experimental study that tests negative strengthening for a variety of strong scalar terms, following up on van Tiel et al. (2016). For example, we tested whether the statement *John is not brilliant* is strengthened to mean that John is not intelligent (see especially Horn 1989). We show that endorsement rates of the scalar implicature (e.g., *John is intelligent but not brilliant*) are anti-correlated with endorsements of negative strengthening. Further, we demonstrate that a modified version of the uniformity hypothesis taking into account negative strengthening is consistent with van Tiel et al.’s data. Therefore, variation across scales may be more systematic than suggested by the van Tiel et al. study.

Keywords: Scalar diversity, scalar implicature, manner implicature, negative strengthening, inferencing task.

1. Introduction

For more than a decade, scalar implicatures haven been a core topic of experimental pragmatics. However, theoretical and experimental research has concentrated on a few scales only, most notably the scales $\langle all, some \rangle$ and $\langle and, or \rangle$. In van Tiel et al. (2016) the authors provide an overview of 29 experimental studies from 2001 to 2014. Of them, only two studies consider scales other than $\langle all, some \rangle$ and $\langle and, or \rangle$. They speculate that the underlying reason for this bias is the belief that these scales are somehow representative for scales in general, such that findings on them can be generalised to all scales. This is the so-called uniformity hypothesis. This hypothesis has received some interest in recent years. The experimental studies in Doran et al. (2009, 2012) and van Tiel et al. (2016) addressed it in a special form: they tested the hypothesis that all scales show the same capacity for generating scalar implicature. This means, in this special form the hypothesis states that there is a constant percentage s such that for all scales i about $s\%$ of the subjects will draw an implicature for the weak scalar alternative. The most thorough and systematic study on this hypothesis was presented by van Tiel et al. (2016). They tested 43 scales, among them 32 scales with adjectives, 6 with main verbs, 2 with auxiliary verbs, 2 with quantifiers, and 1 with adverbs. In their first experiment, they presented 25 subjects with questions of the form: *John says: She is intelligent. Would you conclude from*

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John says:

She is content.

- (2) Would you conclude from this that, according to John, she is not happy?

Yes No

If a subject interprets *content* and *not happy* semantically, then s/he has to answer with *no* since the statement *she is content* is semantically consistent with her being not happy. If the subject narrows the meaning of *content* based on scalar implicature, the subject should answer *yes*. This is how the experiment intended to measure the rate of scalar implicature. However, if participants negatively strengthen the conclusion sentence *She is not happy* to *not content*, this interpretation is incompatible with the semantics and the scalar implicature of *content*. Hence, negative strengthening leads to a *no*-answer, whatever the subject's interpretation of *content* is. The different possibilities of reading *content* and *not happy* and the expected *yes* and *no*-answers are shown in (3).

	<i>content</i>	<i>not happy</i>	Yes	No
	semantic	semantic		✓
(3)	semantic	NegS		✓
	SI	semantic	✓	
	SI	NegS		✓

Hence, a *no*-answer may be based on a semantic interpretation of negative strengthening. For this reason, the lack of scalar implicature may be masked by the effect of negative strengthening. Let us now consider what this means for the *uniformity hypothesis*. As we may recall, van Tiel et al. addressed the uniformity hypothesis in a special form, namely that for all scales i the proportion of observed *yes*-answers $s_o(i)$ is equal to a fixed probability s . In this form, the uniformity hypothesis is clearly refuted by the experimental studies of Doran et al. (2009, 2012) and van Tiel et al. (2016). However, the formula $s_o(i) = s$ assumes that negative strengthening has no influence on the observed *yes*-answers. Let us assume that we can observe negative strengthening with probability $n_o(i)$ for scale i . Now consider (3). The simplest hypothesis about the relation between negative strengthening and scalar implicature is that negative strengthening of *not happy* occurs independently of drawing the scalar implicature for *content*. A *yes*-answer is given if the scalar implicature is drawn (probability s according to the uniformity hypothesis) and no negative strengthening occurs (probability $1 - n_o$). Hence, the observed proportion of *yes*-answers s_o should equal the product $s \times (1 - n_o)$. This leads to the modified uniformity hypothesis that the observed scalar implicature for scale i equals the product of a constant s and the observed probability of no negative strengthening, as formula:

$$(4) \quad s_o(i) = s \times (1 - n_o(i)).$$

A peculiarity of the uniformity hypothesis is that, to our knowledge, it is a hypothesis that

no-one has ever defended. Even though its prior plausibility is low, it seems interesting to defend it for purely methodological reasons. Ultimately, we hope to gain insight into which sub-classes of scales show a uniform behaviour with respect to scalar implicature and negative strengthening.

In order to evaluate the modified uniformity hypothesis, we need an estimate of the proportion of negative strengthening $n_o(i)$. We need to know how likely it is that subjects understand, for example, *not happy* as implying *not content*. We, therefore, ran an experiment with exactly the same items and fillers as (van Tiel et al. 2016: Exp. 1), but modified the questions. For example, for the $\langle \textit{happy}, \textit{content} \rangle$ scale, we asked subjects *John says: He is not happy. Would you conclude from this that, according to John, he is not content?* If the answer is *yes*, this indicates that subjects negatively strengthened *not happy* to *not content*. We will see that the observed rates of *yes* answers shows similar variability between scales as the rates of *yes* answers in the original scalar implicature experiment. We show that $s_o(i)$ and $n_o(i)$ are anti-correlated, and that the anti-correlation is so strong that the modified uniformity hypothesis cannot be rejected on the basis of van Tiel et al.'s results. However, we also show that we can find sub-classes of scales that behave very differently with respect to the uniformity hypothesis, so that the paper ends with an open question: what are the parameters that determine sub-classes of scales that behave uniformly with respect to scalar implicature and negative strengthening?

3. The Experiment

3.1. Methods

3.1.1. Participants

40 participants with US IP addresses were recruited on Amazon's Mechanical Turk platform. They were further screened for their native language. In total, 40 native English speakers (mean age: 37.02, 20 female, 20 male) took part in the study.

3.2. Materials

Our task and all materials were based on the study by van Tiel et al. (2016). Participants were presented with a scenario involving two characters, Mary and John, who make a series of statements. Their task was to decide whether a strengthened interpretation follows from a given statement. For example, participants saw the statement *John is not brilliant* and were asked whether they conclude that John is not intelligent. The latter task is a measure of negative strengthening of the stronger scale-mate. Figure 3.2 presents a sample display participants saw.

If participants respond with *yes*, they have negatively strengthened *not brilliant* to *not intelligent*.

In total, each participant saw statements with 43 scales, all of which are provided in Table 3 in the Appendix, in addition to 6 filler sentences. Two versions of the survey with different orders

Mary says:

He is not brilliant.

Would you conclude from this that, according to Mary, he is not intelligent?

Yes No

Figure 1: Sample item of the negative strengthening task

were created and administered to 20 participants each.

3.3. Results

In our analysis, we used the average endorsement rates of scalar implicature provided in van Tiel et al. (2016) and the negative strengthening rates obtained from our own experiment.

On average, for all scales, 42.3% of the subjects answered *yes* in our rating of negative strengthening. Table 3 in the Appendix presents the negative strengthening ratings for all items. Selected results are shown in (5), plotting the ratings in the scalar implicature (SI) task (van Tiel et al. 2016) and the negative strengthening (NegS) ratings next to each other.

- (5) Results for selected scales: % of scalar implicature (SI) from van Tiel et al. (2016), % of negative strengthening (NegS) from our study

Scale	SI	NegS	Scale	SI	NegS
<i>⟨free, cheap⟩</i> :	100%	28%	<i>⟨impossible, difficult⟩</i> :	79%	25%
<i>⟨all, some⟩</i> :	96%	42%	<i>⟨none, few⟩</i> :	75%	31%
<i>⟨love, like⟩</i> :	50%	43%	<i>⟨unsolvable, hard⟩</i> :	71%	43%
<i>⟨finish, start⟩</i> :	21%	14%	<i>⟨unavailable, scarce⟩</i> :	62%	58%
<i>⟨exhausted, tired⟩</i> :	4%	69%	<i>⟨unforgettable, memorable⟩</i> :	50%	56%
<i>⟨happy, content⟩</i> :	4%	92%			

Overall, we observe a correlation between $s_o(i)$, the observed % of SIs for scale i , and $(1 - n_o(i))$, with $n_o(i)$ the % of NegS for i (Spearman's rank correlation: 0.463, $p < 0.002$).² That is, participants are less likely to endorse a scalar implicature if they apply negative strengthening to the stronger scale-mate. Hence, the lack of scalar implicature can, in part, be explained by the presence of negative strengthening.

We also ran a linear regression model for the negative strengthening ratings involving boundedness, semantic distance, grammatical category, frequency, cloze probability, and latent semantic values (using the values obtained in the van Tiel et al. study) as predictors of variability across

²We based the correlational analysis on the complement rate of the negative strengthening task ($1 - n_o(i)$), which will be explained in detail in Section 4.

scales. The results of the model are displayed in Table 1. The analysis showed that participants were more likely to apply negative strengthening if the weaker and stronger scale-mate had a strong association strength as indexed by the measure obtained in van Tiel et al.'s cloze task. Further, semantic distance (the perceived difference in strength between the statement involving the weaker and the one with the stronger term) had a negative effect on ratings. That is, the occurrence of negative strengthening was less likely the closer the semantic distance between the stronger and weaker term. In our experiment, the upper boundedness of scales did not have a significant effect on negative strengthening rates.

Table 1: Predictors of negative strengthening ratings

	Estimate	SD	t-value	p-value
(Intercept)	1.01843	0.23029	4.422	0.000
Cloze probability	0.45191	0.11194	4.037	0.00028
Category	0.08695	0.104	0.836	0.4088
Frequency	0.04462	0.03086	1.446	0.15706
LSA	-0.11782	0.17463	-0.675	0.50428
Distance	-0.13364	0.04042	-3.307	0.00219
Boundedness	-0.09099	0.05843	-1.557	0.12841

3.4. Discussion

The current study showed that negated strong scalar terms give rise to varying degrees of inferences negating their weaker scale-mates. Such negative strengthening is traditionally thought of as a manner implicature, arising from a different principle than scalar implicatures (Horn 1989, Levinson 2000). In our analysis, we showed that participants' endorsement of scalar implicatures was anti-correlated with the degree of negative strengthening of the stronger scale-mate.

Van Tiel et al. (2016) discussed negative strengthening as a possible confound in their results (p. 144) but dismissed this possibility with the argument that their data show that scales containing a negative element generate high rates of implicature, although these scales are known for showing a robust tendency towards negative strengthening (Horn 1989, Krifka 2007). Table 5 on the right side shows the results for negative scales. Contrary to expectations, negative scales in our study were not particularly strong triggers of negative strengthening.

It should be noted that the numerical correlation we observed was not perfect. Hence, it is not the case that negative strengthening takes away all the variance observed in the scalar implicature task. Further, previous studies by Doran et al. (2009, 2012) demonstrated a similar amount of variation across scales as the van Tiel et al. study and their paradigm did not involve a negation as part of the instructions. In that study, participants were presented with a dialogue and a fact. Their task was to judge whether the answer was true or false given the fact. For example, Sam said *Gus ate most of the birthday cake* and the fact was that Gus had eaten the entire cake. In this verification task, the rates of scalar inferences were comparable to the ones by van Tiel et al. (2016) and there was considerable variation across adjectival scales and quantifiers.

It remains to be established whether the correlation between scalar implicature and negative strengthening we observed here is an artefact of the inferencing task, that is, because the negation of the stronger scale-mate was mentioned in the conclusion sentence. Rather than assuming that the interaction between scalar implicature and negative strengthening is merely a task effect, we might expect this interaction to be of broader importance. While the two kinds of implicature arise from different conversational principles, Levinson (2000) and Horn (1989) assume that the Q and R principle govern each other in conversation (see also Blutner 2004, Krifka 2007). Therefore, whether or not hearers derive a scalar implicature may also be influenced by the availability of other types of inferences.

4. The uniformity hypothesis: A modified version

The studies of Doran et al. (2009, 2012) and van Tiel et al. (2016) convincingly show that the uniformity hypothesis $s_0(i) = s$ for a constant s is false. However, the question arises whether the assumption of a uniform constant can be maintained if the effect of negative strengthening is factored in. Given the anti-correlation between $s_o(i)$ and $1 - n_o(i)$, the simplest reformulation of the uniformity hypothesis (UH) is to postulate a constant ratio between these values, i.e. that there is a constant s such that for all scales i $s_o(i)/(1 - n_o(i)) = s$, or, equivalently, that $s_o(i) = s - sn_o(i)$, see (4). The constant s can be fitted to the data. Using the data from van Tiel et al.'s scalar implicature task and our negative strengthening task, an optimal value of $s = 0.77$ was found.³ Figure 2 shows $s_o(i)$ over $n_o(i)$ for all scales i . A simple linear regression was calculated to predict $s_o(i)$ (*yes*-answers in van Tiel et al.'s SI task) based on $n_o(i)$ (*yes*-answers in our NegS task). A significant regression equation was found ($F(1,41) = 7.80$, $p < .01$), with an adjusted $R^2 = 0.14$. The proportion $s_o(i)$ of *yes* answers in the SI task is equal to $0.68 - 0.55 n_o(i)$. The regression line (blue) is also shown in Figure 2, together with its 95% confidence interval. The green line is the regression line predicted by the modified uniformity hypothesis with $s = 0.77$, i.e. $s_o(i) = 0.77 - 0.77 n_o(i)$. As can be seen from Table 2, the line predicted by the modified uniformity hypothesis lies within the 95% confidence interval of the calculated linear regression line. Hence, the predicted regression line does not significantly differ from the calculated one, and can, therefore, not be rejected. In this sense, the modified uniformity hypothesis is *consistent* with the results found by van Tiel et al.

Clearly, to defend a hypothesis by showing that it cannot be refuted by some statistics is not an argument to accept the hypothesis. However, the modified uniformity hypothesis is nevertheless interesting because it establishes a numeric relation between a scale's propensity to trigger two different types of implicature, in this case a quantity implicature (SI) and an I/M-implicature (NegS). In the following we will see that the modified uniformity hypothesis can be a useful tool for distinguishing different classes of scales that support or do not support it. As previously noted, the presence of an upper bound and semantic distance between scalar alternatives are significant predictors of *yes* answers in van Tiel et al.'s SI task. In Section 3.3, we have seen that semantic distance and cloze probability are significant predictors of negative strengthening. We

³We used the form of the modified uniformity hypothesis as stated in (4) and chose the s that minimizes $|((1 - n_o(i))s - s_o(i))_i|$. Choosing the mean of ratios $s_o(i)/(1 - n_o(i))$ leads to a slightly higher value for s but doesn't change the conclusions. The reason for not choosing ratios is that some of them are greater than 1. As s is supposed to represent the proportion of subjects answering *yes* in the van Tiel et al. task, values higher than 1 are empirically meaningless.

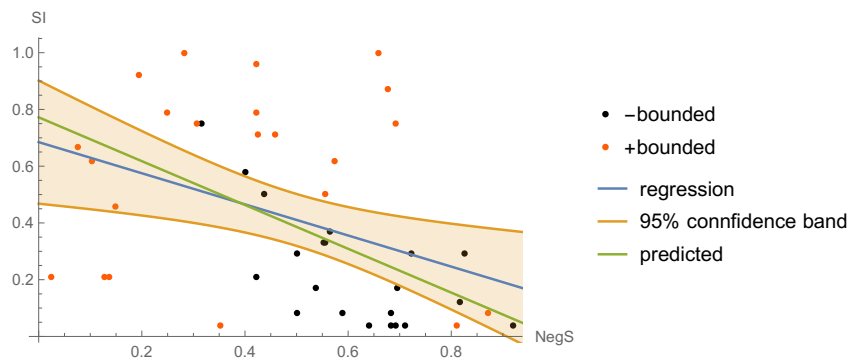
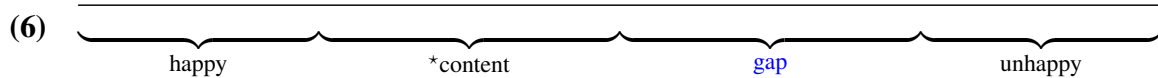


Figure 2: Fit of modified uniformity hypothesis, $s = 0.77$

now introduce a distinction of scale types that is primarily motivated by research on negative strengthening (Blutner 2004, Krifka 2007), and show that the new scale types behave very differently with respect to the modified uniformity hypothesis.

The distinction that we introduce is that between L-scales and M-scales. A prototypical L-scale would be the $\langle all, some \rangle$ scale. If we consider the underlying measurement scale that reaches from proportions of 0% to 100%, then the Horn scale $\langle all, some \rangle$ starts from the *lower* end of the measurement scale. This means that the weak scale mate *some* covers the whole measurement scale except for 0%, that is the lower end. The contrary *none* of *all* is also the contradictory of *some*. In contrast, M-scales are scales that start somewhere in the *middle* of the underlying measurement scale. Examples are the $\langle happy, content \rangle$ scale, and the $\langle hot, warm \rangle$ scale. In both cases, there is a gap between the weaker scale mate and the contrary of the stronger scale mate. In other words, the contradictory of the weaker scale mate is not the contrary of the stronger one. For $\langle happy, content \rangle$ this means that there is a gap between the meaning of *content* and the contrary of *happy*, namely *unhappy*, see (6) and (1). Likewise, for $\langle hot, warm \rangle$ there is a gap between the meaning of *warm* and the contrary of *hot*.



In Blutner (2004) and Krifka (2007), negative strengthening is explained as a blocking phenomenon. In their models, marked expressions narrow their meanings as they are blocked from referring to certain meanings m by the existence of less marked expressions that are better candidates for referring to m . This means that, for example, *not happy* is blocked from referring to states covered by *content*, as *content* is less marked. Likewise, *not happy* is blocked from referring to the extreme end of the unhappiness side because of the less marked expression *unhappy*. Hence, the meaning of *not happy* is narrowed down to the gap between *content* and *unhappy*. If this explanation for negative strengthening is correct, then L-scales should not give rise to negative strengthening as there is no gap which can be filled by the negation of the stronger scale mate. The observed rates of *yes*-answers in our NegS task would then have to be explained as random noise. This also means that we should expect M-scales to better conform to the modified uniformity hypothesis than L-scales. In the following, we test this prediction.

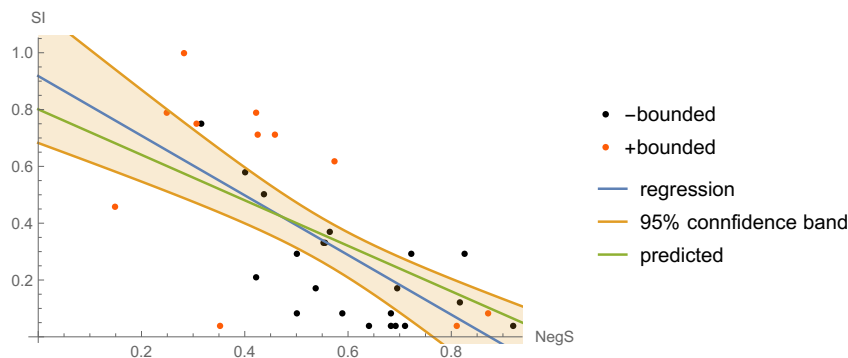


Figure 3: Fit of modified uniformity hypothesis for M-scales, $s = 0.80$

In Table 3 in the Appendix we provide an annotation of the different scale types. There are 32 M-scales among the 43 scales considered by van Tiel and colleagues. A simple linear regression was calculated to predict $s_o(i)$ (*yes*-answers in van Tiel et al.'s SI task) based on $n_o(i)$ (*yes*-answers in NegS task) for M-scales i . A significant regression equation was found ($F(1, 30) = 28.27$, $p < .0001$), with an adjusted $R^2 = 0.47$). The proportion $s_o(i)$ of *yes* answers in the SI task is equal to $0.92 - 1.05 n_o(i)$. The regression line (blue) is shown in Table 3, together with its 95% confidence interval. The green line is the regression line predicted by the modified uniformity hypothesis with $s = 0.80$, i.e. $s_o(i) = 0.80 - 0.80 n_o(i)$. As can be seen from Figure 3, the line predicted by the modified uniformity hypothesis lies within the 95% confidence band of the calculated linear regression line.

Further, the statistical parameters show that the correlation between $s_o(i)$ and $1 - n_o(i)$ is much stronger in the case of M-scales than for all scales taken together.

There are 11 L-scales among the 43 scales considered by van Tiel et al. A simple linear regression was calculated to predict $s_o(i)$ (*yes*-answers in van Tiel et al.'s SI task) based on $n_o(i)$ (*yes*-answers in NegS task) for M-scales i . A marginally significant regression equation was found ($F(1, 9) = 5.02$, $p = .052$), with an adjusted ($R^2 = 0.29$). The proportion $s_o(i)$ of *yes* answers in the SI task is equal to $0.40 + 0.67 n_o(i)$. The regression line (blue) is shown in Table 2, together with its 95% confidence interval. The green line is the regression line predicted by the modified uniformity hypothesis with $s = 0.73$, i.e. $s_o(i) = 0.73 - 0.73 n_o(i)$. As can be seen from Figure 2, the line predicted by the modified uniformity hypothesis does not lie within the 95% confidence interval of the calculated linear regression line; rather, it follows a completely different pattern.

As we can see, there is no significant positive correlation between $s_o(i)$ and $1 - n_o(i)$; to the contrary, there is a marginal negative correlation between them for L-scales. There is also a considerable visual difference between the calculated regression line and the predicted regression line. We conclude that the modified uniformity hypothesis does not explain the pattern L-scales adhere to.

As we mentioned before, the uniformity hypothesis is peculiar in that it has, to our knowledge, not been defended by anyone. It was merely put forward as a likely explanation for why

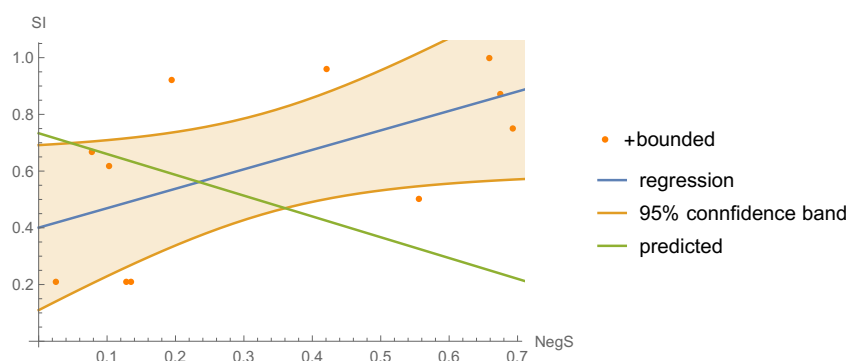


Table 2: Fit of modified uniformity hypothesis for L-scales, $s = 0.73$

previous experimental research concentrated on a few scales, most notably the *<all, some>*-scale. The distinction between L- and M-scales may provide another reason for concentrating on this scale. As it is an L-scale, it should be affected by negative strengthening to a lower extent.⁴ It may, therefore, be better suited to test scalar implicature.

Our analysis of L-scales and M-scales is intended as a demonstration of the usefulness of the modified uniformity hypothesis as a tool for establishing interesting distinctions among scale types. However, one should not over-estimate what we have achieved here. The same contrast between L-scales and M-scales that we find in Figures 2 and 3 exists between bounded and unbounded scales, as well as between non-adjectival and adjectival scales. This means that M-scales, unbounded scales, and adjectival scales conform better to the modified uniformity hypothesis than all scales taken together, and for L-scales, bounded scales, and non-adjectival scales, it has to be rejected. Even this result should be taken with caution. There is a considerable overlap between M-scales, unbounded scales and adjectival scales in the sample collected by van Tiel et al. such that it remains an open issue which of them causes scales to conform or not to conform to the modified uniformity hypothesis.

The issue about the predictors of uniformity carries over to the issue of predictors of *yes*-answers in van Tiel et al.'s paradigm. Van Tiel et al. found that boundedness and semantic distance are significant predictors of *yes*-answers. Due to the overlap between bounded, non-adjectival, and L-scales, however, the significant correlation between boundedness and *yes*-answers vanishes once the effect of being an M-scale or being an adjectival scale is taken into account.

In a similar vein, McNally (2017) argues that the methods used by van Tiel et al. were too crude to (i) detect certain implicatures and (ii) detect effects of the parameters explaining variation across scales tested. Essentially, the problem McNally discusses is that adjectives are polysemous, and in the absence of a context participants may construct a meaning on the fly and not think of the intended pair as scale-mates. This criticism also applies to the current study and it stresses the need to present test sentences within a conversational context. Our analysis showed that it is not entirely clear at this point which predictors of variability are crucial in explaining

⁴In fact, it has been argued that negation of the stronger scale-mate leads to scale reversal, i.e. that *not all* implicates *some but not all* (see e.g. Levinson 2000: p. 80ff, with references to previous literature).

diversity. Hence, our investigation motivates further research into the impact of scale structure on implicature derivation. Comparing how a large variety of scales behave within an enriched communicative context has to be left to future research. One experimental paradigm which might be useful for this endeavour is the action-based task by Gotzner and Benz (2018), and its interactive version (Benz et al. 2018), which has been implemented for the quantifier *some* and the determiner *or* (Benz and Gotzner 2017). The advantage of this paradigm is that utterances are embedded in a communicative situation and candidate readings are made relevant. The current study indicates that for future experiments on scalar diversity, a balanced set of items varying in scale structure is needed.

5. Conclusion

In the current study, we demonstrated an interaction between two kinds of implicature: scalar implicatures which are Q-based, and negative strengthening, which is I- or M-based. In particular, there was an anti-correlation between the endorsement rates of scalar implicatures and the degree of negative strengthening of the stronger scale-mate. We showed that a modified version of the uniformity hypothesis is consistent with the data presented by van Tiel et al.'s study. We also provided evidence that the correlation between scalar implicature and negative strengthening may be sensitive to general scale structure. This shows that a more fine-grained typology of scales can be motivated by numerical analysis. However, the most interesting outcome of our study is the questions that it raises. What are the true predictors of scalar implicature and negative strengthening for different types of scales? Can a classification based on structural properties of scales be established such that all members of a class have the same propensity for triggering different types of implicature? Which other types of conversational implicature are sensitive to scale structure, besides scalar implicature and negative strengthening? Can conversational context make scales behave uniformly? For example, do all scales reliably trigger scalar implicatures if the meaning differences are made contextually relevant? Is there an experimental paradigm which allows the measuring of scalar implicature without negative strengthening or typicality effects as confounding factors? In conclusion, the present paper highlights the importance of further research into the impact of scale structure on scalar implicature.

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6. Appendix

Table 3: Weak and strong scale-mates, their negative strengthening rates obtained in our experiment, scalar implicature rate from van Tiel et al. (2016, reprinted with permission from Oxford University Press), scale type, upper bound (B = bounded, NB = non-bounded) and category (open vs. closed class) and part of speech (Adj = adjective, V = verb, Det = determiner, Adv = adverb)

Weak/Strong	NegS	SI	Scale Type	Boundedness	Category	PoS
adequate/good	0.72	0.29	M	NB	O	Adj
allowed/obligatory	0.08	0.67	L	B	O	Adj
attractive/stunning	0.59	0.08	M	NB	O	Adj
believe/know	0.13	0.21	L	NB	O	V
big/enormous	0.54	0.17	M	NB	O	Adj
cheap/free	0.28	1	M	B	O	Adj
content/happy	0.92	0.04	M	NB	O	Adj
cool/cold	0.55	0.33	M	NB	O	Adj
dark/black	0.35	0.04	M	B	O	Adj
difficult/impossible	0.25	0.79	M	B	O	Adj
dislike/loathe	0.83	0.29	M	NB	O	V
few/none	0.31	0.75	M	B	C	Det
funny/hilarious	0.64	0.04	M	NB	O	Adj
good/excellent	0.56	0.37	M	NB	O	Adj
good/perfect	0.15	0.46	M	B	O	Adj
hard/unsolvable	0.43	0.71	M	B	O	Adj
hungry/starving	0.56	0.33	M	NB	O	Adj
intelligent/brilliant	0.5	0.08	M	NB	O	Adj
like/love	0.44	0.5	M	NB	O	V
low/depleted	0.46	0.71	M	B	O	Adj
may/have to	0.69	0.75	L	B	C	V
may/will	0.68	0.87	L	B	C	V
memorable/unforgettable	0.56	0.5	L	B	O	Adj
old/ancient	0.69	0.17	M	NB	O	Adj
palatable/delicious	0.4	0.58	M	NB	O	Adj
participate/win	0.03	0.21	L	B	O	V
possible/certain	0.19	0.92	L	B	O	Adj
pretty/beautiful	0.68	0.08	M	NB	O	Adj
rare/extinct	0.42	0.79	M	B	O	Adj
scarce/unavailable	0.58	0.62	M	B	O	Adj
silly/ridiculous	0.68	0.04	M	NB	O	Adj
small/tiny	0.81	0.04	M	NB	O	Adj
snug/tight	0.82	0.12	M	NB	O	Adj
some/all	0.42	0.96	L	B	C	Det
sometimes/always	0.66	1	L	B	O	Adv
special/unique	0.87	0.08	M	B	O	Adj
start/finish	0.14	0.21	L	B	O	V
tired/exhausted	0.69	0.04	M	NB	O	Adj
try/succeed	0.1	0.62	L	B	O	V
ugly/hideous	0.71	0.04	M	NB	O	Adj
unsettling/horrific	0.5	0.29	M	NB	O	Adj
warm/hot	0.32	0.75	M	NB	O	Adj
wary/scared	0.42	0.21	M	NB	O	Adj

Embedded implicature in a new interactive paradigm¹

Anton BENZ — *Leibniz Centre General Linguistics*

Nicole GOTZNER — *Leibniz Centre General Linguistics*

Lisa RAITHEL — *Potsdam University*

Abstract. Previous research on scalar implicature has primarily relied on metalinguistic judgment tasks and found varying rates of such inferences depending on the nature of the task and contextual manipulations. This paper introduces a novel interactive paradigm involving both a production and a comprehension component, thereby fixing a precise conversational context. The main research question is what is reliably communicated by *some* in this communicative setting, when the quantifier occurs in unembedded positions as well as embedded positions. Our new paradigm involves an action-based task from which participants' interpretation of utterances can be inferred. It incorporates a game-theoretic design, including a precise model to predict participants' behaviour in the experimental context. Our study shows that embedded and unembedded implicatures are reliably communicated by *some*. We propose two cognitive principles which describe what can be left unsaid. In our experimental context, a production strategy based on these principles is more efficient (with equal communicative success and shorter utterances) than a strategy based on literal descriptions.

Keywords: scalar implicature, embedded implicature, experimental pragmatics, game-theoretic pragmatics.

1. Introduction

In the current paper, we introduce a new experimental paradigm to test implicatures in an interactive scenario. We provide comprehension data on a variety of utterance combinations involving one or multiple scalar terms.

Implicatures of complex sentences have been a controversial topic of discussion. A variety of theoretical approaches have been developed (e.g. Chierchia et al. 2012, Sauerland 2004, Franke 2009, Benz 2012, Pavan 2013, Potts et al. 2016), and conflicting experimental evidence has been produced (e.g. Geurts and Pouscoulous 2009, Chemla and Spector 2011, van Tiel 2014). The relevant complex sentences are those in which an implicature trigger like '*some*' is embedded under a quantifier, which may itself be an implicature trigger. For example, the sentence (A-E) '*Each girl found some of her marbles*' potentially gives rise to the inference that each girl found some but not all of her marbles. In the course of this debate, a view took hold according to which sentence meaning is highly ambiguous, and different implicatures are just different readings that language speakers may entertain (in particular Chierchia et al. 2012). In this paper, we instead are guided by the standard neo-Gricean view (Levinson 1983) that considers implicature as part of communicated meaning. Therefore, our main research question

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is: What can be reliably communicated by sentences containing embedded or un-embedded ‘*some*’? In the following, we operationalise this research question and develop a new interactive experimental paradigm that involves the production and interpretation of embedded ‘*some*’. We started out with the following basic idea: A speaker who wants to communicate a certain proposition can express all he wants to express literally, or he may take advantage of implicature, and leave certain aspects unsaid. This will lead to a shortening of utterances. Hence, our main research question can be reformulated as follows: To what extent can a description be shortened without jeopardizing communicative success? The shortest descriptions will then reveal all the implicatures that can be communicated reliably. To turn this idea into a testable theory, we formulated two cognitive principles that guide the elimination of linguistic material related to embedded ‘*some*’: (ENA-Elim) the simplification of ‘*some but not all*’ to ‘*some*’, and (N-X-Elim) the elimination of ‘*none found X*’. For example, together they allow the simplification of literal ‘*Some found all, some some but not all, and none none*’ to ‘*some all and some some*’. Our assumption was that utterance simplifications based on (ENA-Elim) and (N-X-Elim) communicate the intended message as reliably as the corresponding literal description, and all further simplification leads to unreliable communication.

With utterances composed of sentences of the form (X-Y) ‘*X of the girls found Y of the marbles*’ with *X* and *Y* chosen from quantifier phrases ‘*none*’, ‘*some*’, ‘*any*’, ‘*some but not all*’, ‘*some and possibly all*’, and ‘*all*’, seven different worlds can be semantically distinguished depending on whether there are some who found none, some who found some but not all, or some who found all. As a next step towards a testable hypothesis, we defined a critical production strategy for the seven possible worlds applying the two elimination rules to a literal production strategy.

The main hypotheses we tested in our experiments were the following: (I) The critical strategy is as successful at communicating the state of the world as the corresponding literal strategy; (II) any further reduction of utterance length leads to a considerable decrease in communicative success. In the following, we present an experimental study that tests the efficiency of the critical strategy for all seven worlds. Specifically, we tested whether this strategy is communicatively successful, and how it compares to strategies pursued by naive participants, in particular whether they produce shorter utterances, and if so, whether these utterances are still successful. Our experiments indicate that the critical strategy is among the shortest strategies with almost maximal communicative success.

This paper is organized as follows. First, we review theoretical and experimental research on embedded implicature. Second, we provide the background assumptions for our new interactive paradigm. Third, we present two experiments implementing the paradigm. Finally, we compare our new experimental paradigm to previously-used paradigms and discuss the implications of the findings for theories of implicature.

2. Embedded implicature: theory and experiments

Consider the following scenario: there are four girls that have to clean up their rooms and find their marbles with which they played before. If one parent says ‘*Some of the girls found their marbles*’, then the other parent can infer that not all of the girls found them. Grice (1975)

explained this inference from the assumption that the speaker is truthful and follows the so-called *maxim of quantity*, which requires utterances to be as informative as required. In a situation in which all girls found their marbles, a truthful parent could have said both ‘*all found them*’ and ‘*some found them*’. The first alternative is more informative and, presumably, the additional information is also relevant, hence, the maxim of quantity would compel the parent to say ‘*all*’. As s/he said ‘*some*’, the probable reason is that not all found their marbles. It follows that some but not all must have found them.

This reasoning was systematised by Horn (1972, 1989), Gazdar (1979), and others. Their model is known as the neo-Gricean model of scalar implicature.² In this model, the two alternatives ‘*some*’ and ‘*all*’ form a *scale*, which means that they are equally complex, and that sentences with ‘*some*’ are logically weaker than the corresponding sentences with ‘*all*’. If the speaker chooses the weaker alternative, then *normally* the addressee is entitled to infer that the stronger alternative is false. This inference is called an *implicature*, and since it is triggered by the scale ⟨*all, some*⟩, it is called a *scalar implicature*.

The problem of implicatures of complex sentences can be formulated as follows: How does the neo-Gricean model have to be modified if ‘*some*’ occurs in the scope of another quantifier, or other logical operator? Two critical examples are shown in (1).

- (1) a) All of the girls found some of their marbles.
b) Some of the girls found some of their marbles.

In both sentences, ‘*some*’ occurs in upward entailing contexts. The rule that these sentences implicate the negation of all sentences resulting from a replacement of ‘*some*’ by ‘*all*’ predicts that (1a) implicates (2a), and (1b) all three sentences in (2).

- (2) a) It is not the case that all of the girls found all of their marbles.
b) It is not the case that all of the girls found some of their marbles.
c) It is not the case that some of the girls found all of their marbles.

Here, the whole sentences resulting from replacing ‘*some*’ with ‘*all*’ are negated, therefore these implicatures are called *global implicatures*. There is also the possibility of applying negation locally. This means that the negation of ‘*all*’ is embedded where ‘*some*’ occurs in the sentence. This rule predicts the following additional implicatures:

- (3) a) All of the girls found some but not all of their marbles.
b) Some of the girls found some but not all of their marbles.
c) Some but not all of the girls found some of their marbles.

² See (Levinson 1983: Ch. 3) and (Levinson 2000: Ch. 2) for a summary.

- d) Some but not all of the girls found some but not all of their marbles.

Sentence (3a) is the local implicature of (1a), and (3b), (3c), and (3d) are local implicatures of (1b).³

There exist a variety of theoretical accounts of implicature in complex sentences which make different predictions. In particular, there has been a controversial debate about locally embedded implicatures (see Sauerland 2010, Geurts and van Tiel 2013 for an overview of the debate). Approaches can be divided into structural accounts that predict local implicatures by integrating them into compositional semantics (Chierchia 2004, Fox 2007, Chierchia et al. 2012), or by generalising the neo-Gricean approach so that expected implicature can be derived as global implicature (Sauerland 2004, Geurts 2010). Other approaches derive them from requirements on discourse relations (Asher 2013), or pragmatically from the interaction between speaker and hearer in game-theoretic and probabilistic models (Franke 2009, Benz 2012, Pavan 2013, Potts et al. 2016).

The approaches also make different predictions about the context dependence and strength of implicatures. For example, Chierchia (2004) assumed that the local implicatures predicted by his theory are default inferences, whereas newer grammatical accounts consider them alternative readings which may or may not be preferred (Chierchia et al. 2012). In such an approach, (1b) is considered ambiguous between its standard semantic meaning, and (3b), (3c), and (3d). In probabilistic accounts, there may be a dominant interpretation, but, in general, all semantically possible interpretations receive some positive probability (Potts et al. 2016). Other approaches predict a unique interpretation, which is, however, in some specified manner dependent on context. In the standard neo-Gricean theory, conversational implicatures are part of communicated meaning (Levinson 1983: Ch. 3, p. 131). This suggests that they are communicated as reliably as semantic meaning. Such a strong claim was, however, until now, not supported by the experimental literature. In the case of un-embedded '*some*', proportions of subjects inferring the implicature can be high but for embedded '*some*' they tend to be rather low. Reported numbers for embedded scalars range from 0% (Geurts and Pouscoulous 2009) to 40% (Chemla 2009).⁴ In the same study, Geurts and Pouscoulous report values between 34% and 93% for un-embedded '*some*', depending on the test paradigm. If implicatures are communicated as reliably as literal content, the proportion of subjects inferring implicatures should be close to ceiling. With a few exceptions in the case of un-embedded '*some*', this has generally not been observed. Hence, experimental evidence seems to lend support to grammatical and probabilistic accounts that are consistent with high degrees of uncertainty in utterance interpretation.

In the following experiment, we show that embedded implicatures can be communicated as reliably as literal meaning. As the experimental literature demonstrates, we can only hope

³ However, (3b)–(3d) are already implied by the global implicatures of (1b) in (2) such that (3a) is the only local implicature that is not implicated globally.

⁴ Other studies report values that lie between these extremes, see (Chemla and Spector 2011, Benz and Gotzner 2014, Potts et al. 2016, Franke et al. 2017). Clifton Jr and Dube (2010) used a picture selection task and reported 71% of subjects arriving at local implicature in one of their experiments (Exp. 1, p. 7). However, their study may be affected by typicality effects as van Tiel (2014) argued.

to show this for certain contexts. So, the question arises, for which contexts can we expect implicature to be inferred reliably?

For Grice (1975), an implicature is an inference towards the speaker's intended meaning. The inference is based on the assumption that the speaker adheres to the conversational maxims, which include the maxim of quantity, and the over-arching *cooperative principle*, which states that the speaker contributes to an '*accepted purpose or direction of the talk exchange*' in which s/he and the hearer are engaged (Grice 1989: p. 26). Grice's maxim of quantity requires the speaker to provide enough information and not more than this. In sum, an implicature must be the speaker's intended meaning providing neither more nor less information than is required by a recognisable purpose of the talk exchange. A requirement that is not explicitly listed by Grice is the competence assumption: it must be shared knowledge between speaker and hearer that the speaker is competent enough to contribute the required information. If Grice's was right about the role of the cooperative principle and speaker's intentions, then a sentence produced non-conversationally should generate no conversational implicature.

Given this background, we may consider the picture verification task by Geurts and Pouscoulous (2009), which yielded particularly low proportions of subjects answering in accordance with embedded implicature. In this experiment, the test sentence was not produced by a recognisable speaker, it is not an utterance, there is no addressee, there is no recognisable *purpose of the talk exchange*, and, hence, there is no intended message that could be sought out behind its literal meaning. The situation is detached from purposeful conversation, and, hence, lacks a central precondition in Grice's theory.⁵ To different degrees, all picture verification, graded acceptability and inferencing tasks are affected by this problem.⁶

For this reason, Gotzner and Benz (2018) designed an experimental paradigm which avoided metalinguistic judgments and aimed at implementing Grice's conversational requirements for generating implicature. They used a game-theoretic design in which interpretations are read off from test subjects' choice of action. Grice's purpose or direction of the talk exchange is provided by an explicit decision problem, choosing a set of rewards based on the interpretation of an utterance. In the experimental scenario, each of four girls owns a set of four special edition marbles (extending the scenario by Degen and Goodman 2014). The marbles get lost during play, and in the end they have to find them again. Their mother motivates them by promising rewards which depend on how many of their marbles they find. A girl gets (i) chocolate if she finds all 4 of her marbles, (ii) candy if she finds fewer than 4 of her marbles and (iii) a gummy bear when she finds none of her 4 marbles (as a consolation prize). The task of the participants is to buy sweets for the four girls depending on the statements the mother utters. For example, if the mother says (N-Any) '*None of the girls found any of her marbles*' participants should only buy gummy bears. Participants were asked to give binary responses (yes/no) for each of the three types of sweets: chocolate, candy and gummy bears. Subjects were instructed to

⁵ In fairness, it has to be pointed out that Geurts and Pouscoulous (2009) intended to disprove Chierchia's (2004) assumption that embedded implicature are default inferences triggered by the logical form of sentences. Their results may pose problems for this particular semantic theory.

⁶ Of the aforementioned studies by (Chemla 2009, Chemla and Spector 2011, Benz and Gotzner 2014, Potts et al. 2016, Franke et al. 2017), that by Chemla (2009) is arguably the least affected. He also reports the highest percentages of pragmatically answering subjects.

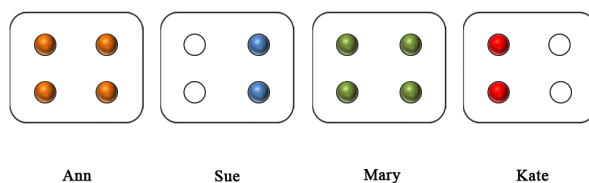


Figure 1: Picture showing boxes of four girls with the marbles they have found.

buy all the sweets that are needed but not more than that. If the mother says ‘*all found some marbles*’, then for subjects drawing the local implicature ‘*all found some but not all*’ the best response is to buy hard candy only. If they only draw the weaker implicature ‘*not all found all*’, then it is better to buy both hard candy and chocolate. If the mother says ‘*some found some marbles*’, then subjects inferring the global implicatures listed in (2) should buy gummy bears and hard candy but no chocolate. Gotzner and Benz (2018) implemented this scenario in an MTurk experiment. Subjects saw sentences produced by the mother and had to decide by ticking off yes/no buttons which of the sweets they had to buy.

The results indicated that subjects draw the strong local implicature (97%) for test sentence ‘*All of the girls found some of their marbles*’, and the strong global implicature (87%) for test sentence ‘*Some of the girls found some of their marbles*’.⁷ Hence, this experiment showed that, in a context that satisfies Grice’s conversational requirements, controversially discussed embedded implicatures can be reliably drawn.

One limitation of the study by Gotzner and Benz (2018) is that it only tested the comprehension of certain embedded implicatures in two possible worlds. In the current study, we develop an interactive version of the best response paradigm, which provides both comprehension and production data for a variety of utterance combinations in seven possible worlds. The main research question we address in this collaborative scenario is: To what extent can speakers shorten their description of a state of affairs without jeopardizing communicative success? The shortest descriptions will then reveal all the implicatures that can be communicated reliably in a given communicative context.

3. The interactive best response paradigm: Background

In the following, we describe the background assumptions for our interactive best response paradigm. Let us again consider the marble scenario from Gotzner and Benz (2018). A situation in which two girls found all of their marbles and two found some of them is shown in Figure 1. The mother can describe this situation by saying, for example, ‘*Ann found all of her marbles,*

⁷ There was a surprisingly high percentage of subjects not buying gummy bears for the ‘*some some*’ sentence (24%), indicating that subjects had problems inferring implicature E-N from E-E. The study compared predictions of four theories: a localist (Chierchia 2004), a globalist (Sauerland 2004), and two game-theoretical (Franke 2009, Benz 2012). All theories agreed that subjects should buy hard candy for sentences A-E and E-E, gummy bears for the E-E sentence, but not for the A-E sentence. Hence, only the values for chocolate were critical to the comparison.

Mary found all, Sue found some, and Kate found some. As it does not matter how the individual girls performed in the marble scenario, only whether there are girls that found none, some, or all of the marbles, the mother could also say (E-A & E-E) ‘*Some of the girls found all of their marbles, and some found some.*’ Intuitively, this should communicate enough information for the addressee to buy the appropriate sweets. However, it is not a literal description of the situation. The second use of ‘*some*’ leaves open whether or not all found all marbles. Hence, the mother could have said more precisely (E-A & E-ENA) ‘*Some of the girls found all of their marbles, and some found some but not all.*’ This is not a literal description either as it leaves open the possibility of some finding nothing. To rule out this possibility, the mother should have said (E-A & E-ENA & N-N) ‘*Some of the girls found all of their marbles, some found some but not all, and none found none.*’ If we start with the full literal description of the scene, then the short description E-N & E-E can be derived by first eliminating the ‘*not all*’ part of ‘*some but not all*’, and then by elimination of ‘*none found all*’, as shown in (4).

	description
(4)	E-N & E-ENA & N-A <i>literal</i>
	E-N & E-E & N-A <i>elimination: ENA → E</i>
	E-N & E-E <i>elimination: N-A → –</i>








Our hypothesis is that all that can be eliminated by these two rules can be left unsaid without reducing chances of communicative success. If more is left unsaid, i.e. if the utterance is shorter than E-N & E-E in the situation of Figure 1, then communication becomes unreliable. The two rules can then be used to derive the shortest reliable descriptions of each possible world. To do this, we first have to define what the possible worlds and their possible descriptions are. We begin with the latter.


We consider sentences of the form (Q-Q’) ‘*Q of the girls found Q’ of their marbles,*’ where Q and Q’ were one of the quantifiers ‘*some*’ or ‘*all*’. To describe the situation in Figure 1, the mother may also want to use ‘*none*’ and ‘*some but not all*’. She may also want to use ‘*some and possibly all*’, and ‘*any*’ in a negative context. To produce literal descriptions of situations it is also sometimes necessary to build conjunctions of Q-Q’ sentences. We use abbreviations for referring to these sentences. If Q and Q’ are the quantifiers ‘*all*’, ‘*some*’, or ‘*none*’, then the following abbreviations are used:

	A-A	all found all	E-A	some found all	N-A	none found all
(5)	A-E	all found some	E-E	some found some	N-E	none found some
	A-N	all found none	E-N	some found none	N-N	none found none

For the more complex construction ‘*some but not all*’ we write ENA. For ‘*any*’ we write ‘*Any*’. We abbreviate conjunctions by combining sentences with ‘&’.








With these sentences, it is possible to distinguish seven possible worlds that are definable by whether or not the sentences E-A, E-ENA, and E-N are made true by them. We use pictograms for referring to these worlds. They are shown and defined in the next table:

	E-N	E-ENA	E-A	world
(6)	1	0	0	
	0	1	0	
	0	0	1	
	1	1	0	
	1	0	1	
	0	1	1	
	1	1	1	

In the marble scenario each situation is represented by one of the possible worlds, for example, Figure 1 represents world .

Next, we define a literal description of each of the possible worlds by conjoining their defining basic sentences in (6), except for the first three worlds for which universally quantified or negated basic descriptions exist. Then we simplify these descriptions by application of the two elimination rules.

We derive two production strategies, the critical strategy defined by elimination rules and the corresponding literal strategy. They are shown in (7).

	world	critical strategy	literal strategy
(7)		N-Any	N-Any
		A-E	A-ENA
		A-A	A-A
		E-E & E-N	E-ENA & E-N & N-A
		E-A & E-N	E-A & E-N & N-ENA
		E-A & E-E	E-A & E-ENA & N-N
		E-A & E-E & E-N	E-A & E-ENA & E-N

As we stated before, our assumption is that the application of the two elimination rules will not change communicative success. This means that the critical production strategy has the same degree of communicative success as the literal strategy. Communication is successful if the hearer interprets an utterance as intended by the speaker. *Degree* of communicative success can then be measured by the proportion of utterances that are correctly understood. We further assume that any additional eliminations will lead to utterances that are too short to communicate successfully.

4. Experiments

4.1. Goals and rationale

The goal of the first experiment is to implement an interactive version of the best response paradigm involving a comprehension and a production side. This experiment is set up as a game involving groups of up to 4 participants in the lab. The system always pairs two par-

ticipants, a speaker and hearer. The speaker is shown a picture and his task is to describe the state of affairs with up to five sentences. Then, this utterance is sent to another participant, the comprehender. The comprehender's task is to choose a set of rewards, reflecting his interpretation of the speaker's utterance. Communication between the two individuals is successful, if the hearer has chosen the appropriate set of rewards for the state of affairs the speaker described. In our analysis, we measure the relative success rate and utterance length of different production strategies based on the comprehension data. In Experiment 1a, we test the critical strategy defined in Section 3 and compare it to a strategy based on literal descriptions. The main research question of the second experiment is whether the critical strategy can be further shortened without jeopardising communicative success. We will first present the methodology of both experiments together and then describe the results.

4.2. Methods

4.2.1. Apparatus

For our experiments, we programmed a system in Python using the GUI toolkit wxPython⁸, which allowed us to implement a game with four participants. Participants were seated in a lab with four computers separated by a booth. The computers (DELL Optiplex 3020, 4GB RAM, Windows 8.1 Enterprise) each had an LG monitor with a resolution of 1920×1080 and a refresh rate of 64 Hz (15.62 ms). The system controlled stimulus presentations and pairings of participants. The system itself is based on a server-client architecture, where each client corresponds to a participant, while the server connects those clients, sends messages back and forth, pre- and post-processes the data and saves the results.

In general, the system allows to run experiments with either two or four subjects. Furthermore, it is possible to use only one (or three) computers, while the second (the fourth) PC/participant is replaced by the system itself (as was done in Experiment 1b), acting according to a predefined plan to investigate production strategies in a controlled manner.

4.2.2. Experiment 1a

Participants Participants were recruited via a subject pool of the Psychology Department from Humboldt University. In total, 38 German participants (21 female, 17 male, mean age: 29.3) took part in the experiment. Participants took the experiment in groups of varying sizes: there were groups with 4 players, groups with 2 players, and groups with 3 players in addition to the experimenter, who played the critical strategy (see Section 3). 8 participants took part in the version with 4 players (2 groups), 10 participants in the version with two players (5 groups) and 18 participants in the version with 3 players (6 groups). Finally, 2 participants played a version with 1 player in addition to the experimenter (2 groups). These two participants were not included in the analysis reported below.

⁸ <https://www.wxpython.org/>

The mother says: ‘Each girl found all of her marbles’		
chocolate	<input type="radio"/> YES	<input type="radio"/> NO
candy	<input type="radio"/> YES	<input checked="" type="radio"/> NO
gummy bear	<input type="radio"/> YES	<input checked="" type="radio"/> NO

Table 1: Example item *each-all* with example response choice, participants were asked to check a radio button for each type of sweets.

Scenario Participants in our experiment were presented with a scenario involving six girls who each own a set of four special edition marbles (extending the basic best response paradigm by Gotzner and Benz 2018).⁹ While the girls are playing the marbles get lost and they have to find them again. Participants in our experiment were told that the nursery school teacher of the girls wants to reward them depending on how many marbles the girls find. In particular, participants were presented with the following reward system in the instructions:

A girl gets:

- chocolate if she finds all 4 of her marbles
- candy if she finds fewer than 4 of her marbles
- a gummy bear when she finds none of her 4 marbles (as a consolation prize).

Experimental tasks Participants were randomly assigned to two different roles in the experiment: a speaker or a comprehender. The speaker saw a picture showing the marbles each girl had found, representing all seven possible worlds. The seven worlds we distinguished corresponded to the model presented in Section 3.

The task of the speaker was to describe the picture so that the comprehender can buy the appropriate sweets for the girls. Participants were presented with a sentence frame and they were required to fill in two blanks. They were allowed to type in one of the following words or phrases: *all*, *some*, *none*, *some but not all*, *some and possibly all* and *any* (in German). Participants were allowed to produce up to five sentences to describe a given picture. Participants’ responses were checked for spelling by the system. If they used a word which was not allowed, the corresponding box was highlighted and they had to correct their response.

When the speaker was done describing the picture, the comprehender received his message. The comprehender’s task was to select the appropriate kind of sweets for the six girls depending on the message he received. An example trial with the utterance ‘*Each girl found all of her marbles*’ and the appropriate response choice is presented in (1). Participants gave their response by checking one of two radio buttons for each type of sweets.

⁹ In this experiment we introduced six girls rather than four in order to avoid referring to a single entity with *some*. Even though the basic semantics of *some* is existential, the quantifier most naturally denotes a set of at least two items (see for example Degen and Tanenhaus 2015 and van Tiel 2014).

In Experiment 1a, we used a confederate, the experimenter, who produced the critical utterances outlined in Section 3.

Procedure At the start of a session, participants were presented with instructions describing the basic setup of the experiment. We told them about the scenario and the different roles they have to take during the experiment. After participants had read the instructions, they performed seven practice trials to learn the reward system used in the comprehender's task. During practice trials, participants saw a picture representing the state of the world and had to choose the appropriate sweets (while during test trials, participants chose the appropriate sweets based on an utterance produced by the speaker). The system checked the responses and reported an error if participants chose the wrong sweets.

In the main part of the experiment, participants were assigned to the two different roles in succession. That is, in a given experimental block, a participant either described a picture or interpreted an utterance he received. In these critical trials, no feedback was given by the system so that participants were not biased to pursue a certain interpretation. Each participant took every role 3 times during the course of the experiment. Hence, there were 6 experimental blocks in total. The system always paired two participants for a given world-message pair. For example, the first participant produced a description of the picture and then the second participant received this description and had to choose the reward depending on the statement(s). The pairing of the subjects varied from round to round to make sure each participant plays with every other participant and adopts both roles.

One experimental block consisted of 7 trials representing the different worlds (randomized across the different blocks). The system waited until all participants made their responses and then the next trial was initiated. While the producer typed in a description of the current picture, the comprehender had to wait and vice versa. In the 4 and 3 participant versions, we obtained a total of 82 observations (production/comprehension pairs). In the 2 participant versions, there were 41 observations in total.

4.2.3. Experiment 1b: Shortening strategy

Participants In total, 20 German participants (13 female, 7 male, mean age: 31.0) took part in the second experiment. In Experiment 1b, there were four groups with 3 players and the critical production strategy was fed in by the system. In two sessions 4 participants took part and the production data of these participants were saved and replaced by the computer strategy.

Materials Participants were presented with the same instructions and scenario as in Experiment 1a.

In Experiment 1b, we tested whether the critical strategy can be further shortened and therefore included the following three simple utterances:

1. *Some of the girls found some of their marbles* (E-E)
2. *Some of the girls found all of their marbles* (E-A)
3. *Some of the girls found none of their marbles* (E-N)

In worlds N-E, A-E and A-A we used the same critical utterances as in Experiment 1a. And for world we tested the utterance N-N, which is not relevant for the shortening of utterances.

Procedure The procedure was the same as in Experiment 1a except that there were no groups in which the experimenter took part. Instead of using the experimenter as a confederate, the shortening strategy was fed in by the system. That is, if only 3 participants played the game, the critical messages were sent by the computer. In 2 groups, 4 participants came and we saved the production data of the fourth participant and fed in the critical strategy instead. The comprehension data were used from all participants.

4.3. Results

4.3.1. Experiment 1a

We analysed participants' success rate (expected utility) as a function of whether the hearer selected the appropriate sweets depending on the picture the speaker saw. Only if the hearer selected all required sweets correctly was the choice considered a success. Overall, the success rate was quite high (89.7 %), showing that participants understood the task. We, then evaluated how successful different production strategies were, also taking into account utterance length. A t-test showed that the critical strategy was significantly more successful than the average participant strategy ($t = -3.85$, p -values $<.001$) and it was also significantly shorter in terms of mean utterance length ($t = 6.13$, p -values $<.001$). Table 4.3.1 compares the success rate of the critical and literal strategy in each individual world. Interestingly, when participants produced exact descriptions such as *Each girl found some but not all of her marbles* the communicative success was not better compared to utterances where the short form was used. Hence, for each world the critical strategy was at least as successful as the literal strategy and shorter in terms of utterance length.

4.3.2. Experiment 1b

To show that the critical strategy is the most efficient one, we need to establish that shortening utterances any further lowers communicative success. In Experiment 1b, we replicated the findings concerning the success rate of the utterances also used in Experiment 1a (detailed results are shown in (8) in the Appendix). In the following, we focus on the results of the critical

world	critical strategy	# int.	% success	literal strategy	# int.	% success
□	N-Any	49	100%	N-Any	49	100%
■	A-E	36	94%	A-ENA	54	93%
■	A-A	114	99%	A-A	114	99%
▒	E-E & E-N	37	95%	E-ENA & E-N & N-A	12	100%
▒	E-A & E-N	52	96%	E-A & E-N & N-ENA	16	88%
■	E-A & E-E	41	98%	E-A & E-ENA & N-N	13	100%
▒	E-A & E-E & E-N	48	100%	E-A & E-ENA & E-N	29	97%

Table 2: Results Exp. 1a: Success rate of critical and literal strategy per world (# int: absolut number of items interpreted by subjects).

short utterances	□	■	■	▒	▒	■	▒
E-E	-	32%	-	21%	-	5%	42%
E-A	-	-	11%	-	-	16%	74%
E-N	11%	6%	-	17%	6%	-	61%

Table 3: Results Exp. 1b: Success rate of shortening strategy per world

shortening strategy. Table 4.3.2 details the interpretation data for the critical short utterances.

The success rate of the short utterances was lower than that of the critical strategy. We computed a one sample t-test with the lowest success rate of the critical strategy as expected value (94 %), which found the differences to be significant ($t = 6.25, p < .05$).

Finally, in Table 4, we present an overview of the average success rate and utterance length of the critical strategy, the literal strategy and participants' average strategy (taking into account the data from both experiments for all seven worlds).

strategy	mean utterance length	%success
average	2.09	89%
critical	1.71	97%
literal	2.5	93%

Table 4: Comparison of mean utterance length and success rate of different production strategies (average of Experiments 1a and 1b)

In sum, these data demonstrate that the critical strategy is maximally efficient in the sense that it is equally successful as the corresponding literal strategy and cannot be shortened without introducing interpretative uncertainty.

5. Discussion

In two experiments we tested our new interactive paradigm. We showed that participants reliably communicate embedded and unembedded implicatures in our interactive setting. This

confirms Grice's central requirement for implicature: contextual relevance. Our data confirmed our main hypotheses: The critical strategy is as successful as the corresponding literal strategy, and shortening it further significantly reduces communicative success. The results, thereby, support the hypothesis that the two proposed elimination principles (ENA-Elim and N-X-Elim) characterize what can be left unsaid.

Whereas previous experimental studies focused on the comprehension of a few test sentences in isolation, we have gathered data on a variety of utterance combinations in a precise communicative context. Some previous studies had already indicated that embedded implicatures exist (Chemla 2009, Clifton Jr and Dube 2010, Chemla and Spector 2011, Benz and Gotzner 2014, Potts et al. 2016, Franke et al. 2017, Gotzner and Romoli 2017). However, the experimental paradigms used by these studies have been criticized for being unnatural or being prone to typicality effects (see especially Geurts and van Tiel 2013, van Tiel 2014). What is more, our goal was to show that, in a context that makes certain implicatures relevant, they should be reliably communicated, that is as successfully as corresponding literal descriptions. In our new interactive best response paradigm, we have implemented contextual relevance as an explicit decision problem, choosing a set of rewards. We believe that our action-based task, which distinguishes between relevant readings, is the crucial reason why implicatures are communicated successfully (see Gotzner and Benz 2018). In turn, the meta-linguistic tasks used in previous studies (inferential and truth value judgments) seem to highlight the ambiguity between implicature-based responses and literal interpretations of an utterance.

We now turn to theoretical implications of the current results. The model we based our critical strategy on was developed as a refinement of the game-theoretic model of (Benz 2012), but, for the purposes of this paper, we can keep a relatively theory-neutral position. However, there are two sentences that are particularly problematic for globalist theories (e.g. Sauerland 2004). They are E-E '*Some of the girls found some of their marbles*', and E-E & E-A '*Some of the girls found some, and some found all*'. Our model predicts that E-E will fail to reliably communicate the state of the world, and that E-E & E-A communicates that the actual world is \blacksquare . Gricean globalism predicts that E-E implicates that not A-E '*all some*' and not E-A '*some all*', and, hence, that E-E implicates \square . For E-E & E-A we find the stronger alternative A-E & E-A, hence, Gricean globalism predicts the negation of A-E & E-A, and, therefore, that the speaker meant \square or \blacksquare . However, we have seen that it is reliably interpreted as \blacksquare . We find here a clear conflict between our experimental results and the globalist principle by which sentences implicate the negation of their stronger alternatives. Other theories, in general, do not make predictions that are specific enough to decide whether they are in conflict with our model or not. This does not mean, however, that there are no problems. For example, there is no simple explanation in the standard localist model of (Chierchia et al. 2012) for why E-E & E-A implicates that none found none.

6. Conclusions

Our experiments demonstrated that, in an interactive context involving a speaker and a hearer, embedded implicatures are reliably communicated. We also presented a critical production strategy that was defined by two rules that allow simplifications of literal descriptions. These

rules were i) the rule that ‘*some but not all*’ can be simplified to ‘*some*’, and ii) the rule that conjuncts stating that ‘*none found X*’ can be eliminated. In our experiments, the critical strategy was maximally efficient in the sense that it a) communicated the state of the world as reliably as the literal strategy from which it was derived, and b) could not be shortened further without losing communicative success.

Our new paradigm opens up the possibility to investigate a variety of sentences of particular theoretical interest in a controlled manner. The advantage is that the sentences are embedded in a natural communicative situation in which subjects are more strongly immersed in the experimental setting. The software that we developed can be used to test speaker-related and other contextual factors, for example by using a confederate. This is done in such a way that subjects do not notice that sentences have not been produced by an actual dialogue partner. On request, we will make the system available to researchers. We hope that our new paradigm will spark further research on implicatures in interactive settings with controlled dialogue.

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A. Summary results

Results for critical and literal strategy in Experiment 1b (# int: number of items that had been presented to subjects for interpretation)¹⁰:

¹⁰The absolute numbers of literal utterances were lower in Exp. 1b than in Exp. 1a due to the lower number of participants.

	world	critical strategy	# int	% success	literal strategy	# int	% success
(8)	□	N-Any	37	100%	N-Any	37	100%
	■	A-E	24	92%	A-ENA	25	92%
	■	A-A	60	95%	A-A	60	95%
	■	E-E & E-N	5	100%	E-ENA & E-N & N-A	3	67%
	■	E-A & E-N	22	86%	E-A & E-N & N-ENA	6	67%
	■	E-A & E-E	5	100%	E-A & E-ENA & N-N	1	0%
	■	E-A & E-E & E-N	8	100%	E-A & E-ENA & E-N	10	90%

Results for critical and literal strategy for the accumulated data of both experiments (# int: number of items that had been presented to subjects for interpretation):

	world	critical strategy	# int	% success	literal strategy	# int	% success
(9)	□	N-Any	86	100%	N-Any	86	100%
	■	A-E	60	93%	A-ENA	79	92%
	■	A-A	174	98%	A-A	174	98%
	■	E-E & E-N	42	95%	E-ENA & E-N & N-A	15	93%
	■	E-A & E-N	74	93%	E-A & E-N & N-ENA	22	82%
	■	E-A & E-E	46	98%	E-A & E-ENA & N-N	14	93%
	■	E-A & E-E & E-N	56	100%	E-A & E-ENA & E-N	39	95%

Note that the number of items presented to subjects include those that had been produced by a confederate (experimenter in Exp. 1a, system in Exp. 1b).

Notation Quantifiers within one utterance are separated by ‘-’ and ‘&’ represents conjunction of multiple utterances; A = *all*, E = *some*, N = *none*, ENA = *some but not all*.

Modal height and modal flavor: The case of Wolof *di*¹

M. Ryan BOCHNAK — *University of Konstanz*

Martina MARTINOVIĆ — *University of Florida*

Abstract. The Wolof imperfective auxiliary *di* is compatible with event-in-progress, habitual and future readings. Furthermore, while varieties of all these readings are available for *di* when it sits in a syntactically low position, only future readings are available when it sits in a syntactically high position. We aim to account for this puzzle by combining several ingredients independently motivated in the literature: (i) event-relative circumstantial modality for event-in-progress, habitual, and a subset of future readings; (ii) metaphysical modality for generalized future readings; (iii) the idea that syntactic height determines the type of modal anchor that projects a modal base. This study contributes to our understanding of the relation between syntactic height and modal flavor, as well as the nature of modal-aspectual interactions cross-linguistically.

Keywords: aspect, future, habitual, imperfective, modality, modal flavor, progressive.

1. The puzzle

The central puzzle discussed in this paper has two parts, and concerns the verbal auxiliary *di* in Wolof (Niger-Congo). First, *di* – glossed as ‘imperfective’ in the descriptive literature² – is associated with several readings (Church, 1981; Robert, 1991): an event-in-progress/progressive reading as in (1); a habitual reading as in (2); and a future reading as in (3).³

(1) **Progressive reading; low *di***⁴

Dafa **di** (> *dafay*) añ, mën-ul ñëw.
do.C.3SG IMPF eat.breakfast can-NEG come
‘Il est en train de manger, il ne peut pas venir.’
‘He is eating, he cannot come.’

(Robert, 1991: p. 263)

(2) **Habitual reading; low *di***

Dafa **di** (> *dafay*) jaay.
do.C.3SG IMPF sell

‘Il vend.’ = ‘Il est marchand.’/‘He sells’ = ‘He’s a merchant.’ (Robert, 1991: p. 267)

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²“Inaccompli” in Church 1981 and Robert 1991; we use the gloss IMPF ‘imperfective’ in this paper.

³Data from Robert 1991 uses translations and context descriptions in French. The English translations are our own. Examples not otherwise marked are from Martinović’s fieldwork. The notation *Dafa di* (> *dafay*) invokes the pronunciation whereby *di* cliticizes to the previous phonological word as is pronounced -y (IPA [j]) after a vowel-final word.

⁴Abbreviations: C = complementizer, CM = class marker, DEF = definite, IMPF = imperfective, INDEF = indefinite, LCL = locative clitic, NEG = NEGATION, PL = plural, SG = singular.

(3) **Future reading; low *di***

Context: devant la maison en construction/in front of a house under construction

Kii mu-a **di** (> mooy) rafet kër!

this.one 3SG-C IMPF be.pretty house

‘Elle va être drôlement belle, sa maison, à lui!’/‘It’s going to be really beautiful, this one’s house.’

(Robert, 1991: p. 269)

In comparison, a clause with an eventive verb without *di* such as (4) only receives an episodic, default past interpretation. Clauses with stative predicates without *di* have a default present reading, as in (5).⁵

(4) **Episodic reading with eventive; no *di***

Xale yi lekk-na-ñu ceeb.

child DEF.PL eat-C-3PL rice

‘The children ate rice.’(5) **Present reading with stative; no *di***

Mbaye bég-na-∅.

Mbaye be.happy-C-3SG

‘Mbaye is happy.’

The second part of the puzzle is the fact that the availability of these readings depends on *di*’s structural position. In (1)-(3), when *di* is in its base-generated position in Asp (“low *di*”), all readings are available. However, when *di* is in C (in non-copular sentences), only the future is possible, as in (6) (Martinović, 2015). The context description (from Robert) indicates that an event-in-progress reading is not possible for “high *di*”; we will show later that a habitual reading is also not possible for high *di*.

(6) **Future reading; high *di*****Di**-na-∅ gor garab bi.

IMPF-C-3SG cut tree DEF.SG

‘(À ce moment là) il abattra l’arbre.’/‘(At that time) He’s going to cut the tree.’

[impossible if he is already trying to cut it] (Robert, 1991: p. 272)

Whereas Robert (1991) took the different readings of *di* in the different positions as evidence for two distinct lexical items, in this paper we aim to provide a unified analysis of *di* that derives all the attested readings.

In particular, we aim to provide a unified analysis of the readings of *di* by combining and expanding on several independently motivated analysis for progressives, habituals, and modality in the literature. First, we follow Portner (1998) and Ferreira (2016) in claiming that event-in-progress and habitual readings crucially involve *event-relative* circumstantial modality. We

⁵Note that Wolof is an optional tense language (Bochnak and Martinović, 2017), but we only show tenseless clauses here (see Smith (1997); Smith and Erbaugh (2005) for an account of default readings of tenseless clauses in other languages).

then extend this idea to cover a subset of future readings, arguing that all readings of low *di* can be captured using an event-relative circumstantial modal base. We then argue that future readings for high *di* are derived from a metaphysical modal base, following Condoravdi (2002); Kaufmann (2005), and others. Given that the availability of different readings for *di* when it is located in different syntactic positions, we argue that this behavior of *di* provides new evidence for the idea that modal height correlates with modal flavor, following Hacquard (2010); Kush (2011). Specifically, following Kush (2011), we argue that different modal bases are available at different syntactic heights because of the availability of different types of modal anchors from which a modal base is projected, and that the semantic type of *di*'s complement determines the type of the modal anchor. This work thus contributes to our understanding of the relation between syntactic height and modal flavor, as well as the nature of modal-aspectual interactions cross-linguistically.

The rest of the paper is organized as follows. In section 2 we provide more background on the Wolof language and the syntactic analysis of *di* that we assume, and in section 3 we provide more data that corroborate the empirical picture sketched here in the introduction. In section 4 we introduce a proposal for event-in-progress and habitual readings in terms of event-relative circumstantial modality, following Portner (1998) and Ferreira (2016). In section 5 we sketch how future readings can be incorporated into this view, but also point out its shortcomings, arguing for a metaphysical modal base for future readings of high *di*. We connect the (un)availability of certain readings for *di* with its syntactic position in section 6, following ideas from Kush (2011). Section 7 concludes.

2. Background on Wolof and syntax of *di*

Wolof is a Niger-Congo language of the West-Atlantic branch. It is spoken by around 5.2 million people in Senegal, where it is also the lingua franca, and as a minority language in the Gambia and Mauritania (Leclerc 2015). The data in this paper come largely from Martinović's fieldwork in Saint-Louis, Senegal, during 3 trips undertaken between 2014 and 2017.

Wolof finite indicative clauses all have a CP-layer, hosting complementizer-like elements (Dunigan 1994; Martinović 2015). Syntactically, there are two clause-types (Martinović, 2015). The first type is non-*wh*-movement clauses, where a verbal element necessarily appears in C. This can be the lexical verb, as in (7), the dummy verb *def* 'do'⁶, exemplified in (8), or the imperfective auxiliary *di*, shown in (9).

(7) **Main verb in C**

Demba **tabax**-na- \emptyset kër.
Demba build-C-3SG house
'Demba built a house.'

(8) **'Do' (*def*) in C**

Demba **daf**-a- \emptyset tabax kër.
Demba do-C-3SG build house
'Demba **BUILT** a house.'

⁶The *do*-support clauses express V/VP focus. We use all caps in the translation to indicate this.

(9) **Imperfective auxiliary *di* in C**

Demba **di**-na- \emptyset tabax kër.
 Demba IMPF-C-3SG build house
 ‘Demba will/is going to build a house.’

The second clause-type is *wh*-movement clauses in which an element moves to Spec,CP. There is no verbal element in C in this case.

(10) **Wh-question**

Lan la Demba **tabax**?
 what C Demba build
 ‘What did Demba build?’

(11) **Relative clause**

kër g-i Demba **tabax**
 house CM-C Demba build
 ‘the house which Demba built’

The imperfective morpheme *di* is a verbal head, as evidenced by its syntactic behavior. First, when it is the highest verbal element in the clause, it raises to C (see (9)). Second, if it is present in the clause, other verbal functional morphology (negation and tense) suffixes onto it, and not onto the lexical verb as shown in (13).

(12) **Main verb with negation**

Demba daf-a- \emptyset **tabax-ul** ay kër.
 Demba do-C-3SG build-NEG INDEF.PL house
 ‘Demba didn’t BUILD houses.’

(13) ***Di* with negation**

Demba daf-a- \emptyset **d(i)-ul** tabax ay kër.
 Demba do-C-3SG IMPF-NEG build INDEF.PL house
 ‘Demba won’t BUILD houses.’/‘Demba isn’t BUILDING houses.’/‘Demba doesn’t BUILD houses.’

Phonologically, *di* behaves as a clitic. When there are no suffixes, it forms a phonological unit with the material in C and pronominal clitics that follow it. In that case, it is pronounced as -y, as in (14).⁷

⁷Robert (1991) considers *di* and -y to be different morphemes. There is good evidence that this is not the correct analysis. For example, in certain situations, like in biclausal progressives, an adjunct can intervene between the imperfective morpheme and the preceding phonological word. When the adjunct is absent the imperfective is pronounced as -y, when present, it surfaces as *di*, shown in (i) and (ii). (See Martinović and Schwarzer (forthcoming) for more on Wolof progressives.)

(i) Ma-a-ngi di (> maangiy) lekk.
 1 SG-C-LCL IMPF eat
 ‘I am eating.’

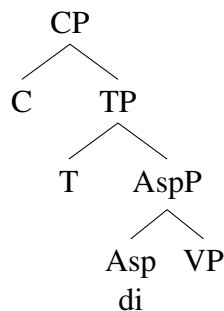
(ii) Ma-a-ngi ci tiitange **di** lekk.
 1 SG-C-LCL in fear IMPF eat
 ‘I am fearful, eating.’

(14) **Di as a clitic**

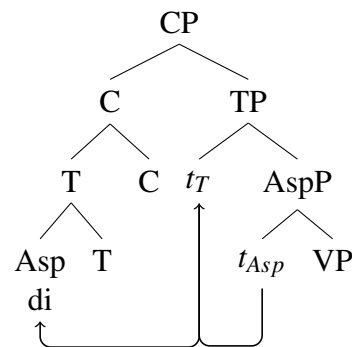
Demba daf-a- \emptyset =ko di (> koy) tabax.
 Demba do-C-3SG=it IMPF build
 ‘Demba will BUILD it.’/‘Demba is BUILDING it.’/‘Demba BUILDS it.’

We assume that *di* occupies an Asp head below T (as in (15)), and in clauses with V in C raises to C (in (16)):

(15)



(16)



3. The empirical picture

In general, the readings that we have seen are available for all aspectual classes. As we have seen, low *di* is compatible with an event-in-progress readings, as in (17). If the event is an achievement, the reading obtained is an iterative one, as in (18).

(17) **Low di event-in-progress; accomplishment**

[CONTEXT: I am standing in front of a wall with a bucket of paint and I just put a brush to the wall and started drawing something. Someone walks into the room and asks *What are you doing?* I respond:]
 Da-ma di (> damay) rëdd wërëngërël.
 do.C-1SG IMPF draw circle
 ‘I am drawing a circle.’

(18) **Low di event-in-progress; achievement**

[CONTEXT: I hear a repetitive noise from another room, and I ask what that is. Someone answers me:]
 Dudu daf-a- \emptyset di (> dafay) tisooli.
 Dudu do-C-3SG IMPF sneeze
 ‘Dudu is sneezing.’

A habitual reading is also possible when *di* is in the low position, as shown in (19) and (20).⁸

(19) **Low *di* habitual; accomplishment**

[CONTEXT: My friend Fatou goes around and draws circles on walls every Monday. Another friend has seen her a few times walking around with a bucket of paint, and asks me what that’s about. I tell him:]

Altine b-u nekk, Faatu daf-a-∅ di (>dafay) rëdd ay wërëngërël.
Monday CM-C be, Fatou do-C-3SG IMPF draw INDEF.PL circle
‘Every Monday, Fatou draws circles.’

(20) **Low *di* habitual; stative**

[CONTEXT: Magatte visits her village rarely, only once every two years, but whenever she goes there, her friend Binta is pregnant. Magatte comments to her mother:]

Binta daf-a-∅ di (>dafay) ëmb rekk!
Binta do-C-3SG IMPF be.pregnant only
‘Binta is always pregnant!’

Meanwhile, future readings are available for both low and high *di*. Examples (21) and (22) show this for low *di*; (23)-(26) show this for high *di*.

(21) **Low *di* future; accomplishment**

[CONTEXT: I see Mbaye walking around the town with an architect, buying building materials, etc., and I ask our mutual friend what Mbaye is up to, and he tells me:]

Mbaye daf-a-∅ di (>dafay) tabax kër.
Mbaye do-C-3SG IMPF build house
‘Mbaye is going to build a house.’

(22) **Low *di* future; stative**

[CONTEXT: Fanta and her husband Ibrahim cannot conceive a child, so they go to see a ‘doctor’ who uses local plants and herbs to make medicine. He gives them a tea and tells Fanta to drink it every day, promising:]

Fanta daf-a-∅ di (>dafay) ëmb.
Fanta do-C-3SG IMPF be.pregnant
‘Fanta is going to get pregnant.’

(23) **High *di* future; accomplishment**

[CONTEXT (same as (21)): I see Mbaye walking around the town with an architect, buying building materials, etc., and I ask our mutual friend what Mbaye is up to, and

⁸Generic readings are also possible for low *di*, as shown in (i). We set aside these readings for the rest of the paper, though we are hopeful they can be accounted for under the analysis we pursue; see Deo 2009 for unifying event-in-progress, habitual, and generic readings of imperfectives.

(i) jant bi, penku la di (>lay) fenke
sun DEF.SG east C IMPF rise
‘Le soleil, c’est à l’est qu’il se lève.’
‘The sun, it’s in the east that it rises.’

(Church, 1981: p. 114)

he tells me:]

Mbaye di-na-∅ tabax kër.
Mbaye IMPF-C-3SG build house
'Mbaye is going to build a house.'

(24) **High *di* future; stative**

[CONTEXT: Fatou is making Oussman's favorite dish for lunch and I walk in and say:]

Usmaan di-na-∅ bég.
Oussman IMPF-C-3SG happy
'Oussman is going to be happy.'

(25) **High *di* future; achievement**

[CONTEXT: I am throwing a party and I ask Fatou if anyone from her family will be there. She tells me that her brother Moussa will come:]

Musaa di-na-∅ ñëw.
Moussa IMPF-C-3SG come
'Moussa will/is going to come.'

(26) **High *di* future; achievement**

[CONTEXT: I am playing a game with Loulou in which we stare into each other's eyes and try not to blink. Ibrahim is watching us and he sees that Loulou's eyes are starting to water and that she is having trouble keeping them open. He says:]

Lulu di-na-∅ xef.
Loulou IMPF-C-3SG blink
'Loulou is going to blink.'

Only a future reading is possible for high *di*. The context for (27) and (28) make an event-in-progress reading or habitual reading plausible, and a future reading implausible. In such a context, speakers reject the use of high *di* in (28).

(27) **Low *di*; progressive or habitual**

[CONTEXT: There is a party and Magatte is dancing. Her husband Mbaye does not like it when she dances in public, so he is in a bad mood. A friend asks what is wrong, and Mbaye says:]

Magatte daf-a-∅ di (> dafay) fecc.
Magatte do-C-3SG IMPF dance
'Magatte is dancing.'/'Magatte always dances.'

(28) **High *di*; only future reading**

[CONTEXT (same as (27)): There is a party and Magatte is dancing. Her husband Mbaye does not like it when she dances in public, so he is in a bad mood. A friend asks what is wrong, and Mbaye says:]

#Magatte di-na-∅ fecc.
Magatte IMPF-C-3SG dance
'Magatte is going to dance.'

	event-in-progress	habitual	future
low <i>di</i>	✓	✓	✓
high <i>di</i>	#	#	✓

Table 1: Readings of low and high *di*

In sum, when *di* is in the low position, it is compatible with event-in-progress, habitual, or future readings. When *di* is in the high position, only the future reading is possible. These findings are summarized in Table 1. Our analysis is an attempt to account for these two facts.

4. Event-in-progress and habitual readings

It has long been acknowledged in the literature that readings associated with imperfective morphemes incorporate a modal component (Dowty, 1979; Landmann, 1992; Portner, 1998; Deo, 2009; Arregui et al., 2014; Ferreira, 2016). Many of these authors have also explicitly attempted to offer a unified analysis of the several readings associated with imperfective morphology cross-linguistically, especially for event-in-progress and habitual readings. In this section, we introduce Portner’s (1998) analysis of the English Progressive, couched within a framework of event-relative modality, and Ferreira’s (2016) extension of Portner’s analysis for habituals, and map these on to the event-in-progress and habitual readings for (low) *di* in Wolof.

4.1. Portner’s analysis for event-in-progress

Following previous analyses by Dowty (1979) and Landmann (1992), Portner (1998) offers a modal analysis of the English Progressive form. The key components of Portner’s analysis are the following.

First, in a departure from a classical Kratzerian semantics for modality (Kratzer, 1981, 2012), the modality involved is *event-relative*, rather than world-relative. That is, a set of modal alternatives is projected from an event of evaluation, rather than a world of evaluation. The modal base for the Progressive operator is a circumstantial one – it consists of the set of worlds w' where the circumstances surrounding event e in the evaluation world w also hold. Among the circumstances include properties of the event participants, such as their abilities and dispositions. The modal base is further relativized to an event description P . This move is important, since one and the same event may be described in different ways, but the nature of the event description has an effect on whether speakers judge a sentence containing a Progressive as true or false. Compare (29a) and (29b):

- (29) a. Alex was swimming westward.
b. Alex was swimming to New York.

Both sentences could in principle be used to describe one and the same event qua set of actions (e.g., Alex jumps into the ocean in Portugal and begins swimming west), but we would generally judge (29b) as false if Alex is a typical human who wouldn’t have the ability to swim all the

way across the Atlantic. The goal PP isn't part of the event description in (29a), and so doesn't figure in to our reasoning for deciding on its truth. An adaptation of Portner's formalization of the modal base is given in (30):

$$(30) \quad \text{Event-relative circumstantial modal base:} \quad (\text{cf. Hacquard 2010}) \\ \cap \text{CIRC}(e, P, t, w) \\ = \{w' \mid w' \text{ is compatible with the circumstances surrounding } e \text{ qua } P\text{-event at } t \text{ in } w\}$$

Second, in line with a Kratzerian analysis of modality, Portner makes use of an ordering source that further restricts the quantification over the modal base. For the Progressive, the ordering source is a set of propositions that represent the "set of outside factors that need to go right" (Portner, 1998: p.773) for the event in progress at the reference time to be completed. It is the set of propositions that entail that e qua P -event does not get interrupted, as in (31).

$$(31) \quad \text{Non-interruption ordering source:} \\ \text{NI}(e, P, t, w) = \{p \mid p \text{ entails that } e \text{ qua } P\text{-event in } w \text{ does not get interrupted after } t\}$$

The propositions in NI serve to order the worlds in CIRC. Worlds where more of the propositions in NI are true are better worlds than those where fewer propositions in NI are true. The idea is that the Progressive does not quantify over the entire modal base, but only a subset of the modal base which is ranked "best" or ideal according to the ordering source. We adapt Portner's definition of BEST in (32), where $w'' <_{\text{NI}} w'$ means that w'' is ranked better than w' according to the ordering source NI:

$$(32) \quad \text{BEST}(\text{CIRC}, \text{NI}, w) = \{w' \text{ in } \cap \text{CIRC} \mid \neg \exists w'' \text{ in } \cap \text{CIRC} \text{ where } w'' <_{\text{NI}} w'\}$$

The Progressive universally quantifies over the set of worlds in BEST, and those worlds (the "inertia" worlds) are those where a P -event is actually completed.

Finally, there is a temporal component to the Progressive, namely that the reference time be a non-final subinterval of the run time of the event that is completed in the inertia worlds. In other words, the event e ongoing at the reference time t is a temporal subevent of a P -event e' , whose temporal trace is a superset of and extends into the future of t .

Putting these pieces together, a Portner-style semantics for the Progressive can be modeled as in (33), where P is a property of events, τ is the temporal trace function, and $t \subset_{\text{non-final}} t'$ means that t is a non-final subinterval of t' .

$$(33) \quad \llbracket \text{PROG} \rrbracket = \lambda P_{\langle v, st \rangle} \lambda t \lambda w. \exists e [t \subseteq \tau(e) \ \& \ \forall w' \in \text{BEST}(\text{CIRC}, \text{NI}, w) [\exists e' \exists t' [t \subset_{\text{non-final}} t' \\ \ \& \ t' = \tau(e') \ \& \ P(e', w')]]] \quad (= \text{preliminary analysis of } \llbracket di_{(low)} \rrbracket)$$

This analysis accounts for the possible non-actualization of a P -event in the actual world. Although the actual world will be located in the circumstantial modal base, it might not be among the set BEST according to the ordering source (i.e., if the event gets interrupted).

Let us propose that the event-in-progress reading for Wolof *di* can be modeled using (33). The sentence (17), repeated here as (34), is given the truth conditions in (35), assuming a modal base and ordering source along the lines of (35a) and (35b).⁹

(34) Da-ma di (> damay) rëdd wërëngërël.
do.C-1SG IMPF draw circle
'I am drawing a circle.'

(35) $\llbracket \text{damay rëdd wërëngërël} \rrbracket$
 $= \lambda w. \exists e \exists t [t \subseteq \tau(e) \ \& \ \forall w' \in \text{BEST}(\text{CIRC}, \text{NI}, w) [\exists e' \exists t' [t \subset_{nfin} t' \ \& \ t' = \tau(e')$
 $\ \& \ \mathbf{draw}(sp, c, e', w')]]]$
 a. $\text{CIRC}(e, P, t, w) = \{ \text{'The speaker intends to draw a circle'}, \text{'The speaker knows how to draw a circle'}, \text{'The speaker is paying attention to the task'}, \dots \}$
 b. $\text{NI}(e, P, t, w) = \{ \text{'The speaker's paintbrush doesn't break'}, \text{'The speaker doesn't run out of paint'}, \text{'The speaker doesn't get distracted'}, \dots \}$

Summing up, the key ingredients of a Portner-style analysis of event-in-progress readings are an event-relative modal base (and ordering source), together with a forward-shifting temporal component (i.e., the runtime of a *P*-event extends into the future of the reference time in the inertia worlds).

4.2. Habitual readings

It is widely known that imperfectives in many languages are compatible with both event-in-progress and habitual readings (among others), and several proposals in the recent literature have emerged to make sense of this fact under a unified analysis of imperfectivity (Arregui et al. 2014; Cipria and Roberts 2000; Deo 2009; Ferreira 2016, among others). In this paper we will follow Ferreira (2016), since it is a recent analysis that explicitly and minimally extends Portner's analysis of the Progressive for habitual readings as well.

Ferreira aims to give a generalized meaning for imperfective morphology to account for the event-in-progress/habitual syncretism found in many languages. He argues that Portner's analysis for event-in-progress readings can be carried over straightforwardly to habitual readings as well, with one important innovation: event plurality. Specifically, Ferreira argues that the imperfective can apply to singular or plural events. When the imperfective applies to a singular event, the event-in-progress reading obtains; when applied to plural events, the imperfective yields a habitual reading.

On this view, the VP denotes a set of events, to which singular and plural event operators can apply, returning sets of singular and plural events, respectively. These operators apply at the VP level below Asp, and are defined in (36):

(36) a. $\text{SG}(\llbracket \text{VP} \rrbracket) = \{e_1, e_2, e_3, \dots\}$

⁹For simplicity, we assume the reference time variable is existentially bound in a tenseless clause.

$$b. \quad \text{PL}(\llbracket \text{VP} \rrbracket) = \{e_1 \oplus e_2, e_2 \oplus e_3, e_1 \oplus e_3, e_1 \oplus e_2 \oplus e_3, \dots\}$$

We can maintain the semantics for *di* following the denotation in (33), assuming that it applies not to VP directly, but to VP plus a singular or plural operator. When the singular operator applies, the event-in-progress reading obtains, as in (35).¹⁰ When the plural operator applies, the habitual reading obtains. Our analysis for the habitual sentence (19), repeated as (37), is given in (38):

(37) (Altime b-u nekk,) Faatu daf-a- \emptyset di (>dafay) rëdd ay wërëngërël.
Monday CM-C be, Fatou do-C-3SG IMPF draw INDEF.PL circle
'(Every Monday,) Fatou draws circles.'

(38) $\llbracket \text{Faatu dafay rëdd ay wërëngërël} \rrbracket$
 $= \lambda w. \exists e \exists t [t \subseteq \tau(e) \ \& \ \forall w' \in \text{BEST}(\text{CIRC}, \text{NI}, e) [\exists e' \exists t' [t \subset_{nf} t' \ \& \ t' = \tau(e')$
 $\ \& \ \text{PL}(\mathbf{draw}(f, c, e', w'))]]]]]$

For such a habitual sentence to be true, a single *P*-event need not be ongoing at *t*, but the run-time of a habit (a plurality of events) must be ongoing at *t*.

5. Future readings of *di*

In this section, we seek to extend the analysis for event-in-progress and habitual readings of *di* to future readings. We first explore whether the semantics we already have is enough to account for these readings, and we will see that there are problems. We then consider the possibility that future readings (for high *di*) make use of a metaphysical modal base instead.

5.1. Circumstances are not enough

While futures are in general typically analyzed as involving modality, future readings are not usually taken to involve circumstantial modality, but something else: either metaphysical (see Condoravdi, 2002; Copley, 2002, 2008; Kaufmann, 2005) or epistemic (see Giannakidou and Mari, 2018).

There is, however, a variety of futures that might plausibly be analyzed as involving circumstantial modality. These are the futurate readings of the present tense (with Progressive or non-Progressive aspect) in English (Copley, 2002, 2008).

(39) The Red Sox {play/are playing} the Yankees tomorrow.

(40) #The Red Sox {defeat/are defeating} the Yankees tomorrow.

As Copley and others have pointed out, these readings require that some kind of plan or schedule be available in the context. (40) is thus odd since it suggests that the game is fixed.

¹⁰Instead of the conjunct $\mathbf{draw}(sp, c, e', w')$ in (35), we have $\text{SG}(\mathbf{draw}(sp, c, e', w'))$.

Copley argues for a modal semantics of futurates that involves the following ingredients. First, such sentences (i) presuppose that there is some director d who is able to “direct” the prejacent proposition p , and (ii) assert that d is committed to bringing about that p in the worlds quantified over. Copley argues that futurates involve a metaphysical modal base with a bouletic ordering source. However, it seems intuitively plausible that a circumstantial modal base with non-interruption ordering source could also get these facts. We have already seen in (29) that dispositions and abilities of the event participants can be part of the circumstances of an event from which a modal base can be projected for event-in-progress readings (and Ferreira (2016) shows this to be true for habituals as well). If we can include a plan for a future event as part of the circumstances that hold at the reference time, then in principle the semantics we have already developed for *di* should be able to derive future readings as well.

The analysis for a sentence like (21), repeated here as (41), would look something along the lines of (42), where the event e that is ongoing at the reference time is the planning event, and e' is a temporal superevent that includes the planning event and the event of actually building the house.

- (41) [CONTEXT: I see Mbaye walking around the town with an architect, buying building materials, etc., and I ask our mutual friend what Mbaye is up to, and he tells me:]
 Mbaye daf-a- \emptyset di (> dafay) tabax kër.
 Mbaye do-C-3SG IMPF build house
 ‘Mbaye is going to build a house.’

- (42) $\lambda w.\exists e\exists t[t \subseteq \tau(e) \ \& \ \forall w' \in \text{BEST}(\text{CIRC}, \text{NI}, e)[\exists e'\exists t'[t \subset_{nf} t' \ \& \ t' = \tau(e') \ \& \ \text{SG}(\text{build.a.house}(m, e', w'))]]]]]$

Such an analysis does seem on track for the examples we have collected so far where a future reading is available for low *di*. In (22), for instance (see section 3), the relevant circumstances would be the fact that the doctor has prescribed the medicine and that Fanta plans to take it.¹¹

However, this analysis will not derive all the future readings available for sentences with *di*. In particular, there are several examples with high *di* which seem to simply involve a prediction, and a relation to any planning event seems tenuous at best, for instance (24) and (26) in section 3. It would seem, then, that not all future readings for high *di* can be accounted for using a circumstantial modal base.

5.2. Another modal base for future readings of high *di*

Following a Kratzerian view on modals (Kratzer, 1981, 2012), different modal flavors for one and the same modal is due not to ambiguity, but to the availability of different modal bases. Thus, epistemic and deontic *must* have the same lexical entry, but the different readings are due

¹¹A reviewer for SuB asks whether we have independent motivation for the idea that planning or preparatory events can be targeted by grammatical operators in Wolof. We have not yet been able to adduce such evidence from the data at our disposal.

to the availability of different sorts of modal bases (epistemic and circumstantial, respectively). Since our semantics for *di* makes use of a modal base and ordering source, we can extend the idea of having different modal bases available for *di* as well.¹²

Now, we have just seen that a circumstantial modal base won't derive the future readings for (high) *di* that don't seem to involve any sort of planning or preparatory event. Other authors have treated future readings as involving either metaphysical or epistemic modality. For Condoravdi (2002); Copley (2002, 2008); Kaufmann (2005) and others, futures involve a metaphysical modal base with inertial or bouletic ordering sources. For Giannakidou and Mari (2018), apparent 'futures' in Italian and Greek are always epistemic, but can receive their future temporal orientation from a non-past tense scoping under the modal.

In Wolof, we find that *di* cannot have an epistemic reading. In the context of (43), the modal *mën* is used instead.¹³

- (43) [CONTEXT: Loulou and I are expecting our friend Magatte and someone knocks.]
- a. #Di-na-∅ nekk Magatte.
IMPF-C-3SG be Magatte
intended: 'That will be Magatte.'
 - b. Mën-na-∅ nekk Magatte.
can-C-3SG be Magatte
'That could be Magatte.'

In the absence of evidence for epistemic uses of *di*, we will stick to the more standard view that futures are metaphysical. We will follow the idea that a metaphysical modal base consists of the set of possible futures branching from an evaluation time *t* (Condoravdi, 2002; Kaufmann, 2005; Klecha, 2016). The future orientation of a metaphysical modal base is derived via the *Diversity Condition* (Condoravdi, 2002), which requires that a modal base contain worlds where the prejacent (embedded) proposition is true and worlds where the prejacent is false. This condition derives future temporal orientation, since the past is already 'settled'. We take a metaphysical modal base to be anchored to world-time pairs, as in (44) (cf. Kush 2011; Klecha 2016).

- (44) METAPHYSICAL MODAL BASE:
 $\bigcap \text{METAPH}(< w, t >) = \{w' \mid w' \text{ is identical to } w \text{ up to time } t\}$

We will assume a stereotypical inertial ordering source; cf. Copley (2002, 2008), where the ordering source for futures can also be bouletic. Putting these pieces together, a preliminary semantics for the future readings of (high) *di* can be modeled as in (45), where *P* is now a

¹²Arregui et al. (2014) also make use of different types of modal bases to derive the variability in the interpretation of imperfectives in several languages.

¹³Further examples of this kind should be tested. For instance, Winans (2016) shows that there are interpretational differences in English between the two types of epistemic statements using *will*:

- (i) a. That will be the neighbors barbecuing.
- b. The neighbors will be barbecuing.

property of times. A preliminary analysis of (25), repeated below as (46), is then given in (47).

(45) **Preliminary proposal for future readings of *di*:**

$$\llbracket di_{high} \rrbracket = \lambda P_{\langle i, st \rangle} \lambda t \lambda w. \forall w' \in \text{BEST}(\text{METAPH}, \text{STER}, t, w) [\exists t' > t [P(t', w')]]$$

- (46) Musaa di-na-Ø ñëw.
 Moussa IMPF-C-3SG come
 ‘Moussa will/is going to come.’

(47) $\lambda w. \exists t [\forall w' \in \text{BEST}(\text{METAPH}, \text{STER}, t, w) [\exists e \exists t' [t' > t \ \& \ t' \circ \tau(e) \ \& \ \text{come}(m, e, w')]]]$

A couple of comments are in order before we continue. First, we assume that when *di* takes a metaphysical modal base, the event variable is existentially closed. Second, we assume that the metaphysical readings for futures subsume the circumstantial ones, i.e., futures where there is a planning or preparatory event ongoing at the reference time are compatible with a metaphysical modal base as well, so we don’t rule out the compatibility of circumstantial futures with (45). Finally, we note that the future temporal profile of *di* is derived in two different ways, comparing (45) with (33). We discuss this issue more in the next section, after detailing our proposal for connecting modal flavor with the syntactic position of *di*.

6. Modal variability and syntactic height

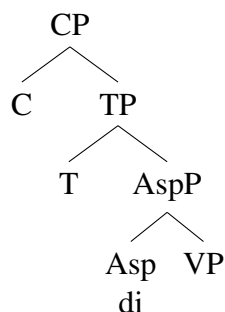
Taking stock of where we have come, we have proposed that the different readings for *di* are derived by different types of modal bases. The event-in-progress and habitual readings, as well as future readings involving a planning or preparatory event, are derived by a circumstantial modal base anchored to an event. The other future readings involve a metaphysical modal base anchored to a world-time pair. Recall as well that the availability of these readings depends on the syntactic position where *di* appears in the clause. For low *di*, the readings available are those derived from a circumstantial modal base. For high *di*, the only reading available is the future reading, based on a metaphysical modal base. The remaining work, then, is to correlate the choice of modal base for *di* with its syntactic position, which will in turn derive the desired readings for *di* in the two positions.

The availability of certain readings depending on syntactic height is reminiscent of the generalization that epistemic and root modality correlate with modals occupying high and low positions, respectively (e.g., Cinque 1999; Hacquard 2006, 2010; Kush 2011). Under Hacquard’s analysis, low-scoping modals (below T) necessarily take a circumstantial modal base, and high-scoping modals (above T) necessarily take an epistemic modal base. We too derive the readings for low *di* via a circumstantial modal base. If we follow Hacquard closely, the modal base would be *epistemic* for high *di*. We have already argued against having an epistemic modal base for high *di*, and settled on a metaphysical modal base to derive the future readings of high *di*.

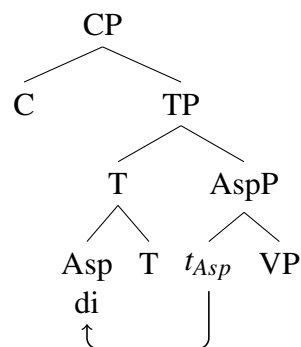
We propose the following. Low *di* is located in Asp, where only a circumstantial modal base is available. High *di*, in contrast, moves to its high position via T, where it has access to a

metaphysical modal base. The structural aspect of our proposal is sketched in (48)-(49).

(48) CIRC modal base



(49) METAPH modal base



The mechanics of the proposal are as follows. The choice of modal base for *di* not only correlates with syntactic height, but also with the semantic type of *di*'s complement. When *di* is in Asp, its complement (VP) is type $\langle v, st \rangle$. When *di* is in T, its complement (AspP) is type $\langle i, st \rangle$. This type difference in turn determines the type of modal anchor available to derive the modal base. In Asp, the modal anchor available to *di* is an event, which projects a circumstantial modal base (cf. Portner 1998; Hacquard 2010); in T, the modal anchor available to *di* is a world-time pair, which projects a metaphysical modal base (cf. Kush 2011).

Our final proposal for the semantics of *di* in its different positions is as follows in (50):

(50) When *P* is eventive:

$$\llbracket di_{low} \rrbracket = \lambda P_{\langle v, st \rangle} \lambda t \lambda w. \exists e [t \subseteq \tau(e) \ \& \ \forall w' \in \text{BEST}(\text{CIRC}, \text{NI}, w) [\exists e' \exists t' [t \subset_{nfin} t' \ \& \ t' = \tau(e') \ \& \ P(e', w')]]]]$$

When *P* is temporal:

$$\llbracket di_{high} \rrbracket = \lambda P_{\langle i, st \rangle} \lambda t \lambda w. \forall w' \in \text{BEST}(\text{METAPH}, \text{STER}, t, w) [\exists t' > t [P(t', w')]]$$

Although our analysis is disjunctive, the readings that are (un)available for *di* are still derived in a systematic way. The lexical entries don't make direct reference to the syntactic position of *di*, but rather depend on the semantic type of its complement.¹⁴

One issue that remains in deriving a truly unified analysis for all uses of *di* lies in the temporal component. Although both entries for *di* in (50) have a future-oriented temporal interpretation, the ways in which this is derived is different for high and low *di*. For high *di*, there is a direct future-shifting meaning incorporated into its semantics: there is a time *t'* in the future of the reference time *t* of the clause. For low *di*, the future orientation is a bit more indirect. An event *e'* takes place over the interval *t'*, which is a superinterval of the reference time *t*. Since it is specified that *t* be a non-final subinterval of *t'*, it follows that a part of *t'* continues into the future of *t*. It is thus only the culmination of *e'* that is guaranteed to be in the future of *t*.¹⁵

¹⁴If we assume a temporal variable located in the T head (cf. Bochnak and Martinović 2017), then given the tree in (49), the order of the first two arguments for *di* when *P* is temporal should be reversed, with the semantic type for *di* in this case being $\langle i, \langle \langle i, st \rangle, st \rangle \rangle$.

¹⁵Recall that in the case of circumstantial futures, *e'* includes preparatory stages ongoing at the reference time.

Given the connection we have proposed between the type of modal anchor and the semantic type of the modal operator’s complement (following Kush 2011), we can ask how an epistemic modal base would be derived in such a system. Kush (2011) proposes that an epistemic modal base is projected from a world anchor, which is available when a modal has a complement of type $\langle s, t \rangle$, i.e., when a modal is located higher than T.¹⁶ If this idea is on the right track, the natural question is why (high) *di* cannot take on an epistemic modal flavor, given that it appears in C after moving through T (see (16)), where it presumably has a complement of type $\langle s, t \rangle$.

We make the following speculations. First, there could be a lexical specification in *di* that it cannot take an epistemic modal base. Although many modals (in English and other languages) can take a variety of modal bases to take on a variety of modal flavors, certain modals are lexically restricted to certain flavors. For example, the German modal *dürfen* is restricted to deontic interpretations in the indicative mood. So it could be that *di* is restricted to circumstantial and metaphysical modal bases. This would be a stipulation, but would rule out epistemic modal bases for *di*. Second, it could be that something about the temporal/aspectual profile of *di* is incompatible with an epistemic modal base. For instance, certain authors have argued that there is no future epistemic readings for English *must* (Werner, 2006). However, Giannakidou and Mari (2018) argue for future epistemic readings in Greek and Italian, and Winans (2016) offers the following example as a future reading of epistemic *must* in English:

(51) John must leave tomorrow, the train only leaves once a month and it is tomorrow.

Thus, it is not clear that there is some deep incompatibility between futurity and epistemic modality that would independently rule out epistemic interpretations for *di*. We leave a more principled investigation into why *di* cannot take on epistemic readings for future research.

Another remaining question has to do with the correlation of syntactic height and modal flavor. On our analysis, low *di* has the readings it does because it sits in Asp, and only has access to a circumstantial modal base projected from an event. Meanwhile, high *di* moves through T and receives its metaphysical modal base in that position. However, given the analysis in section 2 based on Martinović (2015), *di* continues to move up to C. We have speculated why *di* cannot receive an epistemic modal base in the C position, but another question remains. If high *di* can pick up its modal base in T before moving on to C, why can it not pick up a circumstantial modal base in Asp before moving on to T and C? In other words, what rules out the progressive and habitual readings for high *di* in our analysis? There are a couple directions one could take to address this question. First, there could be a general principle at work such that *di* must receive its modal base in the highest position possible, while independently ruling out taking on an epistemic modal base in C. We know of no independent motivation for such an analysis. Second, perhaps *di* receives a metaphysical modal base in C after all, and not in T. The mechanics of such an analysis remain to be worked out, but if a world-time pair anchor for a metaphysical modal base were available when *di* is in C, then this would take care of at least part of this issue. For now, we must leave the spelling out of these suggestions for future research.

¹⁶Compare Hacquard (2010), where all modal bases are projected from events.

7. Conclusions

To sum up our analysis of the puzzle we introduced at the beginning, we correlate the available readings for Wolof *di* with its syntactic height. For low *di* in Asp, the modal base is anchored by an event, deriving a circumstantial modal base and Portner/Ferreira semantics for progressives and habituals, and circumstantial future readings. For high *di* in T, the modal base is anchored by a world-time pair and is metaphysical, and only a future interpretation is derived. The choice of modal base depends on type of modal anchor, which depends on semantic type of *di*'s complement.

Our analysis offers a new cross-linguistic perspective on the way modal height determines modal flavor via different types of modal anchors. We have departed from Hacquard (2010) in not claiming that all modal bases are projected from events, but the analysis we propose is along the same spirit, in that objects other than worlds can project a modal base. This case study from Wolof furthermore contributes to our understanding of the modal ingredients of aspectual operators, and more generally of the interactions between aspect, modality and temporality in natural language.

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Miners and modals¹

David BOYLAN — *Massachusetts Institute of Technology*

Abstract. I generalise Kolodny and MacFarlane’s miners puzzle by showing epistemic analogues of their case exist. After motivating various conservative approaches to the original problem, I show how they fail to solve the problem in its epistemic guise. I argue that a probabilistic approach to information-sensitivity gives a general solution to the problem.

Keywords: deontic modals, miners puzzle, epistemic ‘should’, probability.

1. Introduction

Kolodny and MacFarlane introduced the infamous miners problem to the literature on deontic modals. I show that this semantic puzzle runs deeper than previously thought: there are epistemic analogues of Kolodny and MacFarlane’s case and they have a variety of upshots for our understanding of the problem.

After outlining the classic semantics and the problem it faces in section 1, I clarify what questions are at stake in section 2. Miners cases motivate not just a more expressive semantics but also the use of orderings based on measure-theoretic notions like expected utility and probability in our semantics for ‘ought’ and ‘should’. I show in section 3 that epistemic miners cases pose a major stumbling block for responses that try to avoid appealing either to information-sensitivity or measure-theoretic tools. Classic responses like Kratzer’s and Cariani, Kaufman, and Kaufman’s are geared explicitly towards the deontic case and do not generalise naturally. In section 4, I argue that information-sensitivity should be understood as a probabilistic phenomenon. I give an emendation of the classic semantics that can access probabilistic orderings and is sensitive to conditionalisation.

2. The problem

Take the following case from Kolodny and MacFarlane (2010):

Miners. Ten miners are trapped either in shaft A or in shaft B, but we do not know which. Flood waters threaten to flood the shafts. We have enough sandbags to block one shaft, but not both. If we block one shaft, all the water will go into the other shaft, killing any miners inside it. If we block neither shaft, both shafts will fill halfway with water, and just one miner, the lowest in the shaft, will be killed.

The following sentences seem true here:

- (1) I ought to block neither shaft.

¹Thanks to audiences at Sinn und Bedeutung 22 and the New York Philosophy of Language Workshop, three anonymous referees for Sinn und Bedeutung, Kai von Fintel, Milo Phillips-Brown, Ginger Schultheis, and, especially, Justin Khoo and Robert Stalnaker.

(2) If the miners are in shaft A, I ought to block shaft A.

(3) If the miners are in shaft B, I ought to block shaft B.

Surprisingly, it has been shown that the classic view of ‘ought’ and ‘should’ cannot predict the joint truth of (1) – (3).²

2.1. Information and the classical theory

The classic view, so-called in von Fintel (2012), assumes that ‘ought’ and ‘should’ are necessity modals:³ ‘ought ϕ ’ is true just in case for any world w in the modal’s domain ϕ is true at w . More precisely:

$$\llbracket \text{ought } \phi \rrbracket^{c,i} = 1 \text{ iff } \forall w' \in \text{BEST}(i) : \llbracket \phi \rrbracket^{c,i[w_i \rightarrow w']} = 1^4$$

This aspect of the classic view will not be under dispute here.

The classic view also says how the domain, $\text{BEST}(i)$, is determined. Following Kratzer,⁵ it is constrained by two ingredients, a modal base, f , and an ordering source, g . The modal base is a function from worlds to sets of propositions.⁶ These propositions represent the information we take to be held fixed in the background. The relevant body of information might be what a given agent knows, in which case the modal base is *epistemic*. Or it might simply be what is compatible with some relevant set of facts, in which case the modal base is *circumstantial*. On the classic theory, the role of the modal base is simply to restrict the domain of quantification: only worlds in the intersection of the modal base can feature in the domain of quantification.

The ordering source is used to construct an ordering on worlds. Its job is to represent, for each world, what the relevant priorities are. To do this, we let the ordering source be a function from worlds to sets of propositions, a function that, when given a world, yields us the set of priorities at that world. We generate an ordering from this as follows:

$$w_1 \leq_{w,f,g} w_2 \text{ iff } \{p \in g(w) : w_1 \in p\} \supseteq \{p \in g(w) : w_2 \in p\}$$

In other words, w_1 is at least as good as w_2 relative to $\langle w, f, g \rangle$ just in case w_1 makes true all the propositions in $g(w)$ w_2 does and possibly more.

The domain of quantification of the modal is just the set of top \leq -ranked worlds compatible

²See, for instance, Charlow (2013), Cariani et al. (2013), Silk (2014).

³This semantics has been challenged by many: see, for instance, Lassiter (2011) and Cariani (2013). However, such challenges are orthogonal to the problem discussed here and so we can safely use the above semantics as our working theory.

⁴Here i is a variable over indices and $i[w_i \rightarrow w']$ is the index formed by replacing the world in i with w' .

⁵Kratzer (1977), Kratzer (1991).

⁶When it does not cause confusion, I sometimes use the term ‘modal base’ to pick out what is strictly speaking the intersection of modal base.

with the information in the modal base.⁷ In other words,

$$BEST(w, f, g) = \{w \in \cap f(w) : \neg \exists w' \in \cap f(w) : w' <_{w, f, g} w\}$$

For us, the important feature of the classic semantics is that it rules out any interaction between these parameters: the ordering does not vary as we vary the modal base (but keep the other parameters fixed). In other words, on the classic semantics we have

No *f*-shifting: For any modal bases f_1 and f_2 , given a world w and ordering source g , $w_1 \leq_{w, f_1, g} w_2$ iff $w_1 \leq_{w, f_2, g} w_2$.⁸

Given this principle, the only role for the modal base is to direct our attention to a certain portion of the ordering.

This is the crucial feature of the classic semantics: even as we add information to the modal base, the classic semantics will keep the background ordering on possibilities fixed.

2.2. The need for information-sensitivity

Miners challenges **No *f*-shifting:** Kolodny and MacFarlane (2010) have argued that, on their deontic readings, adding information can change the relevant ordering for ‘ought’ and ‘should’. In particular, they think **Miners** shows that worlds can move up in the ordering as we add more information to the modal base.

To see why the classic semantics struggles here, we will need a theory of conditionals. I adopt throughout Kratzer’s restrictor theory of conditionals.^{9,10} On this theory, ‘if’-clauses restrict the domain of the modal in the consequent. More formally, where $f + \phi$ is the modal base such that $f + \phi(w) = f(w) \cup \{\phi\}$, we have:

$$(4) \quad \llbracket \text{if } \phi \text{ then } MODAL \psi \rrbracket^{c, w, f, g} = 1 \text{ iff } \llbracket MODAL \psi \rrbracket^{c, w, f + \phi, g} = 1$$

Conditionals like (2) and (3) then have the following truth-conditions:

$$\llbracket \text{if } \phi \text{ then ought } \psi \rrbracket^{c, w, f, g} = 1 \text{ iff } \forall w' \in BEST(w, f + \phi, g) : \llbracket \psi \rrbracket^{c, w', f + \phi, g} = 1$$

So ‘if ϕ then ought ψ ’ will be true just in case all the best worlds which are ϕ -worlds are also ψ -worlds.

⁷Here and throughout I make the limit assumption in stating the classic semantics.

⁸It is straightforward to see that this holds on the classic semantics. While f is an argument for \leq , it actually does not appear on the right-hand side of the definition. Hence, on the classic semantics it is a redundant argument. I include it as an argument to emphasise the point that the classic semantics does not allow the order to shift as the modal base changes.

⁹Kratzer (1991), Kratzer (2012).

¹⁰As Charlow (2013) shows, the problem still arises even if we adopt other theories of the conditional, such as those of Stalnaker (1968) and Lewis (1973).

To see why **Miners** creates a problem, it will help to get some parameters on the table. I do not know the location of the miners, so $\cap f(w)$ will contain worlds where they are in shaft A and worlds where they are in shaft B.¹¹ Given that I have not made up my mind about what to do, the modal base will also contain worlds where I block shaft A, where I block shaft B and where I block neither. Since this is the only relevant information here, we can simplify and represent my knowledge with this set of worlds:

$$\cap f(w) = \{(A, blA), (A, blB), (A, blN), (B, blA), (B, blB), (B, blN)\}$$

We'll take $g(w)$ to say that I should save as many miners as I can; or in other words,

$$g(w) = \{I \text{ save } 10 \text{ miners}, I \text{ save } 9 \text{ miners}, \dots, I \text{ save } 1 \text{ miner}\}^{12}$$

Given these parameters, we can see that the best worlds will be ones where I block the correct shaft. So the ranking will be

$$(A, blA), (B, blB) < (A, blN), (B, blN) < (A, blB), (B, blA)$$

This will give us the right predictions for (2) and (3). $BEST(w, f+A, g)$ will be $\{(A, blA)\}$ and $BEST(w, f+B, g)$ will be $\{(B, blB)\}$. But we fail to predict the truth of (1). $BEST(w, f, g)$ will be a superset of $BEST(w, f+A, g)$, namely $\{(A, blA), (B, blB)\}$. In both of these worlds I block one of the shafts. This forces us to predict that (1) is false, the wrong prediction.

We can also consider what happens if we pick an ordering source which predicts the truth of (1).¹³ Suppose $BEST(w, f, g)$ is $\{(A, blN), (B, blN)\}$. This predicts that (1) is true: both worlds are ones where I block neither shaft. But now notice that $BEST(w, f, g)$ contains worlds where the miners are in A; so $BEST(w, f+A, g)$ will be $\{(A, blN)\}$. But then, (2) is false: all the best worlds where the miners are in A are worlds where I still block neither shaft. For similar reasons, we will predict (3) is false.

In either case, we have a problem: we cannot both keep the background ordering of worlds fixed and predict the truth of (1), (2) and (3). Kolodny and MacFarlane's diagnosis is that, to make the right predictions, $BEST$ must be defined in such a way that makes it *information-sensitive*:

$BEST$ is information-sensitive iff there exist f_1, f_2 and w such that:

1. $\cap f_1(w) \supseteq \cap f_2(w)$
2. $BEST(w, f_1, g) \cap \cap f_2(w) \neq \emptyset$
3. $\exists w' : w' \in BEST(w, f_2, g) \ \& \ w' \notin BEST(w, f_1, g)$

¹¹It is shown in Cariani et al. (2013) how the problem arises for a circumstantial modal base. In fact, as we are about to see, the problem is independent of the particular choice of parameters.

¹²I use italicisation to refer to propositions i.e. ' p ' denotes the propositions that p .

¹³From the results in Lewis (1981) we know there will have to be some such ordering source. But we will also see an example of an ordering source which makes similar predictions in section 3.1.

To see why the miners case seems to involve information-sensitivity, let us show that each condition appears to be met in **Miners**. Condition 1 follows from the set-up of the case and the restrictor semantics: we leave open possibilities where the miners are in A , so $\cap f(w) \supseteq \cap f + A(w)$. Condition 2 follows also from the set-up of the case: the best worlds, the ones where I block neither, include worlds where the miners are in A and worlds where they are in B . The crucial condition is condition 3. This condition is met just in case $BEST(w, f + A, g)$ contains something that was not originally in $BEST(w, f, g)$. And indeed, if (2) is true, then there must be such a world, (A, bIA) .¹⁴

Information-sensitivity is incompatible with **No- f -shifting**. It is a consequence of **No- f -shifting** that, when there are ϕ -worlds in $BEST(w, f, g)$, then $BEST(w, f + \phi, g)$ is $BEST(w, f, g) \cap \phi$. That is, whenever we add a proposition ϕ to the modal base that is true some of the best worlds, the new best worlds are always the old ones where ϕ is true. **Miners** appears to be a counterexample: the conditionals add a new proposition to the modal base that is true in some of the best worlds; but the new set of best worlds in fact must be *disjoint* from the old one.

Thus it looks like we need some new way of defining $BEST$ which allows the ordering to shift as we add information to the modal base. This is the semantic challenge of the miners case.¹⁵

3. What is at stake

The literature has gone in different ways from this point, taking various morals from the case. I will try to carve out what seem to me the key questions here. In doing so, I will try to get clear on what reasons there might be to favour the various conservative impulses the literature has displayed.

3.1. A pragmatic solution

The first, most straightforward question is whether we really need to add information-sensitivity to our semantics. When semantic explanations fail, it is natural to turn to pragmatics for an answer. By doing so, we might explain the judgments in **Miners** without altering the classic semantics. We'll call a theory that tries to do without any information-sensitivity a *very conservative* theory.

Adding information-sensitivity has met with strong resistance in some quarters.¹⁶ For some, information-sensitivity is a deeply dubious property. Charlow (2013) for instance asks how

¹⁴In fact, something somewhat stronger will have to be true: $BEST(w, f, g)$ and $BEST(w, f + A, g)$ will have to be *disjoint*. However, the weaker principle, information-sensitivity, captures the main conceptual contrast with the classic semantics, the idea that possibilities get ranked higher as we get more information.

¹⁵The semantic challenge is to be distinguished from what we might call the *inferential* challenge. As Kolodny and MacFarlane note, (1), (2) and (3) together give us a counterexample to modus ponens. This feature of the case will not concern us here. Moreover, as has been shown in Khoo (2013), our background theory of conditionals, the restrictor view, does not validate modus ponens anyway.

¹⁶See, for instance, von Stechow (2012).

it could be possible that certain worlds get *better* as more information is added.¹⁷ But this reads too much into the semantics: even when the modal is deontic, our ordering need not represent how good worlds themselves are. Preference orderings can surely change as we get more information: which possibilities seem best to me can change as I gain more information.

That being said, resistance here *is* well-motivated, even if not by the reasons that have been given. Adding information-sensitivity would result in a theory more expressive than the classic theory. As well as the readings provided by the classic semantics, we now predict new possible interpretations of modals where shifting the modal base shifts the ordering. But we should prefer less expressive theories where possible: if we can postulate fewer possible readings and still capture the data, then that is what we should do. In this case, we should wonder if we can capture the appearance of information-sensitivity using some pragmatic mechanisms.

The main kind of very conservative response denies that (1), (2) and (3) are all evaluated within the same context. In particular, it claims that the ordering source used to evaluate (1), the ‘subjective’ ought, is different from that used to evaluate (2) and (3), the objective ‘ought’. As outlined in von Fintel (2012),¹⁸ such a strategy can successfully predict the judgements. Suppose the ordering source for (1) were

$g_{(2)}(w) = \{ \text{If we know where the miners are, our chosen action yields the optimal outcome for the miners, If we do not know where the miners are, our chosen action yields a still acceptable outcome for the miners and would not yield a less acceptable outcome if they weren't where they in fact are} \}$

We then get the result that (1) is true. If we suppose that the ordering source for (2) and (3) is

$g_{(2)}(w) = \{ I \text{ save } 10 \text{ miners, } I \text{ save } 9 \text{ miners, } \dots, I \text{ save } 1 \text{ miner} \}$

we predict true readings for both.

Context-shifting strategies are only as plausible as the claim that context might supply those parameters. But these particular parameters are plausible. There is a genuine difference between the subjective and the objective ‘ought’: the former tracks what we should do given what we know, and the latter tracks what would be best for us to do given all the facts. What’s more, it gives us an understanding of the case which is intuitively satisfying. This approach cannot be accused of dreaming up *ad hoc* parameters to solve the problem.

3.2. A non-probabilistic solution?

There is another aspect of the classic semantics at stake, even if we admit information-sensitivity. If ‘ought’ is information-sensitive, there is a serious question about where the information-

¹⁷It is not clear that this is Charlow’s final view on the matter. (See, for instance, Charlow (2016).) But this thought does seem to account for some of the suspicion of information-sensitivity in the literature.

¹⁸Von Fintel attributes it to unpublished notes by Kratzer.

sensitivity comes from. MacFarlane and Kolodny give no clear guidance here — nothing in their system tells us anything about how it is to be generated. But our semantics should be predictive. Given a plausible story about the context, it should tell us *why* information-sensitivity comes into play in cases like miners.

The classic semantics gives us a very clear story about where our orderings come from: they are constructed out of sets of propositions by appeal to entailment. Something like this story might yet hold up, even if the classic semantics must be altered in other ways. This brings us to our second question: can miners cases be explained using only possible worlds machinery? This question is an important one about the structure of our theory of modal vocabulary and its relations to other important concepts. We'll call a theory that answers *no* to this question a *moderately conservative* account.

It is striking that the judgements in the miners case track natural judgements about the expected utilities: blocking neither shaft has the highest expected utility; and conditional on the miners being in A, blocking A has the highest expected utility (and similarly for B). But such measure-theoretic notions carry far more information than measure-theoretic tools: they tell us not just how possibilities are ranked, but carry information about *how much* better certain possibilities are than others. Before allowing these kinds of structures to access our semantics for modals, we should want good reason to think they are needed.

A leading moderately conservative theory is that of Cariani et al. (2013). This semantics allows information-sensitivity but remains close to the spirit of the Kratzer framework in constructing its orderings. Cariani, Kaufman, and Kaufman (CKK from henceforth) add a decision problem to the Kratzer semantics, a set of propositions representing the actions available to an agent in a given scenario. For instance, in the miners case, the decision problem δ would be $\{I \text{ block } A, I \text{ block } B, I \text{ block neither}\}$. What ends up being important is not just the decision problem but also the decision problem as restricted by the modal base. Such a restriction is obtained by intersecting each member of the decision problem with the modal base. In our example, the decision problem restricted by f would be $\{I \text{ block } A \text{ and the miners are either in } A \text{ or } B, I \text{ block } B \text{ and the miners are either in } A \text{ or } B, I \text{ block neither and the miners are either in } A \text{ or } B\}$.

Importantly, the relevant orderings on worlds, though information-sensitive, are still generated by means of entailment. An ordering is defined on the members of the restricted decision problem and used to create a corresponding ordering on worlds. A member of the decision problem p is at least as good as another q just in case p entails all the same ordering source propositions as q and maybe more. More precisely:

$$p \lesssim_{f,g,w} q \text{ iff } \{r \in g(w) : p \subseteq r\} \supseteq \{s \in g(w) : q \subseteq s\}$$

A world is then taken to be just as good as the restricted decision problem proposition of which it is a member. Where $\Delta_{\delta,f}(w)$ denotes the decision problem proposition (as restricted to f) containing w , we say that $w' \leq_{w,f,g,\delta} w''$ just in case $\Delta_{\delta,f}(w') \lesssim_{f,g,w} \Delta_{\delta,f}(w'')$. Our clause for the modal is more or less as before:

$$\llbracket \text{ought } \phi \rrbracket^{c,w,f,g} \text{ iff } \forall w' \in \text{BEST}(w, f, g, \delta) : \llbracket \phi \rrbracket^{c,w',f,g} = 1$$

where the *BEST*, like before, is:

$$\text{BEST}(w, f, g, \delta) = \{w \in \cap f(w) : \neg \exists w' \in \cap f(w) : w' <_{w,f,g,\delta} w\}$$

4. Epistemic miners cases

I have shown that conservativity at each point is well-motivated. But now that we have built it up, I intend to knock it down. Both kinds of conservativity are insufficiently general. There are epistemic analogues of **Miners** and conservative solutions cannot account for them.

4.1. The case

So far we have seen only deontic ‘ought’s. But ‘ought’ can also be read *epistemically*. For example, suppose that Jane has been told the bus left 30 minutes ago and it usually takes 40 minutes to get to her bus stop. Jane might truly say

(5) The bus ought to arrive in 10 minutes.

This sentence says that it is probable, given Jane’s evidence, that the bus will arrive in 10 minutes. More generally, ‘ought ϕ ’ seems to communicate that ϕ is probable, given the relevant agent’s evidence.

Once we have isolated the epistemic ‘ought’, it becomes natural to ask whether it too is (apparently) information-sensitive. If so, then we should be able to generate cases analogous to **Miners** for the epistemic ‘ought’. In fact we can. Take the following case:

Exam. Alex and Billy are the top math students in their class and will take their weekly algebra exam tomorrow.

- Alex does best in 66% of the exams.
- Given that Billy studies tonight, Billy will probably get the best grade: out of exams he studied for, Billy did best in 66% of them.
- Given that Billy doesn’t study, Billy will certainly not do best. Alex did better in all of the exams that Billy didn’t study for.
- Billy always lets a fair coin toss decide whether he will study. He studies just in case it comes up heads.

Imagine we are asked who will do best and consider the following replies:

(6) Alex should do best.

(7) But, if turns out that Billy studied, then he should do best.

Both seem true here. The first seems true because, given what we know, it is more likely that Alex will do best. The second seems true because, were we to learn that the coin came up heads, we would think it more likely that Billy will do best.

Just as in **Miners**, the classic semantics cannot predict the truth of both (6) and (7). We can see that $BEST(w, f, g)$ should both contain worlds where Billy studies and worlds where he doesn't. After all, it's neither likely that he will nor likely that he won't.¹⁹ So $BEST(w, f, g) \not\subseteq Billy\ studies$ and $BEST(w, f, g) \not\subseteq Billy\ doesn't\ study$. To predict (6), we need the set of best worlds to entail the proposition that Alex does best. So we want $BEST(w, f, g) \subseteq Alex\ does\ best$. To predict (7), we want the set of best worlds which are worlds where Billy studies to be ones where Billy does best. In other words, we want $BEST(w, f + Billy\ studies, g) \subseteq Billy\ does\ best$.

Suppose we have $BEST(w, f, g) \subseteq Alex\ does\ best$, $BEST(w, f, g) \not\subseteq Billy\ studies$ and $\not\subseteq Billy\ doesn't\ study$. This means that the updated modal base we use to evaluate (7) is consistent with $BEST(w, f, g)$: as we said, $BEST(w, f, g)$ neither entails that Billy studies nor that Billy doesn't study. This means that $BEST(w, f + Billy\ studies, g)$ must be a subset of $BEST(w, f, g)$. But if $BEST(w, f + Billy\ studies, g)$ is a subset of $BEST(w, f, g)$, then $BEST(w, f + Billy\ studies, g)$ also entails that Alex studies. We then fail to predict that (7) is true. So whenever $BEST(w, f, g)$ contains both worlds where Billy studies and ones where he doesn't, if we make (6) true, we are forced to make (7) false.

Information-sensitivity looks to be needed here too. Condition 1 is met because of the restrictor semantics: the modal base used to evaluate (7) is a subset of that used to evaluate (6). Condition 2 is met: $\cap f + Billy\ studies(w)$ is consistent with $BEST(w, f, g)$; in other words, the set of best worlds is consistent with the antecedent of (7). Finally, the third condition is satisfied. $BEST(w, f, g)$ and $BEST(w, f + Billy\ studies, g)$ must be disjoint. If (6) is true, then all worlds in $BEST(w, f, g)$ are ones where Alex does best; if (7) is true, all worlds in $BEST(w, f + Billy\ studies, g)$ are ones where Billy studies; and, of course, in no worlds do they both do best.

By running it through the classic semantics, we can see that **Exam** has the same problematic structure as **Miners**. We shall now see that unlike the original case, our epistemic miners case is also problematic for conservative solutions.

4.2. Against context-shifting

As we saw, the most natural very conservative strategy posits a context-change in **Miners**: the ordering source used to evaluate (1) is different to that used for (2) and (3). It will have to say

¹⁹What's more, neither of the sentences

(i) Billy should study.

(ii) Billy should fail to study.

has a true reading here.

something similar about **Exam**. The ordering source used to evaluate (6) (call it $g_{(6)}$) is not that used to evaluate (7) (call it $g_{(7)}$).

But notice that if $g_{(6)}$ is available in the context, then we predict that it should be available to evaluate the conditional:

(8) (Even) if Billy studied, Alex should get the best results.

If this were the case, (8) should have a true reading. It would be heard to say:

(9) Even if Billy studied, it is still the case that, just given what we know *now*, Alex should get the best results.

But this is not the case: (8) has no true reading here. The context-shifting strategy thus over-generates here: it predicts that, in addition to (7), we should also have a true reading of a conditional like (8). This is a bad prediction for the context-shifting view. Overgeneration is the hallmark of too much context-sensitivity.

The proponent of this strategy will have to say that, for some reason, the ordering source used to evaluate (6) is not available for (8). This is puzzling, particularly when (6) and (7) are uttered in sequence. They would be claiming the context shifts in such a way that, instead of giving (8) a true and non-trivial reading, it delivers instead a *false* reading of the sentence. None of the familiar mechanisms of context-change, such as accommodation in the sense of Lewis (1979), fit this profile. When context change happens, very often it does so to interpret a speaker charitably. Accordingly, it rarely changes to make utterances *false*. There is no obvious reason why the steadfast reading of (8) should be inaccessible.

Note that things get worse when we look back to **Miners**. Consider the following conditional:

(10) Even if the miners are in shaft A, I ought to block neither shaft.

This conditional is structurally analogous to (8); but unlike (8), this conditional is actually true here. This disparity poses an extra challenge for the very conservative theorist. Whatever way we try to explain the overgeneration here, we do *not* want it to carry over to the original miners case. As we noted, a steadfast reading is genuinely accessible there and so the context-shifting strategy must walk a fine line: its story must be strong enough to secure that there is no true reading of (8), but must not rule out a steadfast reading of (10). It is not clear how this could be done.

This issue does not put the same pressure on a non-conservative view. Unlike the context-shifting view, it need not say that some available ordering source makes (8) true. It can posit an ordering source in **Miners** to make (10) true. But such a view is under no obligation to say the same thing for (8). This is a considerable advantage: when we posit just one ordering source to explain the truth of (6) and (7) we never open up the question of how we avoid predicting a true reading of (8).

4.3. Against moderate conservativity

Exam poses a separate and severe challenge for the approach in Cariani et al. (2013). Their account relies heavily on deontic features of the scenario in **Miners** to predict the consistency of the original miners sentences. But just this feature makes it hard to see how their theory can be adapted to the epistemic case.²⁰

The first problem is how to interpret the decision problem parameter. Decision problems model the choices an agent must make in a given scenario; but in the scenario we outlined, there is no such choice at issue. In such a case, CKK say that the decision parameter should be set to the set of all worlds. This is designed to make the decision problem redundant, as they suppose the decision parameter will not be needed outside of deontic contexts. But naturally the decision problem for **Exam** must be non-trivial.

Probably the best way to generalise the view here is to think of the decision problem more generally as some salient partition of the modal base. In **Exam** we might let the decision problem be

$$(11) \quad \{Alex\ does\ best, Billy\ does\ best\}.$$

Even still, when we give the semantics plausible ordering sources, it does not make the right predictions.

Take a probability based ordering source:

$$(12) \quad g(w) = \{\phi : \phi \text{ is probable in } w.\}$$

To simplify things, suppose that the only things probable on our evidence are that Alex does best, that if Billy studies, Billy does best and that if Billy does not study, Alex does best. This gives us the following:

$$(13) \quad g(w) = \{Alex\ does\ best, If\ Billy\ studies, Billy\ does\ best, If\ Billy\ doesn't\ study, Alex\ does\ best\}$$

To predict the truth of (6) we want this ordering on decision problem cells:

$$(14) \quad Alex\ does\ best < Billy\ does\ best.$$

Our current choice of ordering source delivers this. Only *Alex does best* entails any ordering source proposition (namely itself). To predict (7) we want a new ordering on decision problem cells:

²⁰The solution in Charlow (2013) seems to face similar issues. For him information-sensitivity is generated by the interaction of two ordering sources, one tracking what is deontically best and another tracking what is actionable. Information-sensitivity is generated by the fact that, against different modal bases, different propositions will be actionable. Again, it's not clear how to extend this idea to epistemic cases, as there is no obvious parallel for the actionable propositions.

(15) *Billy studies and Billy does best* < *Billy studies and Alex does best*.

But we do not get this. Grant that *Billy studies and Billy does best* entails the conditional *If Billy studies, Billy does best*. The proposition *Billy studies and Alex does best* also entails an ordering source proposition, namely *Alex does best*. Neither cell of the decision problem entails all the ordering source propositions of the other and more besides. This means that, rather than giving us (15), the two cells are *incomparable*.

The CKK approach yields information-sensitivity, but not in all of the right places. When we chose a plausible ordering source for **Exam**, one that tracks the probabilities of the case, refining the decision problem is not enough to get the change in ordering we need. Here too conservatism looks unpromising because it fails to generalise.

5. A solution

Cases like **Exam** are important evidence that information-sensitivity is more prevalent than previously thought. It appears not just in the deontic realm, but in the epistemic too. Conservatism fails because it is too narrow in scope. It cannot explain away information-sensitivity, as the very conservative theorist hopes. Nor can it be explained with possible worlds machinery alone, as the moderate conservative hopes.

If instead we account for information-sensitivity by appeal to probability, we do better. I will start by outlining a connection between the set of best worlds and probabilistic notions and show that if this connection were to hold, we would predict our data. Crucially, the role played by conditionalisation is what allows the orderings to shift. Then I will outline a semantics which delivers those principles and so predicts what we want in **Miners** and **Exam**.

5.1. The role of probability

I suggest that, in the relevant miners cases, we want our semantics to predict the following:

Deontic: $\forall w' \in BEST(w, f, g) : \llbracket \phi \rrbracket^{c, w', f, g} = 1$ iff $\neg \exists \psi : EU(\psi | \cap f(w)) > EU(\phi | \cap f(w))$.

Epistemic: $\forall w' \in BEST(w, f, g) : \llbracket \phi \rrbracket^{c, w', f, g} = 1$ iff for the contextually supplied threshold probability $\theta : P(\phi | \cap f(w)) > \theta$.

In each case, conditionalisation generates information-sensitivity. The expected utility of ϕ might be overtaken by that of some other option entailing $\neg\phi$ whenever we conditionalise on some other proposition ψ . When the set of best worlds tracks expected utilities, updating the modal base with ψ will change the relevant best worlds: now they include $\neg\phi$ worlds that were not there before. Similarly for probabilities: conditionalising on some proposition ψ may cause the probability of ϕ to drop below the threshold and push that of $\neg\phi$ above it. This will mean that updating the modal base with ψ will change the ordering on worlds: they will now include $\neg\phi$ worlds that were not there before. So in each case, conditionalisation can lead to worlds

getting a higher position in the ordering.

Let's now see this in action. Recall our sentences from **Miners**:

- (1) I ought to block neither shaft.
- (2) If the miners are in shaft A, I ought to block shaft A.
- (3) If the miners are in shaft B, I ought to block shaft B.

We can fill in the details of the case to see how **Deontic** will give us the right results. The miners are just as likely to be in A as they are to be in B. Outcomes where I save more miners have higher utility than those where I save less. So let's imagine that P and U are as follows:

$$P(A) = P(B) = 0.5$$

$$U(A \wedge blA) = U(B \wedge blB) = 1$$

$$U(A \wedge blB) = U(B \wedge blA) = 0$$

$$U(A \wedge (\neg blA \wedge \neg blB)) = U(B \wedge (\neg blB \wedge \neg blA)) = 0.9$$

When we conditionalize P on $\cap f(w)$, this will not change the probabilities above. When we do the expected utility calculations,²¹ the resulting order on propositions is

$$block\ neither < block\ A \approx block\ B$$

Thus *block neither* has the highest expected utility and so, given **Deontic** we predict (1) to be true in this context.

When we conditionalise on $\cap(f + A(w))$, the probabilities change. The ordering on propositions shifts accordingly:²²

²¹We can see that conditionalising P on $\cap f(w)$ will make no difference to any of the values of P which we have specified. So the value assigned to blA will be

$$U(A \wedge blA)Pr(A) + U(B \wedge blA)Pr(B) = \\ 1 \cdot (0.5) + 0 \cdot (0.5) = 0.5$$

which will be the same as the value assigned to blB ; whereas as the value assigned to $(\neg blA \wedge \neg blB)$ will be

$$U(A \wedge (\neg blA \wedge \neg blB))Pr(A) + U(B \wedge (\neg blB \wedge \neg blA))Pr(B) = \\ (0.9) \cdot (0.5) + (0.9) \cdot (0.5) = 0.9.$$

²²Our new probabilities will be

$$P(A) = 1 \\ P(B) = 0$$

Recalculating the expected utilities, the value assigned to $(\neg blA \wedge \neg blB)$ will be equal to

block A < block neither < block B

block A now has the highest expected utility. Hence, given **Deontic**, when the modal base restricted to the worlds where the miners are in A, all the worlds in $BEST(w, f + A, g)$ will be ones where we block shaft A. Given the restrictor view of conditionals, it follows that (2) is true here. By similar reasoning, we also predict the truth of (3).

Let's turn now to **Exam** to see how **Epistemic** predicts the right results there. Our sentences there were:

(6) Alex should do best.

(7) But, if turns out that Billy studied, then he should do best.

Given the set up, the probabilities should be

$$P(\text{Alex does best}) = 0.66$$

$$P(\text{Billy does best}) = 0.33$$

$$P(\text{Alex does best} \mid \text{Billy studies}) = 0.33$$

$$P(\text{Billy does best} \mid \text{Billy studies}) = 0.66$$

Suppose now that the threshold probability is 0.5. Conditionalising on $\cap f(w)$ here will make no difference to the probabilities assigned to the above propositions. Hence, the proposition that Alex does best will pass the threshold and, by **Epistemic**, the best worlds will be ones where Alex does best. Hence (6) will be true.

When we conditionalise on $\cap (f(w) + \text{Billy studies})$, the probabilities do change. In fact the probabilities of *Alex does best* and *Billy does best* are now equal to the conditional probabilities given above and the proposition *Billy does best* will now pass the 0.5 threshold. So, relative to our more restricted modal base $f(w) + \text{Billy studies}$, **Epistemic** tells us that all the best worlds are ones where Billy does best. Given the restrictor analysis of conditionals, we then predict that (7) is true in this context.

$$\frac{U(A \wedge (\neg blA \wedge \neg blB))Pr'(A) + U(B \wedge (\neg blB \wedge \neg blA))Pr'(B)}{(0.9).1 + (0.9).0} = 0.9.$$

but the value assigned to *blA* will be

$$\frac{U(A \wedge blA)Pr'(A) + U(B \wedge blA)Pr'(B)}{1.1 + 0.0} = 1.$$

The value assigned to *block B* will

$$\frac{U(A \wedge \text{block B})P(A) + U(B \wedge \text{block B})P(B)}{0.1 + 1.0} = 0.$$

5.2. Implementation

We've seen that allowing probabilities into our semantics gives us a good general picture of where information-sensitivity comes from. Now I outline a more general definition of *BEST* that, when combined with a plausible selection of parameters supplied by context, delivers the desired connection.

Earlier we entertained the question of whether all the necessary orderings for modal semantics can be generated using just propositions. If we want probability to play a serious role, this will be difficult to maintain. Probabilistic notions are notoriously difficult to recover from purely qualitative information. As shown in Lassiter (2015), attempts to do so (like that in Kratzer (1981)), tend to have undesirable logical properties: for instance, Kratzer's approach predicts that whenever ϕ is as likely as ψ and as χ , it is as likely as $\psi \vee \chi$; but probabilistic orderings do not in general have this property.²³ Thus, if probability is to be used in our semantics for 'ought', it is hard to see how it could be moderately conservative in the sense that we outlined earlier.

We will make the classic semantics more flexible so that it can access the kinds of orderings we need. We keep the modal base parameter without any changes: it is still a function from worlds to propositions and intuitively represents the information we are holding fixed. However, we change how ordering sources work. Firstly, we want ordering sources to have, among other things, modal bases as arguments: this is essential to any solution that allows information to shift the relevant ordering.²⁴ Secondly, we want to allow ordering sources to exploit orders on propositions. The final ordering on worlds should track an expected utility ordering in the deontic case and a probability ordering in the epistemic case. We modify our definition of an ordering source accordingly: now an ordering source g is a function from a world and a modal base to an ordering $\lesssim_{w,f,g}$ on propositions.

In the deontic case, the ordering will straightforwardly track the relevant expected utility ordering. That is we will have

$$\phi \lesssim_{w,f,g} \psi \text{ just in case } EU(\phi|\cap f(w)) \geq EU(\psi|\cap f(w)).$$

In the epistemic case, we want the ordering to reflect whether or not a proposition passes a contextually supplied threshold. That is, we want it to be the case that no proposition is strictly better than ϕ whenever the probability of ϕ passes the given threshold. To secure this, we will define the ordering as follows:

$\phi \lesssim_{w,f,g} \psi$ iff, where θ_c is the contextually determined threshold, one of the following conditions holds:

1. $P(\phi|\cap f(w)) > \theta_c$; or

²³One exception to this is the semantics in Holliday and Icard (2013); but as Lassiter (2015) points out, that semantics will have issues validating entailments between probabilistic 'should' and other epistemic auxiliaries.

²⁴As such, it is not distinctive of the approach pursued here: other information-sensitive solutions such as those in Cariani et al. (2013), Silk (2014) and Carr (2015) also suggest this move.

$$2. P(\phi|\cap f(w)) \geq P(\psi|\cap f(w))$$

The first clause helps deliver the constraint we outlined. For once ϕ passes the relevant threshold no other proposition will be strictly better than it.

We have an ordering on propositions and our aim now is to define *BEST* from this ordering. We will form $BEST(w, f, g)$ by simply taking the $\lesssim_{w, f, g}$ -best propositions consistent with the modal base and intersecting them. More formally, letting the set of best propositions be

$$PBEST(w, f, g) = \{p \subseteq \cap f(w) : \neg \exists q \subseteq \cap f(w) : q <_{w, f, g} p\}$$

we then say that

$$BEST(w, f, g) = \cap PBEST(w, f, g)$$

That is, the domain for ‘ought’ is the intersection of the best propositions.²⁵

This will predict **Deontic**, given plausible assumptions. In **Miners**, it is plausible that we are deciding based on the expected utilities of the various options. Conditional on only the information in the modal base, blocking neither shaft has the unique best expected utility. In that case, *we block neither shaft* is the unique best proposition and so the set of best worlds is simply the worlds in the modal base where we block neither shaft. But once we add to the modal base the proposition that the miners are in shaft A, *we block shaft A* is the unique best proposition and so all the best worlds are ones where we block shaft A.

We also predict **Epistemic**, given plausible assumptions. Suppose again that the threshold is 0.5. The proposition that Alex gets the best results has 0.66 probability and so will be one of the best propositions. $BEST(w, f, g)$, being the intersection of $PBEST(w, f, g)$ and $\cap f(w)$ will contain only worlds where Alex gets the best results. Moreover, when we add to the modal base the proposition that Billy studied, then *Billy gets the best results* will be among the best propositions and so, given our semantics, all the best worlds will be ones where Billy gets the best results.

²⁵In fact, this semantics is only really a first pass, as it will deliver the wrong results in cases where the set of best propositions is inconsistent. What we need is a generalisation of the intersecting method for cases like these.

Here is one way to generalise it. We still construct $BEST$ from $PBEST$ but this time the procedure is somewhat more complicated. First, say that a maximal consistent intersection S of $PBEST$ is a set S that has the following properties:

1. S is the intersection of some members S_1, \dots, S_n of $PBEST$
2. The result of intersecting S with any further members of $PBEST$ results in the empty set.

In other words, we form a maximal consistent intersection of $PBEST$ by intersecting as many propositions in $PBEST$ as we can before getting the empty set.

We then form $BEST$ by forming the union of the maximal consistent intersections of $PBEST$:

$$BEST(w, f, g) = \cup \{S : S \text{ is a maximal consistent intersection of elements of elements of } PBEST(w, f, g)\}$$

6. Conclusion

The problem raised by Kolodny and MacFarlane's case runs deeper than previously thought. Miners cases arise not just in the deontic realm, but also in the epistemic realm. This has important ramifications for the ensuing debate. Conservativity, while well-motivated and plausible for the original cases, fails to generalise. This failure, I have argued, should lead us to see miners cases not as a deontic phenomenon, but as a probabilistic one. The classic semantics, in its original form, cannot accommodate this. But I have shown that, by dropping certain assumptions about how orderings are generated, we get a more flexible theory that can give a properly general solution to the miners problem.

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Children’s comprehension of pronouns and definites.¹

Saskia BROCKMANN — *University Tübingen*

Sara MCCONNELL — *University Maryland*

Valentine HACQUARD — *University Maryland*

Jeffrey LIDZ — *University Maryland*

Abstract. We present an experiment which tests children’s comprehension of the requirements of use of pronouns and definites. An adult-like use of definites and pronouns imposes different but related requirements. In the case of definites, a unique referent is required in the context, whereas in the case of a pronoun, the referent in the context has to be salient. In this experiment, we use a novel word task to test three-year-olds’ sensitivity to these requirements. Our results show that children are adult-like in their sensitivity to salience in their comprehension of pronouns, compared to definites. However, they failed to show sensitivity to the uniqueness requirement on the use of definites.

Keywords: pronouns, definiteness, language acquisition, salience, uniqueness, familiarity.

1. Introduction

In this paper, we present an experiment on children’s comprehension of the requirements of use of pronouns and definites. An adult-like use of the definite article and pronouns imposes different but related requirements. In the case of the definite article, a unique referent is required in the context (see e.g., Heim and Kratzer, 1998; Elbourne, 2005, 2013). For example, in (1), there should only be one doll in the context. If there were two dolls, the indefinite article should be used. In the case of a pronoun, the referent in the context has to be salient (see e.g., Roberts, 2003): if no object were salient in the discourse of (2), the addressee would likely not know how to obey the command. In this experiment, we use a novel word task to test three-year-olds’ sensitivity to these requirements.

(1) Put the doll in the suitcase!

(2) Put it in the suitcase!

A mature understanding of what it means for an expression to be context sensitive is necessary for children’s acquisition of pronouns and definites. More specifically, children have to be aware that conversations follow certain rules and goals, e.g., that an utterance serves the goal of adding information to the commonly shared pool of information, the the Common Ground (cf. Stalnaker, 1978). Related to this is the distinction between given and new information, such that given information is attributed to information within the Common Ground, while new information seeks to expand the Common Ground further. In the comprehension of definites and pronouns, children have to be able to track given information, because both constructions

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can only access referents in the discourse that have already been introduced and which have been identified as unique or salient, respectively.

Another important fact about language which children have to be aware of when hearing a pronoun or an article is that language is referential, i.e., that their task is to link the utterance to specific individuals within their discourse context. Which individual is mapped to which pronoun differs from context to context. Research on these pragmatic prerequisites has found that from a very early age on, and sometimes even in the preverbal period of language development, children are already sensitive to the purposes of communication. Roughly, children ages one or two demonstrate sensitivity to the goals within a conversation, the common ground, to given and new information and the distinction thereof, and to the interpretation of referring expressions (see for more detail Clark, 2016 and references therein). However, it remains less clear how and when children distinguish between different ways of referring to entities in the context, such as using a pronoun instead of a definite, i.e., picking the salient versus the unique referent, or an indefinite instead of the definite. Here we aim at giving first answers to these questions. We test three-year-olds' comprehension of pronouns and definites via a selection task, using novel words. Because the unfamiliar objects are described using unfamiliar labels, the only information children can use to identify the right object are the cues coming from the use of a pronoun or definite or indefinite in different contextual situations, where a toy is unique or salient or both. Our results show that children are sensitive to the salience requirement of pronouns, but they may still struggle with the uniqueness requirement of definites.

In the following, we will delve deeper into the theoretical background regarding the contextual requirements on pronouns and definites in Section 2.1 to 2.3 and introduce previous work on the constructions and their contextual requirements in Section 2.4 We introduce the experiment in Section 3 and conclude in Section 4.

2. Theoretical Background

2.1. Definite Article: Uniqueness

The definite article 'the' has been associated with triggering a presupposition of uniqueness, meaning that its interpretation can only be defined if there is exactly one unique referent in the context that has the characteristics specified by the NP complement (see e.g., Heim and Kratzer, 1998; Elbourne, 2013; Roberts, 2003).

- (3) # The semanticist gave a talk at Sinn und Bedeutung 22.
- (4) A semanticist gave a talk at Sinn und Bedeutung 22.

In the examples above, the DP 'the semanticist' fails to refer to one unique referent in the context, as there were more semanticists present at the Sinn und Bedeutung 22 conference. The indefinite article is not associated with a uniqueness condition and using it in the same context is natural. The dominant view to explain the infelicity of (3) is to assume that when a definite article is used, the DP, and thus also the complete sentence, is only well-formed if there is only one uniquely available semanticist. If there were two or none, the sentence would

not be false, it would just be inappropriate. A standard formal definition of 'the' including the presupposition of uniqueness can be seen below.

$$(5) \quad \llbracket the \rrbracket^{g,c} = \lambda f_{\langle e,t \rangle} : \exists! x[f(x) = 1]. \iota x[f(x) = 1]$$

2.2. Pronouns: Saliency

Elbourne (2005, 2013) argues that third person pronouns are interpreted in parallel to the definite article, i.e., they equally evoke a uniqueness condition on a contextually determined referent. The difference between definites and pronouns, according to Elbourne, lies in the NP complement: with pronouns, the NP complement is covert and contextually determined. For example, in (6) below, 'it' in the second sentence refers to the unique cat in the context. 'The cat' in the first sentence and 'it' in the second end up having the same interpretation, but in the latter case, the NP 'cat' is phonologically covert. 'It' under this analysis would thus be analysed as 'the' in (5) above.

- (6) *The cat is sleeping. It eat snores.*

Roberts (2003) proposes a refinement of Elbourne's account, focussing on the specific contextual requirements associated with third person pronouns and the definite article, respectively: third person pronouns trigger a presupposition of saliency entailing uniqueness, while the definite article triggers the classically assumed presupposition of uniqueness. She discusses the following examples originally introduced by Heim (1982):

- (7) I dropped ten marbles and found all of them, except for one.
 (a) It is probably under the sofa.
 (b) # The marble is probably under the sofa.
- (8) I dropped ten marbles and found only nine of them.
 (a) ?? It is probably under the sofa.
 (b) # The marble is probably under the sofa.
 (examples adapted from Roberts, 2003: 335)
- (9) A woman entered from stage left. Another woman entered from stage right.
 (a) #The woman / The FIRST woman / The SECOND woman was carrying a basket of flowers.
 (b) She was carrying a basket of flowers, while #the woman/ the FIRST woman/ #the SECOND woman led a goat.
 (examples from Roberts, 2003: 324)

In (7), the missing marble is made sufficiently salient, so that referring to it with the pronoun 'it' is natural, even though there are more marbles in the context. Using an underspecified definite NP 'the marble' violates uniqueness. In contrast, in (8), the missing marble is not sufficiently

salient, so that using ‘it’ to refer to it seems inappropriate, while using an underspecified definite NP is equally inappropriate as in (7). The only difference between (7) and (8) is the explicit mention of the missing marble. Example (9) highlights a similar point; the pronoun ‘she’ in (9b) can only refer to the lastly introduced woman, so the more salient one. This becomes evident by looking at the continuations of the sentence. Using an underspecified DP ‘the woman’ is still inappropriate, because the uniqueness requirement of the definite article is not satisfied by salience. Roberts (2003) takes these examples as a case in point that the definite article is not sensitive to salient discourse referents, but that third person pronouns are. Roberts’ formal analysis assumes the same lexical entry for ‘the’ as in (5) and the following lexical entry for pronouns (see (10)).

- (10) $\llbracket it \rrbracket = \lambda f_{\langle e, t \rangle} : \exists x [f(x) = 1 \& SALIENT(x) \& \forall y [SALIENT(y) \rightarrow y \leq_{SAL} x]]$.
 $\iota x [f(x) = 1]$
- (11) $\llbracket SALIENT \rrbracket^c = \lambda x. x$ is among the salient discourse referents in context c
- (12) The ordering \leq_{SAL} : For all a, b that are discourse referents in c : $a \leq_{SAL} b$ if (a) b is strongly familiar and a is weakly familiar, (b) b pertains to a more immediate Question under Discussion (QUD) than a , (c) b is more prominent than a regarding grammatical relations such as topic/focushood etc. (adapted from Roberts, 2003: 334)

We will assume Roberts’ (2003) analysis for pronouns and the definite article for the purposes of this paper.

2.3. Familiarity

Let us briefly discuss one further contextual requirement that has been identified for definites, specifically in its comparison with indefinites. Most famously, Heim (1982) argues that the definite article should be associated with familiarity, i.e., that the referent of definites has to be already established in the previous discourse. This is different for indefinites, where the referent can be newly introduced into the discourse. Heim gives examples that demonstrate the adequacy of the novelty/familiarity distinction: In (13), the first sentence with the indefinite NP ‘a wine glass’ introduces a new referent in the discourse that can then be taken as a referent for the definite article in the second sentence ‘the glass’. However, if we try to use the indefinite article in order to refer to this already introduced wine glass, we get an inappropriate utterance; ‘A glass’ in (14) can’t refer to the previously introduced wine glass (for more details regarding the familiarity constraint on definites, see Roberts, 2003).

- (13) A wine glass broke last night. The glass had been very expensive.
- (14) A wine glass broke last night. # A glass had been very expensive.
 (examples from Roberts, 2003: 296)

Familiarity applies to both definites and pronouns. In (15) below, the pronoun ‘it’ can be used in the second sentence to refer back to the wine glass introduced by the indefinite in the first sentence, just like the definite in (13).

- (15) A wine glass broke last night. It had been very expensive.

To sum up, the contextual requirement of familiarity differentiates definites and pronouns from indefinites. The uniqueness and salience conditions differentiate definites from pronouns: definites require their referent to be unique, but not necessarily salient, while for third person pronouns, it is the other way around: their referent has to be salient, but not necessarily unique. Rather, it is unique by virtue of being the most salient referent in the discourse. In this paper, we will focus on the latter two requirements and ask if three-year-olds are aware of definites' uniqueness requirement and third person pronouns' salience requirement.

2.4. Previous Work

Previous studies have looked at pronouns and definites separately. For pronouns, it has been observed that children start producing pronouns very early on and roughly seem to understand them by two years of age (see e.g., Cruttenden, 1977; Shipley and Shipley, 1969; Chiat, 1981; Huxley, 1970; Halliday, 1975; Charney, 1980; Loveland, 1984; Moyer et al., 2015).

Song and Fisher (2003) tested whether children demonstrate sensitivity to discourse prominence in their interpretation of pronouns in a series of four experiments. Three-year-olds listened to a story accompanied by two screens simultaneously showing pictures of two discourse referents. In the story, the two discourse referents were mentioned equally often; however, only one of them was made prominent. A pronoun in the target sentence either referred to the prominent referent or to the other referent.² Experiment 1 tested elicited imitation, and Experiments 2 to 4 tested preferential looking by measuring children's fixation on the correct discourse referent. Results confirm that three-year-olds look at the prominent discourse referent right away when hearing a pronoun, while only later switching to the new referent in contexts. Adult controls confirm these results. However, the design in Song and Fisher (2003) leaves open the possibility that children do not really understand the salience requirement of the pronoun, but that they look at the protagonist of the story only because their attention was first drawn to the protagonist, no matter which requirements guide the interpretation of the pronoun. In our study we will test children's understanding of the salience requirement of pronouns further in ways that avoid this possible confound.

For definites, studies report considerable flexibility in the production and comprehension of the definite article compared to the indefinite article: children seem to be overly permissive of using and accepting definites in contexts where they should be unavailable because their uniqueness presupposition is not satisfied (cf. Karmiloff-Smith, 1979; Schaeffer and Matthewson, 2005; Schafer and de Villiers, 2000; van Hout et al., 2010). Importantly, children's difficulty mostly arises in cases where they are expected to use indefinites as opposed to definites.

²Control target items included a definite NP that referred to the referent in question. Note, however, that the presence of the NP argument of the definite article prevents us to conclude anything for the influence of prominence on the definite article per se.

Van Hout et al. (2010) report on two experiments of children's production and comprehension of the definite versus indefinite article at the age of 3;1 to 5;8. In the comprehension task, truth value judgments were elicited by showing children a sequence of two pictures where, in the first picture, a unique referent is singled out (i.e., the picture shows a baby with her father, holding one balloon, standing next to another person holding several balloons). In the second picture one of the balloons in the background, i.e., a new referent, flies away. Then, children were asked a question either including a definite or indefinite article (i.e., 'Did the balloon/a balloon fly away?'). The target answer should be negative when the definite article is used, as the old referent, i.e., the balloon in the dad's hand, doesn't fly away. In parallel, the answer should be positive when the indefinite article is used, as indeed the new referent flies away. Children give a positive answer when the indefinite article is used, but also when the definite article is used, even though it is not the familiar, old referent which flies away. Adults answered mostly target-like. The results of the production study match these results. Overall, children seem over-permissive with definites: they tend to accept sentences with definites referring to a non-familiar referent. A possible confounding factor in this experiment is that the mere depiction of the flying balloon is sufficient to make it familiar: children zoom in on that part of the scene. Furthermore, a limitation of a truth value judgment task like this one is that children may want to be charitable and accept a description that is not completely appropriate to make the sentence true. In our study, we will use a selection task instead, to probe children's sensitivity to the uniqueness requirement of definites: if children are sensitive to this requirement, the use of a definite should lead them to pick a unique object, in contrast to an indefinite.

To sum up, we see that children seem to understand the conditions of use of pronouns early on: they understand that third person pronouns refer to a discourse salient entity as early as age three. On the other hand, children seem to struggle with the conditions of use of the definite article vs. the indefinite article up to seven years of age. In our experiment, we further probe children's comprehension of pronouns and definites and contextual requirements of these within a single experiment, using a simple selection task, incorporating novel words and novel objects. We ask whether (i) children are sensitive to salience when encountering a pronoun vs. a definite or an indefinite, and (ii) children are sensitive to uniqueness when encountering a definite vs. a pronoun or an indefinite.

3. The Experiment

3.1. The Task

As the focus of this experiment is on children's understanding of the contextual requirements associated with definites and pronouns, our goal was to test this within the same task, by manipulating salience and uniqueness. As a control condition, we also included indefinites. In previous work, the comparison between definites and indefinites has proven to be difficult for children. We used a selection task using novel words to label unfamiliar objects, to get children to use information provided by the use of the construction (pronoun vs. definite vs. indefinite) to select the right object. Indeed, with a novel word, children cannot make inferences based on the meaning of the NP complement: they need to base their inferences on the articles or pronouns used in a given context.

3.2. The Design

Children are presented with three unfamiliar objects (pictures of objects unlikely to be familiar to children, e.g., a tube cutter, a bagpipe, or an exotic fruit) as toys. One of the toys is different from the other two. This setting establishes uniqueness in the case of the one unique object. Then, the experimenter draws attention to either the unique object, one of the non-unique objects, or none of the objects. This way, we capture salience.

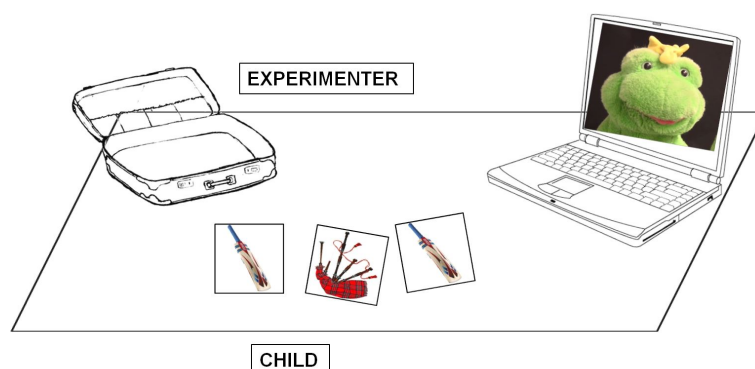


Figure 1: Study Setup

Specifically, the experiment is set up as a game (see Figure 1): Froggy is visiting his grandmother but has forgotten to bring toys. So the experimenter asks the child if they should pack a suitcase for Froggy together. In order to find out which toys Froggy wants, the experimenter and the child Skype with Froggy. The experimenter displays three cards with pictures of unfamiliar objects, Froggy's toys, and draws attention to one of the toys. Then, Froggy gives his clue in the form of a sentence like the following. After this, the child picks one of the three toys and puts it in the suitcase.

- (16) *Pack the blicket in the suitcase!*
- (17) *Pack a blicket in the suitcase!*
- (18) *Pack it in the suitcase!*

The Skype session is a video of Froggy that the experimenter pauses while interacting with the child. In order to give the impression that Froggy is taking an active part in the conversation, experimenter and Froggy exchange some introductory remarks at the beginning. We tested children in a between-subjects design, separating participants into two groups. Group 1 heard either the definite or indefinite article; Group 2 heard the definite article or the pronoun 'it'.

In examples (19) to (21), we provide some sample target interactions within Group 1, comparing the definite and the indefinite article. We include three context conditions, alternating which toy the experimenter pays special attention to:

- (19) Context 1: No Extra Attention
 Experimenter: [*experimenter doesn't point to any toy*] Froggy, which toy do you want us to pack?
 Froggy: Pack {the blicket/ a blicket} in the suitcase.
- (20) Context 2: Attention to Unique Toy
 Experimenter: [*experimenter points to the unique toy*] Oh, look at this one! I really like its color, it's red! Froggy, which toy do you want us to pack?
 Froggy: Pack {the gorp/ a gorp} in the suitcase.
- (21) Context 3: Attention to Non-Unique Toy
 Experimenter: [*experimenter points to one of the non-unique toys*] Oh, look at this one! I really like its shape, it's funny! Froggy, which toy do you want us to pack?
 Froggy: Pack {the glark/ a glark} in the suitcase.

The same context conditions were used for the second group, but Froggy would use either definites or the pronoun 'it' (see (22) below).

- (22) {No Extra Attention/ Attention to Unique Toy/ Attention to Non-Unique Toy}
 Froggy: Pack {the blicket/ it} in the suitcase.

In Table 1, we summarize how the design of the study reflects the theoretically derived contextual requirements. In the first context, where none of the toys is singled out by the experimenter, only uniqueness is given, as the visual setting singles out one of the toys. In the second context, the experimenter draws attention to the unique toy: here, both uniqueness and salience are given and target the same toy. In the third context, the experimenter draws attention to one of the two non-unique toys. Thus, uniqueness and salience are in competition: while the experimenter establishes a non-unique toy as salient, the pure visual context provides a different toy that meets the uniqueness requirement.

	Uniqueness	Salience
Context 1: No Extra Attention	Yes	No
Context 2: Attention to Unique Toy	Yes	Yes
Context 3: Attention to Non-Unique Toy	No	Yes

Table 1: Contextual Requirements as met in the Experiment

3.3. Methods

To make sure that children are able to perform the task in general, we included four trials where the toys presented were familiar, using familiar labels. For the actual experimental trials, we included four trials per condition with a 2x3 design, with two construction conditions (definite/indefinite article or definite article/pronoun) and three context conditions (no attention, attention to unique toy, attention to non-unique toy). We also included 4 control trials where Froggy wants the child to pick a toy without giving a clue. These control trials checked whether

children would pick toys by preference of location only, e.g., if they would always pick the rightmost toy. The order of trials was pseudo-randomized and was the same for all participants. Our measure for the statistical analysis was the percentage to which children would pick the unique toy.

3.4. Subjects

We tested 38 participants, 13 participants in group 1 (7 female, 6 male), 15 participants for group 2 (8 female, 7 male); 10 participants were excluded because they did not finish the study. All participants were between 2;11 and 3;11 years old (mean age: 3;4) and were tested in the Project of Children's Language Learning at the University of Maryland. They were all native speakers of English. In addition, we tested an adult control group with the same material and setup. These were all native speakers of English. 6 participants were tested at the University of Maryland and 18 participants were tested at the University of Tübingen. Participants from each location were distributed evenly over the two groups. The age range of adults was 19 to 37 years with a mean age of 22 years. Female/male ratio was 1:1.

3.5. Predictions

3.5.1. Group 1: Definites vs. Indefinites

Our measure as a basis for the statistical analysis is the selection of the unique toy. If children have an adult-like understanding of the uniqueness requirement of definites, we expect that they should pick the unique toy whenever the definite article is used, irrespective of which toy is being made salient. Regarding the indefinite article, we expect children to be at chance at picking the unique toy. If children have an adult-like understanding of the uniqueness requirement and they are able to compute a scalar implicature that the speaker should have used the definite article if the unique toy was intended, they should pick one of the two non-unique toys. However, given that children have difficulty computing implicatures at this age (see e.g., Pouscolous, 2012; Papafragou & Musolino, 2003; Geurts, 2010; Guasti et al., 2005), we expect that they will be at chance in picking the unique toy or one of the two non-unique toys. We set the chance level here at 33%, because children can pick from three choices.

The difference between expected behavior with definites vs. indefinites leads to an expected main effect of construction type in Group 1: the unique toy should be selected more often across all three context conditions when Froggy uses the definite article than when Froggy uses the indefinite article (see Figure 2).

Regarding the definite article, we estimate that the visual context should suffice in establishing the visually unique toy as the only available referent for the definite article in the 'No Extra Attention' context (see the leftmost black column). Accordingly, if children are adult-like in their comprehension of the definite article, they should pick this toy. However, as no other contextual clue is given, they may not be at ceiling.

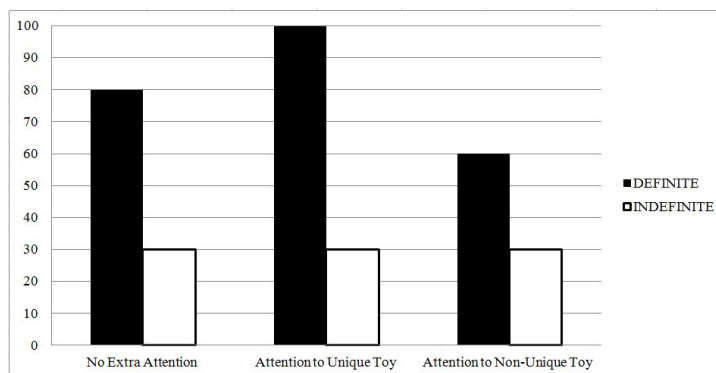


Figure 2: Selection of the Unique Toy: DEF/INDEF Predictions

When the experimenter pays special attention to the visually unique toy ('Attention to Unique Toy', middle black column), the visual context is reinforced through the behavior of the experimenter, who makes the already visually unique toy salient by talking about it. In this case, the unique toy is both unique and salient and so children should be at ceiling when hearing the definite article.

Lastly, when the experimenter draws attention to one of the two non-unique toys ('Attention to Non-Unique Toy', rightmost black column), the visual context is competing with the actions of the experimenter: while visually, the unique toy stands out, the experimenter singles out one of the two non-unique toys as the salient one. When hearing the definite article, children could stick to the visually unique toy and choose that one as the referent, but they could also reinterpret the definite article in picking out that toy which is unique by virtue of having been talked about by the experimenter. Note that this interpretation of the situation goes along a standard interpretation of the definite article. We expect that children should stick to the visual context no matter the manipulations made by the experimenter. However, due to the strong competition, they may pick the unique toy to a lesser extent when hearing the definite article than in the other two contexts, while still being above chance.

3.5.2. Group 2: Definites vs. Pronouns

We expect different results for Group 2. Here, children should pick the salient toy when Froggy utters a pronoun, irrespective of whether the toy is the visually unique one. On the other hand, when children hear the definite article, they should still pick the visually unique toy no matter the context and behave as the children encountering the definite article in Group 1. This leads to an expected interaction between construction and context type (see Figure 3). The type of context should play a much bigger role for pronouns than for definites, as only for pronouns, the choice of referent depends on salience and salience differs from context to context, while (at least visual) uniqueness stays the same.

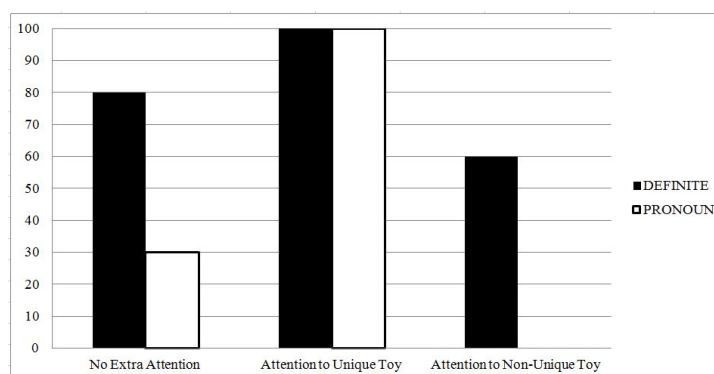


Figure 3: Selection of the Unique Toy: DEF/PRO Predictions

More specifically, in the ‘Attention to the Unique Toy’ context (two middle columns), the visual context and the experimenter’s manipulation both target the unique toy, thus children should always be at ceiling picking it both when hearing the definite article and the pronoun, as the unique toy is the salient toy.

When the experimenter draws special attention to one of the two non-unique toys (two right-most columns), we still expect children to be above chance in picking the visually unique toy when hearing the definite article (see the black column). However, with the pronoun, they should never pick the unique toy when one of the other toys is made salient, so here we expect children to never pick the visually unique toy (see the white column, or rather its absence).

Lastly, when the experimenter doesn’t draw attention to any toy (two leftmost columns), the context doesn’t meet the salience requirement. When Froggy uses a pronoun out of the blue, we expect children to be at chance in picking the unique toy, as nothing else in the context can guide their choice (see white column). The expectations for the definite article are the same as for Group 1. Children should be above chance in picking the unique toy, as the visual context satisfies the uniqueness presupposition.

3.6. Statistical Analysis

The binary dependent variable UNIQUE (1 = unique object; 0 = non-unique object) was analyzed according to a 2x3 design with a Generalized Linear Mixed Model (GLMM) with a logit link function in R (R Core Team (2014)). The two fixed factors were the three-level factor CONTEXT (No Attention, Attention to Unique Toy, Attention to Non-Unique Toy) crossed with the two-level factor CONSTRUCTION (Gr. 1: definite vs. indefinite article; Gr. 2: definite article vs. pronoun); intercepts of participants and items were used as random factors. The ‘No Attention’ condition was determined as a reference condition for the three-level factor CONTEXT, i.e., the two contrasts compared the ‘Attention to Unique Toy’ and the ‘Attention to Non-Unique Toy’ to the ‘No Attention’ condition.

3.6.1. Results Definites vs. Indefinites

Overall, the main finding for Group 1 is that **no main effect of construction** can be observed (see Figure 4). If children were sensitive to the uniqueness presupposition of the definite article, we would expect them to pick the unique toy across all three contexts significantly more often when Froggy uses the definite article than when he uses the indefinite article. However, they pick the unique toy to the same extent regardless of which article is used. We observe a statistically significant contrast ($p = 0.0265$; $z\text{-value} = 2.22$; $SE = 0.418$) comparing the context where the unique toy is made salient with the context where nothing is made salient. Here, the selection of the unique toy only depends on which toy has been made salient in the context, no matter which construction is used. These results mean that either children are not sensitive to the uniqueness presupposition of the definite article, or our task does not provide a strong enough clue for uniqueness.

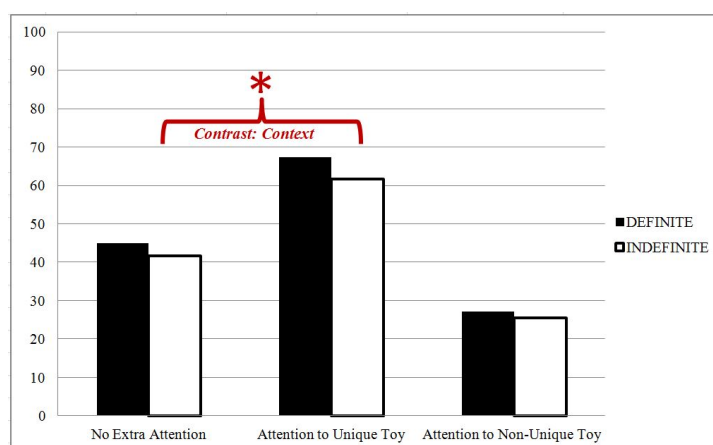


Figure 4: Selection of the Unique Toy: DEF/INDEF, Three-year-olds, Original Material

More specifically, in the context ‘No Extra Attention’ (two leftmost columns), children pick the unique toy roughly 40% of the time both when the definite and when the indefinite article is used. This is not statistically different from chance.³ This finding suggests that the visual context alone is not a strong enough clue for uniqueness or, as stated above, that children have not mastered the uniqueness requirement yet. In the ‘Attention to Unique Toy’ context, children are significantly above chance in picking the unique toy. However, this is the case whether the definite or the indefinite article is used. In the ‘Attention to Non-Unique Toy’ condition, children behave as in the ‘No Extra Attention’ context, they are roughly at chance in picking the unique toy, both when Froggy utters the definite or the indefinite article. In other words, the visually unique toy doesn’t serve as a clear referent in the case of the definite article, but neither does the salient toy.

³In addition to the GLMM and in order to assess whether the relative frequencies in the context conditions (irrespective of CONSTRUCTION) deviate significantly from chance, we computed the confidence intervals for each context condition in each group. If the logit-transformed guessing probability of one third (transformed: -0.693) lies beyond the confidence interval, we consider the frequency to differ significantly from guessing.

Overall, these results suggest one of three possibilities. Either three-year-olds have not mastered the uniqueness presupposition yet, or the visual context is not sufficient in singling out the unique toy, or our material is not fit to test children's sensitivity to uniqueness adequately. With respect to this third possibility, one methodological concern that arises is the way the toys are presented, as pictures on flashcards. The two non-unique toys are represented by two identical pictures. This could lead to a reasoning where these two toys are interpreted as two tokens of the same type of toy and that there being two of them does not really matter, because Froggy identifies the type of toy he wants to pack. In this case, the distinction between unique and non-unique toys vanishes completely and the visual context wouldn't meet uniqueness as a contextual requirement at all. Consequently, the only clue available for both constructions would be whether one of the two types of toys is made salient. Participants would just pick whichever toy is made salient.

Surprisingly, the adult results overall replicate the results of the children: there is no main effect of construction. Adults also pick the unique toy to the same extent regardless of which construction is used. The contrast between the two contexts 'No Extra Attention' and 'Attention to Unique Toy' observed with children is also significant in the adult data: the selection of the toy depends on which one is made salient.

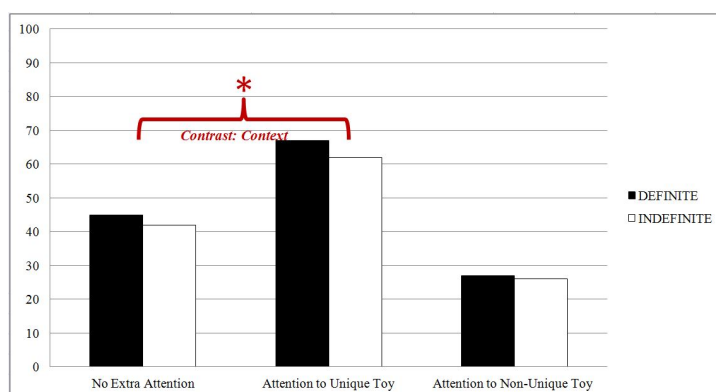


Figure 5: Selection of the Unique Toy: DEF/INDEF, Adults

The percentages in Figure 5 are almost identical to those in Figure 4: adults are at chance in picking the unique toy both when hearing the definite and indefinite article when nothing is made salient and when one of the two non-unique toys is made salient (see the black and white columns on the leftmost and rightmost side, respectively). The percentage of picking the unique toy increases when the unique toy is made salient, but here once again, this increase is observed for the definite and the indefinite article alike. This increase is significant for the comparison between the 'No Extra Attention' and the 'Attention to Unique Toy' context ($p < 0.05$; z -value = 2.44; Standard Error = 0.43).

Given that adults failed to pick the unique toy when the definite is used, it is possible that our material wasn't fit to test the difference between the definite and indefinite article, and we cannot conclude anything about children's sensitivity to the uniqueness presupposition of definites. We attempt to address this methodological concern in a follow-up study, reported on in section 3.6.3 below.

3.6.2. Results Definites vs. Pronouns

Overall, the results from Group 2 matched our expectations (see Figure 6): children pick the salient toy more often when hearing a pronoun than when hearing a definite.

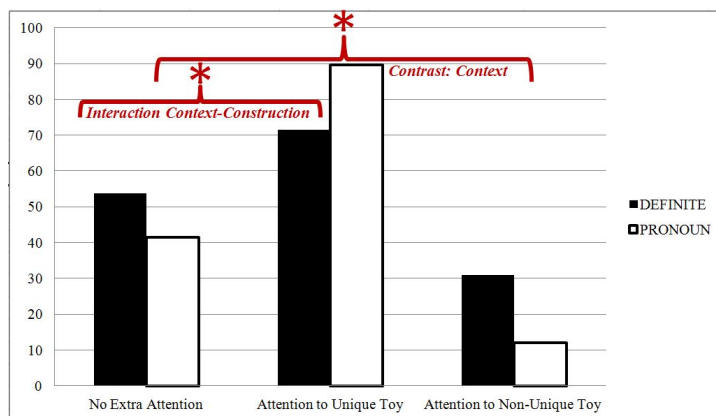


Figure 6: Selection of the Unique Toy: DEF/PRO, Three-year-olds, Original Material

First, there is a significant contrast between the 'No Extra Attention' context and the 'Attention to Non-Unique Toy' context ($p = 0.041$, z -value = -2.04 , Standard Error = 0.53). In the former, children generally pick the unique toy more often than in the latter. This is to be expected because at least in the pronoun case in the 'Attention to Non-Unique Toy' context, children only pick the unique toy 15% of the time, because it is not the salient toy. When Froggy uses the definite article in this context, children are still at chance in picking the unique toy. In the 'No Extra Attention' context, children are significantly above chance in picking the visually unique toy both when they hear the definite article and the pronoun 'it'. Comparing the 'No Extra Attention' context and the 'Attention to Unique Toy' context, we find a significant interaction between context and construction ($p = 0.035$; z -value = 2.11 ; Standard Error = 0.82). The percentages of when children pick the unique toy when hearing the definite article (the two black columns on the left and in the middle) differ slightly across the two contexts. In other words, the additional contextual manipulation of making the already visually unique toy salient increases their choice for the unique toy slightly when hearing the definite article. However, it increases considerably when they hear a pronoun (see the two white columns on the left and in the middle). This finding is compatible with our expectations: only when the visually unique toy is made salient it is the appropriate referent for the pronoun. When nothing is made salient, there is also no appropriate referent for the pronoun. Overall, the results for Group 2 match our expectations.

The adult data for Group 2 (Definite Article vs. Pronouns) also looks promising (see Figure 7). We again observe that between the 'No Extra Attention' and the 'Attention to Non-Unique Toy' context, there is a significant interaction regarding context type and construction ($p < 0.01$, z -value = -3.15 , Standard Error = 0.79): adults, like three-year-olds, pick the salient toy more often when a pronoun is used than when the definite article is used.

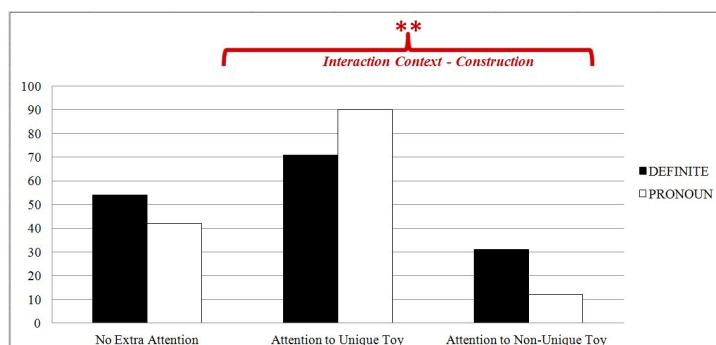


Figure 7: Selection of the Unique Toy: DEF/PRO, Adults

Specifically, in the ‘No Extra Attention’ context, adults are slightly above chance in picking the unique toy both when they hear a definite article and a pronoun (see the two leftmost columns, black for the definite article, white for pronouns). In turn, when one of the two non-unique toys is made salient (two rightmost columns), their selection of the unique toy decreases. The interaction arises because this decrease is more dramatic for pronouns than for a definite: adults almost never pick the unique toy when they hear a pronoun and the salient toy is one of the two non-unique toys (about 10% of the time, see the rightmost white column). They are, however, still at chance in picking the unique toy when they hear the definite article (see rightmost black column). In the ‘Attention to Unique Toy’ context, adults are clearly above chance in picking the unique toy in both cases, meaning when the definite article is used (black column in the middle) and when a pronoun is used (white column in the middle). However, the percentage in the pronoun case is slightly higher. Overall, the results of the adult sample match our expectations.

3.6.3. Results Follow-Up Study

To address the methodological concerns discussed for Group 1, we conducted a follow-up study, in which we tweaked the material to prevent the type/token confusion: we cut out all the toys to make them appear more life-like and we changed one of the two non-unique toys slightly, for instance by changing the color or by adding small dots or stripes to them. With this manipulation we hoped to create a situation where, even though the two non-unique toys can be identified as being the same type of toy, there are two distinct tokens of this toy and because of their differences, Froggy must be referring to the token rather than the type of toy when he says which toy he wants to pack.

We tested 12 native speakers of English (7 female, 5 male) in the Project of Children’s Language Learning at the University of Maryland, between the ages of 3;0 to 3;11 (mean age: 3;6).

The statistical analysis reveals that changing the material does not change children's behavior (see Figure 8). We observe the same contrast ($p = 0.047$, z -value = 1.98, Standard error = 0.45) when nothing is made salient compared to when the unique toy is made salient. Whether Froggy uses the definite or the indefinite article, children pick the unique toy more often when it is made salient. An additional statistical test revealed that the difference between the original sample and the follow-up sample did not reach significance.

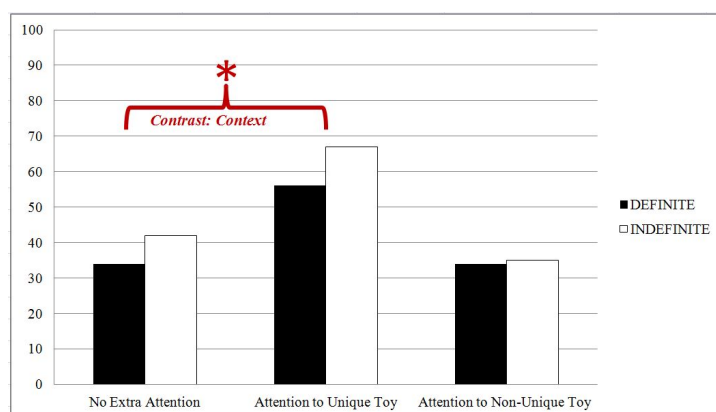


Figure 8: Selection of the Unique Toy: DEF/INDEF, Three-year-olds, New Material

While the change in material did not alter children's behavior, it remains to be determined whether it will lead to an improved performance in adults. Pending these results, we can conclude that three-year-olds are not sensitive to the uniqueness requirement of definites, or that our task is not able to detect their sensitivity.

3.7. Discussion

Overall, the results of our experiment suggest that three-year-olds are adult-like in their comprehension of the salience requirement: salience, defined here as the experimenter's attention to one of the available toys, guides the children's choice when they hear a pronoun, but less so when they hear the definite article. This behavior is mirrored by the choices made by the adult controls. However, it is not clear whether three-year-olds are sensitive to the uniqueness requirement, or whether the set-up of the experiment can capture uniqueness in the first place, as the adult controls failed to pick the unique toy when hearing a definite article and failed to pick at random when hearing the indefinite article. Changing the material to prevent type/token confusions did not alter children's responses.

There are, however, additional problems with the material that could make it unfit for testing for uniqueness with adults: the toys represented on the cards are objects existing in the real world. While these should be unusual enough for children not to know or recognize them, adults clearly know a majority of these objects and their names. This alters the experiment, even though the experimenter makes clear that Froggy is a funny guy who has his own names for these toys. Still, just by virtue of the toys being known to the adults, their reasoning could be different in that they might wonder which connection there could be between the object, its real world name, and its fantasy name. In other words, while a novel word task is quite

natural for young children, it may be unnatural for adults, especially if the objects are familiar. If they reason this way, then the grammatical input of the definite article or the indefinite article becomes less important. This extra-linguistic factor could only be excluded if we would present them with truly novel objects. We leave this manipulation for future research.

Another basic problem with the set-up of the experiment could lie in the disregard of familiarity. We have excluded the requirement of familiarity from this study, as both pronouns and the definite article require their referents to be familiar. However, all the toys in the experiment are unfamiliar to the child and they are only established as familiar through drawing attention to them. Thus, especially in the 'No Extra Attention' context, introducing the toys visually could be insufficient to establish familiarity, and thus referring to the unique toy with a definite article might seem odd in the first place. This factor could influence the choice in the 'Attention to Non-Unique Toy' context, where the visually unique toy might not be familiar on the basis of the visual situation alone, and thus could be disregarded as a competitor for the salient toy. However, results of previous studies (e.g., van Hout et al., 2010) show that the visual context makes a referent familiar in guiding children's interpretation.

4. Conclusion

This experiment tested whether three-year-olds are adult-like in their comprehension of the different contextual requirements for the use of definites and pronouns. Following Roberts (2003), we assume that definites require uniqueness, while pronouns require salience. Our results show that children are adult-like in their sensitivity to salience in their comprehension of pronouns, compared to definites. However, they failed to show sensitivity to the uniqueness requirement on the use of definites. We leave to future research whether this failure is due to an experimental artifact or reflects a genuine delay in children's comprehension of the use of the definite article.

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Painting cows from a type-logical perspective¹

Sebastian BÜCKING — *University of Tübingen*

Abstract. Depiction verbs such as *paint* license i(mage)- and p(ortrait)-readings; for instance, *Ben painted a cow* can convey that Ben produced an image of an unspecific cow or a portrait of a specific cow. This paper takes issue with a property-based intensional analysis of depiction verbs (Zimmermann, 2006b, 2016) and instead argues for an extensional account. Accordingly, the i-reading is rooted in the introduction of worldly representations by the explicit noun *cow* as such, whereas the p-reading is rooted in the interpolation of an implicit representation via coercion. This take on the ambiguity captures the following key traits. On i-readings, only representations are accessible to quantifiers and anaphors; moreover, intensional effects such as substitution failure disappear once ordinary objects and representations are adequately distinguished. P-readings, by contrast, involve representations that depend on the portrayed ordinary objects as particulars; correspondingly, only ordinary objects are accessible to quantifiers and anaphors. The proposal is spelled out in Asher’s (2011) Type Composition Logic.

Keywords: depiction verbs, visual representations, intensional transitives, coercion, Type Composition Logic.

1. Introduction

This paper is concerned with the interpretation of depiction verbs such as *paint* (*draw*, *sculpt*, ...) in combination with a direct nominal object. Examples based on an indefinite noun phrase such as (1) have (at least) two readings (Goodman, 1969; Moltmann, 1997; Forbes, 2006; Zimmermann, 2006b, 2016).

(1) Ben painted (drew, sculpted, ...) a cow.

According to the first reading, Ben produced a portrait of a cow of flesh and blood. I will call this the p(ortrait)-reading (following Goodman’s suggestion). According to the second reading, Ben produced an image of what cows visually amount to in general (that is, a cow-picture in Goodman’s words). I will call this the i(mage)-reading. The indefinite seems to receive a specific (*de re*) construal on the p-reading, as in (2a), and an unspecific (*de dicto*) construal on the i-reading, as in (2b). Correspondingly, directly referring proper names only allow p-readings, as in (3).

(2) a. ‘There is a specific cow that Ben produced an image of.’
b. ‘Ben produced an image of an unspecific cow.’

(3) Ben painted Bella.

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The availability of unspecific readings is usually considered a hallmark of intensional transitive verbs such as *seek*; compare the contrast between *seek* and the extensional verb *meet* in (4). Moreover, on the i-reading, *paint* complies with the second hallmark of intensional transitives, namely, failure of the substitution of extensionally equivalent expressions *salva veritate*, as shown by (5). (On the p-reading, the entailment in (5a) would of course go through.)

- (4) Ben {sought / #met} a baker, but no particular one.
- (5) Let all bakers be joggers and let all joggers be bakers.
- a. Ben {sought / painted} a baker. \rightarrow Ben {sought / painted} a jogger.
- b. Ben met a baker. \rightarrow Ben met a jogger.

Zimmermann (2006b, 2016) distinguishes p- and i-readings from a third reading, which is particularly evident in examples such as (6), where the nouns undoubtedly denote representational artifacts. On the face of it, the third reading contrasts with both the p- and the i-readings by the fact that the noun as such denotes the object produced. I will call it the $i(\text{mage})_N$ -reading.²

- (6) Ben painted {a portrait of a cow / a circle}.

It is still not settled how to derive the various readings and their properties in a systematic way. I will contribute the following new perspective to this task. In Section 2, I will review the crucial descriptive properties of depiction verb constructions. The upshot will be that, despite initial appearances, depiction verb constructions should be given an extensional analysis. In Section 3, I will develop a corresponding meaning adaption account that builds on Asher's (2011) Type Composition Logic. Specifically, two interacting hypotheses will be proposed. First, nouns presuppose the justification of disjoint types consisting of the object-type and its corresponding representation; that is, *cow* relates to either cows of flesh and blood or their representations. Second, depiction verbs such as *paint* select for representations, but license local coercion from objects to representations if a type-conflict arises. In a nutshell, then, $i(N)$ -readings go back to a type-logical ambiguity in the noun itself, whereas the p-reading goes back to the interpolation of an implicit representation. In Section 4, I will defend the adaption account against a property-based intensional alternative as suggested by Zimmermann (2006b, 2016). Section 5 offers a conclusion and a brief outlook.³

2. Review of descriptive properties

2.1. Readings and determiners

For the following discussion, some general background information on determiners is in order. Following Milsark (1977), two groups of determiners can be distinguished. Weak determiners such as *a* are grammatical in *there*-constructions (*There is a cow on the street*), whereas

²Zimmermann (2006b, 2016) mentions a fourth reading, which is exemplified by *Ben painted a wall (red)*. Here, *paint* relates to the application of (red) paint to the wall's surface. I will not discuss this reading here.

³Depiction verbs trigger the so-called imperfective paradox (known for creation verbs in general); that is, *Ben was painting a circle* does not entail that he painted a circle. As this (putatively) intensional effect does not directly bear on the ambiguity relevant here, I will not address it; see von Stechow (2001) and Forbes (2006) for discussion.

strong determiners such as *every* or *both* are not (**There {is every cow / are both cows} on the street*). This has a discourse-structural correlate. Roughly, weak determiners can yield non-presuppositional interpretations; strong determiners, by contrast, presuppose their domain (see Heim and Kratzer 1998: ch. 6 for an introductory discussion). With this in mind, we will return to *paint* and its readings.

While weak determiners license both p- and i-readings (see the examples in Section 1), strong determiners license p-, but resist (certain) i-readings (Forbes, 2006; Zimmermann, 2016). Correspondingly, (7) can be understood as in (7a), but not as in (7b).

- (7) Ben painted {every cow / both cows}.
- a. = ‘For {every / both} cow(s) of flesh and blood: Ben painted {it / them}.’
 - b. ≠ ‘Ben painted an image of the fact that {every / both} cow(s) of flesh and blood {is / are} present.’

For Zimmermann, this restriction is a key argument against a propositional take on i-readings. If one captured the relation between *paint* and its nominal object via some intensionalized predication (the minimal requirement being something like *be present* or *exist*), (7b) should be possible, contrary to fact. This is convincing; however, it is clearly not the full story. Notably, as also pointed out by Zimmermann (2016: 443), strong determiners are compatible with i_N -readings. Crucially, this holds true not only for representational nouns, as in (8), but also for nouns that *prima facie* do not denote representations, as shown by the examples in (9). According to the given contextual information, the relevant presupposed entities are cow pictures instead of cows of flesh and blood.

- (8) [exhibition of {many / two} cow pictures] Ben painted {every / both} cow picture(s).
= ‘For {every / both} cow picture(s): Ben painted {it / them}.’
- (9) a. [exhibition of {many / two} cow pictures] Ben painted {every / both} cow(s).
= ‘For {every / both} cow picture(s): Ben painted {it / them}.’
- b. [picture with many cow representations] Ben painted every cow in this picture.
= ‘For every cow representation: Ben painted it.’

In principle, this i_N -reading exists for (7) as well. However, the context-free presentation provokes the accommodation of entities that correspond to the ordinary meaning of the noun, which yields a p-reading. I will not dwell here on the question of whether this default amounts to a linguistically relevant asymmetry. For the time being, the key observation is just that (given contextual support) nouns can denote representations quite generally. Correspondingly, a strong determiner’s restriction can relate to the relevant representations as contextually given, fully independently of the depiction verb in its scope. This point of view can be strengthened by the observation that representational readings are in fact independent of a verbal lexical trigger, as shown by (10) (following Partee 2010: fn. 6 and Asher 2011: (9.10b)).

- (10) a. [picture book] Where is the cow? There is the cow!
b. [clothes shop] I like the dress with the flowers.

The obvious follow-up question is whether *i*-readings are in fact variants of i_N -readings and, thus, rooted in the representational sense of the noun as well. The difference would just be the following. With a weak determiner, the corresponding existential quantification introduces a discourse-new representation; this blurs the fact that it is rooted not in the verb, but in the noun. With a strong determiner, by contrast, the relevant representations are treated as discourse-old such that they can feed the determiner's restrictor; this givenness renders it transparent that the verb in the scope cannot be the source of the representation. Notably, this uniform perspective on *i*-readings provides an easy explanation for why the putative *i*-reading with strong determiners in (7b) is out. According to (7b), the representation (or, image) is supposed to be independent of the quantificational force of the determiner and its nominal argument. In other words: as on the *p*-reading in (7a), the quantification is said to target cows of flesh and blood. However, if *i*-readings are rooted in the nominal argument itself, the quantifying determiner cannot be independent of the representation, but it must target it. *I*-readings thus do not build on some intensional relation between depiction verbs and nominal objects, but on ordinary extensional quantification over entities in the world, namely, representations.

This extensional approach can be substantiated from two further angles (and one more will be discussed in the following section). The first relates to the substitution failure repeated in (11).

- (11) a. Let all bakers be joggers and let all joggers be bakers.
 b. Ben painted a baker. \nrightarrow Ben painted a jogger.

From the extensional perspective, the explanation for this is simple. The premise in (11a) relates to the identity of joggers and bakers of flesh and blood in a particular situation. Since this does not say anything about the identity of representations in that situation, the entailment in (11b) does not go through on the *i*-reading. In other words, the putative intensional effect in (11) is based on mixing the non-representational and the representational meaning of the involved nouns. Crucially, the effect dissolves once the distinction between objects and their representations is controlled for. Given a premise that relates to representations as in (12a), (12b) is valid on the *i*-reading, irrespective of the fact that *cow* and *cow without horns* are intensionally distinct (with the latter being stronger than the former). This observation, which seems to have gone unnoticed so far, is fully expected on an extensional account.

- (12) a. Let all paintings of cows by Ben be paintings of cows without horns.
 b. Ben painted a cow \rightarrow Ben painted a cow without horns.

Second, Moltmann (1997) shows that run-of-the-mill intensional verbs such as *need* are not relativized to possible worlds as wholes, but to parts of worlds, namely, situations that minimally obey certain restrictions. This comes out in combination with weak determiners that are not (right) upward monotone such as *exactly two* or *no*.⁴ For instance, (13a) is true iff for all minimal situations that satisfy Ben's needs, Ben has {exactly two / no} cows. Crucially, this is compatible with Ben {having more than two / having} cows in non-minimal satisfaction situations and, thus, accounts for the observation that (13a) does *not* entail (13b).

⁴The monotonicity property is, for instance, indicated by the fact that {*Exactly two cows / No cows*} are mooing loudly does not entail {*Exactly two cows / No cows*} are mooing.

- (13) a. Ben needs {exactly two / no} cows.
 b. In view of Ben's needs, it is necessary that he has {exactly two / no} cows.

Depiction verbs are different. On the i-reading, (14a) is true iff there are exactly two cow representations (be they in one picture or in two separate pictures). That is, (14a) would be false for an image that involves more than two cow paintings and that would thus be non-minimal. Similarly, (14b) enforces the lack of any cow paintings by Ben for a situation it describes truthfully.

- (14) a. Ben painted exactly two cows.
 b. Ben painted no cows.

I conclude that, even on i-readings, depiction verbs do not relate to minimal satisfaction situations and are, thus, of a different ilk than intensional verbs. Instead, the explicit quantifying determiner yields a usual extensional quantification over representations.

2.2. Anaphors to representations on i-readings

If i-readings generally build on ordinary extensional quantification, the quantified representations should generally be accessible to definite anaphors. This, however, is disputed by Zimmermann (2016) for i-readings with a weak determiner. His cases in point are given in (15). Crucially, the definite anaphor *it* calls for an explicit reference to pictures in the preceding sentence, which seems to be at odds with the assumption that the noun *camel* as such can introduce pictorial objects.

- (15) a. Ken painted #(a picture of) a camel. It is exhibited in the Louvre.
 b. That is #(a picture of) a camel, and I'll put it in my pocket.
 [see Zimmermann (2016), (65)–(66), where (66) is attributed to Kripke (2013)]

I consider this reasoning flawed in two respects. First, (15a) and (15b) suggest anaphoric links to the media on which the representations are displayed. However, the extensional approach merely says that nouns can introduce the representations themselves, but not these media. Once this distinction is controlled for, anaphors to representations are licit; see (16a), where *turn out* selects representations instead of media, or (16b) and (16c), where medium and representation coincide. (I owe (16c) to C. Fortmann.)

- (16) a. Ken painted a camel. It_{repr.} turned out very beautifully.
 b. Ken drew three camels, cut them_{repr./med.} out, and stuck them_{repr./med.} to the wall.
 c. Ken sculpted a camel and put it_{repr./med.} in his pocket.

The German examples in (17) are even more revealing. They show that the definite anaphor to the relevant representation covaries in gender with its nominal antecedent. This only follows smoothly from tying the introduction of the representation to the noun.

- (17) Ken hat {ein Kamel_i / eine Kuh_j / einen Hund_k} gemalt. {Es_i / Sie_j / Er_k} ist Ken has {a camel.N / a cow.F / a dog.M} painted {it.N / it.F / it.M} is sehr schön geworden.
very beautiful become
'Ken painted {a camel_i / a cow_j / a dog_k}. It_{i/j/k} turned out very beautifully.'

Second, (15b) involves a further complication. Without a specific context and without *a picture of*, the first part of the sentence suggests the non-representational sense of *camel*, which renders the representational sense inaccessible for the subsequent anaphor (see the further discussion for more on the 'destructive' nature of the disambiguation). As there is no depiction verb, the introduction of a representation cannot be traced back to the selection by the verbal predication, which, however, should be the case on the putatively intensional i-reading (recall the discussion in Section 2.1). Instead, the corresponding referent must be established independently. Once this is warranted by a context such as in (18), (15b) becomes felicitous, as expected under the extensional approach.

- (18) [A grandmother shows her grandson several small sculptures of animals.] That is a camel, and I'll put it in my pocket. Which one would you like to have?

Let me turn to a slightly different source of potential counterevidence. Moltmann (1997: 48–49) argues that i-readings are intensional, as they would prohibit definite anaphors and support only impersonal proforms. (For reasons of space, her considerations of identity conditions will not be discussed here.) Her examples look like those in (19) and (20). In (19), the definite anaphors render the i-reading inaccessible; in (20), proforms and possible readings covary.

- (19) Ben painted {an old man_i / a table_j}, and Mia painted {him_i / it_j} too. only p-reading
- (20) a. What did Ben paint? – An old man. only i-reading
b. Whom did Ben paint? – An old man. only p-reading
[see Moltmann (1997), (37)/(38)]

I agree with the judgments, but not with the conclusion. The example in (19) is special because it involves the depiction verb twice. This calls for two representations, as the produced object is bound to its agent here. Therefore, Mia cannot paint the representation already painted by Ben, which excludes the i-reading. The p-reading, by contrast, is fine because the very same old man or table can be portrayed several times. Two further observations support this reasoning. For one, the restriction to multiple representations carries over to examples based on representational nouns, as shown by (21a), while these undoubtedly license definite anaphors, as shown by (21b). Thus, the restriction observed in (19) cannot be due to the putative intensionality of i-readings.⁵

- (21) a. #Ben painted a picture_i, and Mia painted it_i too.
b. Ben painted a picture_i yesterday. It_i is lying on the kitchen table.

⁵Notably, anaphors to pictures in cases such as (21b) are also accepted by Zimmermann (2006a: 758–759). In fact, he considers them a problem for the particular intensional analysis of *paint* he provides for such cases.

Moreover, definite anaphors are felicitous once a depiction verb variant is chosen that does not involve a functional relation between agent and theme and thus escapes the proposed restriction. A case in point is (22). *Malen an etwas* ('contribute to the painting of something') in German does not necessarily map the produced representation to the explicit agent alone. Correspondingly, the anaphor is fine on an i-reading.

- (22) Ben malte an einer riesigen Kuh_i. Mia malte auch an ihr_i.
 Ben painted at a huge cow.F Mia painted also at it.F
 'Ben contributed to the painting of a huge cow, and so did Mia.'

The evidence drawn from the minimal pair in (20) is not convincing either. Crucially, the restriction to impersonal proforms on i-readings extends to extensional verbs. For instance, given coreference to a representational object, *touch* is equally incompatible with a personal proform; see (23). That is, the ban on *whom* is not rooted in intensionality, but in the nature of representations.

- (23) {What / #Whom} did Ben touch? – (A sculpture of) An old woman. He was interested in the surface feel of its material.

I conclude that, upon closer inspection, anaphoric references clearly support an extensional instead of an intensional approach to i-readings of depiction verbs. Let me finally note that i-readings block anaphors to the ordinary object interpretation, as shown by (24).⁶ (I owe (24c) to C. Maienborn.)

- (24) a. #Ben painted {a cow_{repr.} / an old man_{repr.}}. {It_{animal} / He_{human}} was called {Bella / Paul}.
 b. #Ben painted a cow_{repr.}. It_{animal} had eaten a lot.
 c. #Ben painted an old man_{repr.}. He_{human} was very flattered.

This is again indicative of the fact that the specification to one reading disables the other.

2.3. Specific features of p-readings

On p-readings, the noun seems to convey its ordinary meaning: *a cow* introduces a cow of flesh and blood. However, *paint* is still a creation verb and thus involves a representation (the produced portrait). This begs the question of how this representation comes into play and of how it differs from representations on i-readings. Descriptively, three aspects are noteworthy.

First, while i-readings only support anaphors to representations, p-readings show the reversed pattern: they are only compatible with access to the portrayed objects, as shown in (25). That is, any analysis must assure that the portraits, though conceptually present, are kept anaphorically opaque.

⁶Of course, a painter could call his work of art Bella and thereby suggest that the depicted object is the cow Bella. Even then, however, the anaphors in (24a) would not directly refer to these objects of flesh and blood.

- (25) Lisa painted {a horse from this farm / every horse from this farm}.
- a. It was called Lucky. / They were called Lucky, Rusty, and Misty.
 - b. #It turned out beautifully. / They turned out beautifully.
 - c. Then she fed {it / them}.
 - d. #Then she cut {it / them} out and stuck {it / them} to the wall.

The second observation relates to twin scenarios such as (26).

- (26) [Bella and Mia are cow twins that resemble each other to a perfect degree.] Ben painted Bella. The portrait would have been the same if he had painted Mia. But he painted Bella.

As pointed out by Zimmermann (2006b), such scenarios show that p-readings are feasible in situations where uniquely identifying properties of the objects portrayed are missing. I conclude that the representations on p-readings should be made dependent on these referential objects. Correspondingly, these representations are of a very different nature than representations on i-readings. Specifically, they are not rooted in the descriptive content of the explicit noun, but evolve from the interaction between the verb and the referent introduced by the noun phrase as a whole.

The third observation points in the same direction. Consider a situation with Lucky being a stocky, short-legged horse with a round belly and Rusty being a rangy, extraordinarily slender horse. A painter could portray Lucky by painting a circle and Rusty by painting a line. However, neither circle nor line would be considered truthful horse representations in the sense of i-readings. In words adapted from Zimmermann (2016: 427) (and Goodman 1969), a portrait of a horse need not be a horse-picture. This follows smoothly from the suggested distinction between the source of representations on i- as opposed to p-readings. According to Section 2.1, representations on i-readings are rooted in the noun, which explains why they are closely linked to the property associated with that noun; they must be reasonably truthful images of the visual appearance of horses in general (see Section 3.1 for further details). On p-readings, by contrast, representations depend on the nominal referent and, thus, must be reasonably truthful images of what this referent is. The underlying noun merely helps in picking out the portrayed referent; this bears indirectly on what the portrait might look like, but, strictly speaking, the portrait is independent of the noun chosen.

2.4. Interim conclusions

Combinations of depiction verbs such as *paint* with a nominal object are ambiguous between i(image)- and p(portrait)-readings. Their analysis should comply with the following key traits. First, both weak and strong determiners license both i- and p-readings. The relevant quantification operates on an extensional level: while it targets representations in the world on i-readings, it targets ordinary objects in the world on p-readings. The choice of weak as opposed to strong determiners specifies in a regular way whether the representation is newly introduced into discourse via the clause under consideration, or, whether it is presented as discourse-old. This

makes for the (wrong) impression that only i-readings based on strong determiners are rooted in the explicit head noun. Second, the accessibility of anaphors to representations as opposed to the objects represented covaries with the given reading. Anaphors to representations are feasible on i-readings, but not on p-readings; anaphors to the objects represented are feasible on p-readings, but not on i-readings. Third, in contrast to representations associated with i-readings, representations associated with p-readings are independent of the given head noun, but dependent on the portrayed object as introduced by the noun phrase as a whole.

3. Adaption analysis

The adaption analysis I will propose builds on Asher's (2011) type-logical approach to semantic composition. In Asher (2011), semantic representations comprise—besides the usual logical forms—rich typing information. In particular, predicates introduce (fine-grained) type presuppositions for their arguments; the composition succeeds if these are either satisfied directly or made satisfiable by non-random adaptive mechanisms. The lexical entry for *bank* in (27) and the example in (28) serve as illustration.⁷

$$(27) \quad \llbracket \text{bank} \rrbracket = \lambda x \lambda \pi. \text{bank}(x, \pi * \text{ARG}_1^{\text{bank}} : \text{LOC} \vee \text{INST})$$

$$(28) \quad \text{I entrust my money to this bank}_{\text{INST}} \text{ (#although the soil of it}_{\text{LOC}} \text{ is very sandy).}$$

Predicates come along with arguments for contextual parameters π . These parameters encode the relevant presuppositions, the addition of which is symbolized by $*$. According to (27), the predicate *bank* presupposes that its first argument ($= x$) is of type location ($= \text{LOC}$) or of type institution ($= \text{INST}$). This disjunctive type captures that x can be either a river bank or a financial institution (but not both). In (28), the predicate *entrust money* selects an object of type INST , which can easily be satisfied by the disjunctive type offered by *bank* via so-called Simple Type Accommodation: $(\text{LOC} \vee \text{INST}) \sqcap \text{INST} = \text{INST}$. Notably, the choice of the type INST disables access to the type LOC . Therefore, the continuation with *soil*, which presupposes the type LOC for the anaphor *it*, is infelicitous. With this general set-up in mind, let us turn to the combinatorics of depiction verbs.

3.1. Adaption analysis: I-readings

The first crucial assumption is that lexical units such as *cow* are ambiguous between an object reading and a representation reading. The hypothesis H1 in (29) captures this in type-logical terms.

$$(29) \quad \text{H1: Lexical units such as the noun } \textit{cow} \text{ presuppose the justification of disjoint types consisting of object type and object representation type; for } \textit{cow}: \text{ANIMAL} \vee \text{R}_{\text{ANIMAL}}.$$

⁷As this suffices for illustrating the core idea, the typing is simplified; see Asher (2011: ch. 6.3) for details. Specifically, the typing ignores that *bank* can also refer to buildings that host financial institutions.

For the main purpose of this paper, a rough characterization of such lexically given representations suffices. They are artifacts that share visually accessible properties with corresponding ordinary objects in general. The similarities must guarantee that the kind of object represented is recognizable as such according to some contextual standard (for instance, the criteria for what counts as a reasonably truthful artifact is different for a textbook on biology than for a caricature). Notably, this similarity-based characterization closely follows the characterization of images sketched in other approaches such as Forbes (2006) and Zimmermann (2006b, 2016).⁸ What sets my approach apart is that these representations are rooted in the fine-grained presuppositional content of lexical units. This begs the question of how general the underlying ambiguity is. The natural assumption is that it extends to all expressions that denote visually accessible entities. In fact, it does not matter whether the object represented is animate or inanimate, whether it is described in simple or complex terms, or whether it is a physical or an eventive entity. An *i*-reading is possible for all of them, as in (30).

(30) Ben painted {a cow / a stone / a brown cow with huge ears / a soccer match}.

Therefore, in contrast to the accidental ambiguity observed for *bank*, the ambiguity between representations and ordinary objects must have a systematic source. However, I will not speculate about this source and its repercussions on lexical meaning in general here. Instead, I will consider how far H1 gets us for the interpretation of depiction verb constructions.

For the example in (31) with a weak determiner (see (1) and (16a) from above), the relevant lexical entries are given in (32).

(31) Ben painted a cow. (It turned out beautifully.)

- (32) a. $\llbracket \text{cow} \rrbracket = \lambda x \lambda \pi . \text{cow}(x, \pi * \text{ARG}_1^{\text{cow}} : \text{ANIMAL} \vee \text{R}_{\text{ANIMAL}})$
 b. $\llbracket a \rrbracket = \lambda Q \lambda P \lambda \pi \exists x [Q(x)(\pi) \wedge P(x)(\pi)]$
 c. $\llbracket \text{paint} \rrbracket = \lambda \Psi \lambda z \lambda \pi . \Psi(\lambda y \lambda \pi' . \text{paint}(z, y, \pi'))(\pi * \text{ARG}_2^{\text{paint}} : \text{R})$

Following H1, the entry for *cow* in (32a) says that the first argument of the predicate *cow* must be either an animal or a corresponding representation. The entry for *paint* in (32c) says that the second argument of the predicate *paint* must be a representation; this captures the intuition that *paint* necessarily involves the creation of a representational object and binds this object as its second argument. (In order to keep things simple, requirements regarding the subject argument are omitted.) The entry in (32b) takes *a* to be a usual extensional quantifier (enriched by contextual parameters π). Composing these entries in a regular way yields (33).

- (33) $\llbracket \text{paint a cow} \rrbracket = \llbracket \text{paint} \rrbracket(\llbracket a \rrbracket(\llbracket \text{cow} \rrbracket))$
 $= \lambda z \lambda \pi \exists x [\text{cow}(x, \pi * \text{ARG}_2^{\text{paint}} : \text{R} * \text{ARG}_1^{\text{cow}} : \text{ANIMAL} \vee \text{R}_{\text{ANIMAL}})$
 $\wedge \text{paint}(z, x, \pi * \text{ARG}_2^{\text{paint}} : \text{R})]$

⁸For instance, Forbes (2006: 72), summarizing Peacocke (1987), writes: “[...] a depiction of, say, a dog, is something which, when viewed in appropriate conditions, is presented in a region of the visual field experienced as similar in relevant respects (for instance, shape) to one in which it is possible for a dog to be presented”.

Notably, the contextual parameters are part of the composition and, thus, subject to ordinary λ -conversion. In turn, the percolation of presuppositions follows the compositional path. According to (32c), *paint* assigns its presupposition to the outer parameter π (instead of the inner π'). As this π feeds the respective slot in the quantified argument Ψ , *paint* passes its presupposition on to the context parameter of its object, as shown by the result in (33). Correspondingly, the relevant site for the justification of both verbal and nominal presuppositions is the predication for *cow*, that is, the quantifier's restrictor. For (33), the presuppositions for x can easily be met by Simple Type Accommodation; see (34) and Asher (2011: (4.25)) for the corresponding generalized rule. After application to the subject, this yields the simplified result in (35). In prose: (31) is true iff there is a cow representation painted by Ben.

$$(34) \quad (\text{ANIMAL} \vee \text{R}_{\text{ANIMAL}}) \sqcap \text{R} = \text{R}_{\text{ANIMAL}}$$

$$(35) \quad \llbracket \text{Ben painted a cow} \rrbracket = \lambda \pi \exists x: \text{R}_{\text{ANIMAL}}[\text{cow}(x, \pi) \wedge \text{paint}(\text{Ben}, x, \pi)]$$

This is intuitively correct. More specifically, the derivation introduces a particular cow representation that can be accessed anaphorically, as illustrated by the parenthesized continuation in (31). However, there is no particular cow of flesh and blood introduced, which captures why corresponding anaphors are blocked; recall example (24a), repeated in (36).

$$(36) \quad \# \text{Ben painted} \{ \text{a cow}_{repr} / \text{an old man}_{repr} \}. \{ \text{It}_{anim} / \text{He}_{hum} \} \text{ was called} \{ \text{Bella} / \text{Paul} \}.$$

This blocking of the alternative lexical meaning is the crucial reason for modeling the ambiguity in terms of disjoint types. Disjoint types allow a simple meet operation as in (34) and, thus, the exclusion of one of the original types. This contrasts with objects that justify so-called dual aspect types; for these, “both constituent types, the types of the aspects, are in some sense present” (Asher, 2011: 132). A prototypical example is *book*, which denotes objects that are both physical and informational objects (type $\text{PHYS} \bullet \text{INFO}$). Predicates can select one or the other aspect. However, the corresponding accommodation cannot resort to a meet operation, as dual aspect types and simple types do not have a common meet (for instance, $(\text{PHYS} \bullet \text{INFO}) \sqcap \text{PHYS} = \perp$). Instead, the accommodation introduces a new object of the relevant simple type without abandoning the original object bearing a complex type. Correspondingly, anaphors are licit even if the selecting predicates introduce incompatible type requirements, as in (37); see Asher (2011: ch. 5 and 6) for details on dual aspect types and their accommodation.

$$(37) \quad \text{I read}_{\text{PHYS} \bullet \text{INFO}} \textit{Elements of Symbolic Logic}, \text{ did not understand}_{\text{INFO}} \text{ it and, therefore, threw}_{\text{PHYS}} \text{ it out of the window.}$$

The composition for i-readings with strong determiners is fully analogous. Based on the standard entry for *every* in (38), the example in (39) (see (9) from above) receives the interpretation in (40). In prose: (39) is true iff for every cow representation, Ben painted it.

$$(38) \quad \llbracket \text{every} \rrbracket = \lambda Q \lambda P \lambda \pi \forall x [Q(x)(\pi); P(x)(\pi)]$$

$$(39) \quad \llbracket \text{exhibition of many cow pictures} \rrbracket \text{ Ben painted every cow.}$$

$$(40) \quad \llbracket \text{Ben painted every cow} \rrbracket = \llbracket \text{paint} \rrbracket (\llbracket \text{every} \rrbracket (\llbracket \text{cow} \rrbracket)) (\llbracket \text{Ben} \rrbracket) \\ = \lambda \pi \forall x: \mathbf{R}_{\text{ANIMAL}} [\text{cow}(x, \pi); \text{paint}(\text{Ben}, x, \pi)]$$

This is adequate for the intuitively given i-reading. Recall from Section 2.1 that there is no i-reading according to which Ben painted an image of the fact that every cow is present. Given that the accommodation within the quantifier’s restrictor yields a quantification over cow representations, there is no way to derive this non-existent i-reading, as desired.

According to the terminology from the introduction, (31) exemplifies an i-reading, while (39) exemplifies an i_N -reading. In Section 2.1, I argued for treating them on a par. The given derivations implement this by the uniform accommodation of representations via the representational type of the head noun within the quantifier’s restrictor. The intuitive difference between both cases follows from the independent observation that strong determiners such as *every* partition contextually given entities, here, representations, and weak determiners such as *a* allow their introduction as discourse-new entities. In other words, only with strong quantifiers is the accommodation of the representational type within the quantifier’s restrictor readily identifiable.

Against this background, it is finally worthwhile to reconsider the case where the head noun undoubtedly conveys a representational meaning, as in (41) (see (6) from above).

$$(41) \quad \text{Ben painted a portrait.}$$

Interestingly, (41) has two i-readings. It can convey that Ben produces a portrait of, say, Mia; this is the most obvious standard reading, as already discussed in the introduction. In addition, it can convey that Ben produces an image of what portraits visually amount to in general, that is, a portrait-picture in Goodman’s terms. This observation might be puzzling, as it seems to bring back the original distinction between i_N - and i-reading and thereby challenge their reduction to one mechanism. However, the given type-logical analysis has a simple explanation for the ambiguity without giving up the uniform treatment. According to H1, *portrait* involves a disjoint type; see (42). This entry is conceptually sound, as it is fully reasonable to assume that there are representations of representations.

$$(42) \quad \llbracket \text{portrait} \rrbracket = \lambda x \lambda \pi. \text{portrait}(x, \pi * \text{ARG}_1^{\text{portrait}} : \text{REPRESENTATION} \vee \mathbf{R}_{\text{REPRESENTATION}})$$

Crucially, this predicts that the accommodation within the restrictor has two options. It can resort either to the ordinary representational type, as sketched in (43a), or to the secondary representational type, as sketched in (43b).

$$(43) \quad \text{a. } \lambda \pi \exists x: \text{REPRESENTATION} [\text{portrait}(x, \pi) \wedge \text{paint}(\text{Ben}, x, \pi)] \\ \text{b. } \lambda \pi \exists x: \mathbf{R}_{\text{REPRESENTATION}} [\text{portrait}(x, \pi) \wedge \text{paint}(\text{Ben}, x, \pi)]$$

(43a) is the standard reading, and (43b) is the portrait-picture reading. In other words: as the accommodation for *sui generis* representational nouns can use either of both types of the given disjoint type, it triggers an ambiguity not observed for non-representational nouns such as *cow*.

3.2. Adaption analysis: P-reading

The example in (44) (see (7) from above) exemplifies the p-reading. Based on the lexical entries from Section 3.1, the compositional result in (45) is as it would be on a corresponding i-reading.

(44) [on a farm] Ben painted every cow.

$$(45) \quad \begin{aligned} \llbracket \text{Ben painted every cow} \rrbracket &= \llbracket \text{paint} \rrbracket (\llbracket \text{every} \rrbracket (\llbracket \text{cow} \rrbracket)) (\llbracket \text{Ben} \rrbracket) \\ &= \lambda \pi \forall x [\text{cow}(x, \pi * \text{ARG}_2^{\text{paint}} : \text{R} * \text{ARG}_1^{\text{cow}} : \text{ANIMAL} \vee \text{R}_{\text{ANIMAL}}); \\ &\quad \text{paint}(\text{Ben}, x, \pi * \text{ARG}_2^{\text{paint}} : \text{R})] \end{aligned}$$

However, the satisfaction of presuppositions is different. Crucially, on the p-reading, the given noun relates to (contextually given) cows of flesh and blood. Accordingly, the predication for *cow* within the quantifier's restrictor should use the type *ANIMAL* for the specification of *x*'s type and, thus, ignore the type requirements brought in by the verbal predicate *paint*. This yields (46).

$$(46) \quad \begin{aligned} \llbracket \text{Ben painted every cow} \rrbracket \\ &= \lambda \pi \forall x : \text{ANIMAL} [\text{cow}(x, \pi); \text{paint}(\text{Ben}, x, \pi * \text{ARG}_2^{\text{paint}} : \text{R})] \end{aligned}$$

Of course, *x* cannot be both a cow of flesh and blood and a painting. Therefore, as it stands, the global commitment to animals in the restrictor yields an unresolvable conflict in the nuclear scope. Nevertheless, the analysis seems to be on the right track. Recall the evidence from Section 2.3: the p-reading renders animals, but not their representations, accessible to anaphors; moreover, portraits can diverge in substance from the content of the explicit noun. So, the global commitment to cows of flesh and blood and the elimination of the representational type of *cow* is correct. Instead, the representation required by *paint* should be made available locally, that is, within the nuclear scope and thus independently of the global type specification in the restrictor. Notably, such locality effects are well known for coercion (see Asher 2011, Bücking 2014, Maienborn and Herdtfelder 2017 for discussion). For instance, *enjoy* selects an event. If the object does not comply with this restriction, a suitable event can be interpolated, as in example (47), which suggests a consumption event. Analogously to the findings for *paint* on p-readings, the interpolation is locally operative: the quantifying determiner *three* counts dishes instead of events. Therefore, (47) cannot convey that there are three consumption events involving just one dish.⁹ Furthermore, the anaphor *they* relates to dishes, but not to events.

(47) Mia enjoyed three dishes. *They*_{dish/#consumption} were great.

Given this parallel, I propose to complement hypothesis H1 by hypothesis H2 in (48).

(48) H2: Depiction verbs such as *paint* license local coercion from objects to their representations.

⁹This is not a conceptual restriction. Let Mia eat a dish not all at once, but in three stages (morning, afternoon, evening). This is a situation with one dish, but three consumption events. But (47) cannot describe this situation.

In Type Composition Logic, coercion is rooted in the lexicon and thereby constrained by the linguistic system. Specifically, the coercive potential of lexical expressions is captured by so-called polymorphic types. Only these license the interpolation of additional material in order to resolve a pending type conflict. For *paint*, I propose the refinement in (49), which differs from the original entry in (32c) by including the polymorphic type $\rho(\text{HEAD}(\Psi))$. In a nutshell, this says that, if the second argument of *paint* is not a representation, the presupposition can be satisfied by interpolating a representation that is related to the head type of the explicitly given argument.

$$(49) \quad \llbracket \text{paint} \rrbracket = \lambda \Psi \lambda z \lambda \pi. \Psi(\lambda y \lambda \pi'. \text{paint}(z, y, \pi'))(\pi * \text{ARG}_2^{\text{paint}} : \text{R} - \rho(\text{HEAD}(\Psi)))$$

Given (49), the revised compositional starting point for the example in (44) is (50). Notably, in order to render the type conflict local, the typing information as determined for *cow* within the restrictor is mapped onto the contextual parameter for *paint* in the nuclear scope.¹⁰

$$(50) \quad \begin{aligned} & \llbracket \text{Ben painted every cow} \rrbracket \\ &= \lambda \pi \forall x : \text{ANIMAL} [\text{cow}(x, \pi); \\ & \quad \text{paint}(\text{Ben}, x, \pi * \text{ARG}_1^{\text{cow}} : \text{ANIMAL} * \text{ARG}_2^{\text{paint}} : \text{R} - \rho(\text{COW}))] \end{aligned}$$

The polymorphic type in (50) licenses so-called Type Accommodation with Generalized Polymorphic Types; see (51) adapted from Asher (2011: 225). According to (51), a \mathcal{D} -functor such as given in (52) introduces a mediating representation that meets the type requirement imposed by *paint* and that is linked to the given cow.¹¹ In the revised result in (53), the second argument of *paint* and the first argument of *cow* differ. Therefore, all presuppositions can easily be satisfied, which yields the simplified adapted meaning in (54).

$$(51) \quad \frac{\psi(v, \pi), \pi \text{ carries } \text{ARG}_i^P : \text{D} - \delta(\text{SUBTYPE}(\text{A})) * \text{ARG}_j^Q : \text{A}, v \in \text{ARG}_i^P \cap \text{ARG}_j^Q, \text{A} \sqcap \text{D} = \perp}{\mathcal{D}(\lambda w \lambda \pi' \psi(w, \pi'))(v)(\pi)}$$

$$(52) \quad \lambda P \lambda x \lambda \pi \exists y : \rho(\text{COW}) [\phi_{\rho(\text{COW})}(y, x, \pi) \wedge P(y)(\pi)]$$

$$(53) \quad \lambda \pi \forall x : \text{ANIMAL} [\text{cow}(x, \pi); \exists y : \rho(\text{COW}) [\phi_{\rho(\text{COW})}(y, x, \pi * \text{ARG}_1^{\text{cow}} : \text{ANIMAL} * \text{ARG}_2^{\text{paint}} : \text{R} - \rho(\text{COW})) \wedge \text{paint}(\text{Ben}, y, \pi * \text{ARG}_1^{\text{cow}} : \text{ANIMAL} * \text{ARG}_2^{\text{paint}} : \text{R} - \rho(\text{COW}))]]$$

$$(54) \quad \lambda \pi \forall x : \text{ANIMAL} [\text{cow}(x, \pi); \exists y : \rho(\text{COW}) [\phi_{\rho(\text{COW})}(y, x, \pi) \wedge \text{paint}(\text{Ben}, y, \pi)]]$$

In prose: (44) is true iff for every cow of flesh and blood, there is a representation that Ben painted of it. This is correct for the p-reading. Furthermore, it complies with all its specific

¹⁰The reasoning in favor of local coercion is sound. However, the mapping of the nominal type onto the verbal predication in the nuclear scope does not follow from the composition of contextual parameters. Recall that the lexical entries only facilitate the mapping of the presuppositions of *paint* onto the presuppositions of *cow*. Coercion based on *enjoy* faces the same problem; therefore, Asher (2011: 223) stipulates that the type accommodation pertains to the nuclear scope. I leave this more general computational problem for further research.

¹¹I dispense with the detailed derivation here; it follows the steps as given for instance by (45) to (47) in Bücking (2014).

traits. The representations are introduced locally and are thus opaque for anaphors, and they do not depend on the nominal disjoint type, but on the particular objects of flesh and blood they are representations of: y must be a representation of each x as given by the restrictor. This both solves the puzzle with twin scenarios and conforms to the observation that representations on p-readings can be untruthful images of what the nominal property amounts to. Let me conclude with a brief remark on the instantiation of the underspecified predicate variable ϕ for the interpolated representation. As the verbal predication is very specific, ϕ can only be a predicate for paintings.¹²

4. Comparison to intensional approaches: Zimmermann (2006b, 2016)

Zimmermann (2016) distinguishes between three approaches to i-readings: a proposition-based intensional analysis, a property-based intensional analysis, and a non-intensional so-called intentional analysis. He convincingly argues against the propositional approach, which I will not recap here for reasons of space (but recall the remark on it in Section 2.1). Before turning to the property-based intensional alternative, a brief comment on the intentional approach is in order. The adaption account developed here amounts to one implementation of intentionalism; the general characterization in Zimmermann (2016: 445) says: “If the object position of a transitive verb appears to be intensional, the restrictor nouns of its objects need to be suitably reinterpreted so as to make them extensional.” I consider my proposal an elaborate defense of such an approach regarding depiction verbs, not least against Zimmermann’s own skepticism. Furthermore, in contrast to Zimmermann’s rough ideas on how suitable reinterpretations come into play, the present proposal provides specific hypotheses on their roots.

According to the property-based intensional analysis of i-readings, *paint* contributes a “relation between painters and properties that characterize the pictures painted by them” (Zimmermann, 2016: 442). I implement this as in (55)/(56) (which slightly modifies Zimmermann’s version).

- (55) a. $\llbracket \text{paint} \rrbracket = \lambda P_{\langle e, \langle s, t \rangle \rangle} \lambda y. \exists x [\text{paint}(y, x) \wedge \text{representation of}(x, P)]$
 b. $\llbracket \text{a cow} \rrbracket = \lambda z \lambda w. \text{cow}(z)(w)$

- (56) $\llbracket \text{Ben painted a cow} \rrbracket = 1 \text{ iff } \exists x [\text{paint}(\text{Ben}, x) \wedge \text{representation of}(x, \lambda z \lambda w. \text{cow}(z)(w))]$

Contentwise, the representation relation does not differ substantially from its use within the proposed adaption account; in fact, as pointed out in Section 3.1, I basically follow the assumption made by Zimmermann and others that representations build on visual resemblance to possible ordinary objects as introduced by the nominal property. The crucial difference lies in their roots. While representations are introduced by the noun (i-reading) or by coercion (p-reading) in the adaption account, they are invariably rooted in the depiction verb in the property-based account (notably, without coercion in the relevant sense, as the adaption of properties for existential quantifiers underlying (55b) is of a different nature). This, however, poses several problems.

¹²This is different from event coercion as based on *enjoy*. Here, the specification varies according to the type of object and further contextual information. For instance, for (47) above, I assumed that Mia enjoyed the consumption of the dishes. However, in more specific contexts, she could also enjoy preparing them.

First, Zimmermann (2016: 443) points out that the property-based analysis is at odds with *i*-readings based on strong determiners such as *every*, as in (57). It lacks a plausible compositional derivation. Strong DPs are usually considered inappropriate for a shift to properties (as they are not existential). Moreover, even if the quantified DP could be shifted, this would not render representations sensitive to *every*; the representation would still be bound by the fixed existential quantifier in (56).

(57) [exhibition of many cow pictures] Ben painted every cow here.

This problem can be strengthened. In Section 2.2, I pointed out that anaphors to representations are compatible even with *i*-readings based on weak determiners (contra Zimmermann's assumption). Moreover, these anaphors are sensitive to grammatical features of the preceding object phrase. For instance, (58) (based on (16a) and (16b)) licenses a plural anaphor to representations. This is predicted by tying the representations to the explicit existential quantifier *three camels*, but it is fully unexpected once the representation is tied to some implicit existential quantifier given by the verb. (A similar argument follows from the gender agreement observed for German.)

(58) Ben drew three camels. They turned out beautifully.

A second source of trouble relates to the *p*-reading. Zimmermann (2006b: (13)) offers the standard *de re*-construal in (59) (again slightly modified). Crucially, the relevant property is presupposed to uniquely identify the portrayed object.

(59) $\llbracket \text{Ben painted a cow} \rrbracket$
 $= \exists y \exists P [\text{cow}(y) \wedge \text{given qua}(y, \text{Ben}, P) \wedge \exists x [\text{paint}(\text{Ben}, x) \wedge \text{representation of}(x, P)]]$

However, as pointed out by Zimmermann himself, this is at odds with twin scenarios as discussed in Section 2.3, where no such property is given. I conclude that (59) does not properly capture the link between portrait and portrayed object. The adaption account, by contrast, captures this link by rendering the representation dependent on the portrayed object as such. One can add that, according to the property-based analysis, representations are introduced in the same way on *i*- and *p*-readings. This hardly seems to be compatible with their being discourse-transparent only on *i*-readings.

Third, examples with ordinary representational objects such as *paint a portrait* typically convey that the explicit object is the representation produced by the painting. The lexical entry in (55a) does not allow for its derivation, as the produced representation is bound existentially, while the explicit object relates to the property *P* it represents. This enforces a separate entry for these examples, which is neither economic nor consistent with the commonalities between *i*-readings of different flavors. This speaks in favor of a uniform treatment as provided by the adaption account.

In sum, a property-based approach to depiction verbs such as *paint* faces several serious problems. I conclude that it is not a feasible alternative to the proposed adaption analysis.¹³

5. Conclusion and outlook

Combinations of depiction verbs such as *paint* with nominal objects based on nouns such as *cow* are ambiguous between i(mage)- and p(ortrait)-readings. I-readings involve representations that build on resemblance to corresponding ordinary objects in general. Contrary to first impressions, they are extensional (and in this respect analogous to i-readings based on representational nouns such as *portrait*): both weak and strong determiners license i-readings by quantifying over discourse-new and discourse-old representations in the world, respectively; correspondingly, anaphors to representations are licit. P-readings, by contrast, involve representations that depend on the portrayed ordinary objects as particulars. Here determiners quantify over ordinary objects in the world, while the produced representations are implicit and thus inaccessible to anaphors. I developed a type-logically inspired adaption account that builds on the interaction between two hypotheses. First, nouns such as *cow* presuppose the justification of disjoint types consisting of object type and object representation type. Second, depiction verbs such as *paint* license local coercion from objects to their representations. I argued that this adaption account captures the data considerably better than the property-based intensional alternative.

Finally, I would like to provide an outlook for two key issues worthy of closer scrutiny in future research. For one, the given proposal is well suited for an extension to rarely addressed constraints. For instance, *write* prohibits both p- and i-readings in combination with nouns such as *cow*, as shown by (60a). I-readings are only possible with adequate representational nouns, as in (60b).

- (60) a. #Ben wrote a cow.
b. Ben wrote {a text about / a description of / a poem about} a cow.

The pattern is captured as follows. Representations provided by nouns such as *cow* are based on visual resemblance and thus are not of a propositional nature. Therefore, (60a) cannot receive an i-reading. The examples in (61) provide independent evidence for the constraint.

- (61) [Ben drew a cow and wrote a description of a cow.]
a. Ben proudly showed his cow_{picture} to his mother.
b. #Ben proudly read his cow_{description} to his mother.

Furthermore, *write* can be said to select a physically manifest informational object while lacking a polymorphic type licensing coercion to such objects; see the entry in (62).

- (62) $[[\text{write}]] = \lambda \Psi \lambda z \lambda \pi . \Psi(\lambda y \lambda \pi' . \text{write}(z, y, \pi'))(\pi * \text{ARG}_2^{\text{write}} : \text{PHYS} \bullet \text{INFO})$

¹³For reasons of space, I have to defer a thorough comparison to the intensional analysis in Forbes (2006: 138–150) to another occasion. As far as I see, it is also at variance with the full range of extensional effects attested.

Hence, a p-reading is out for (60a) as well; there is simply no lexical anchor for the required coercion. (60b) is fine because the explicit nouns themselves provide the appropriate type.

The second key issue is more general. In its present form, the disjoint type hypothesis is agnostic to the question of whether object type and object representation type have an equal status or are ranked in a linguistically relevant way. For instance, it could be that the representation reading is systematically derived from the object reading and, thus, less readily accessible than its source. One way of approaching the relation between both readings is a thorough comparison to other types of (lexical) ambiguity; a particularly interesting candidate would be the generalized ambiguity between kinds and particulars. In any case, it is open to discussion what implications the proposed type disjunction has for the lexical system as a whole.

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On acquiring a complex personal reference system: Experimental results from Thai children with autism¹

Nattanun CHANCHAOTAI — *Department of Linguistics, University of Pennsylvania*

Abstract. Reference of pronouns may be constrained via lexical presuppositions, including marked ϕ -features, implicated presuppositions, and deictic center shifting in certain languages. This paper explores the acquisition of personal reference terms in Thai, a language that has a highly complex personal reference system. The participants of the study were 67 typically-developing children (TD) and 29 children with autism spectrum disorders (ASD), a population which has long been observed to have difficulties with pronouns. The children were asked to complete simple production and comprehension tasks on personal reference terms. Overall, ASD children performed on par in production but significantly poorer in comprehension than TD children. Given the freedom of choice in the production task, ASD children preferred using fixed referential terms for self-reference, whereas TD children opted for personal pronouns. In terms of comprehension, ASD children were shown to generally be able to detect the person features but they seemed to struggle the most with the pragmatic aspects of personal reference terms. Our results support previous literature that lexical presuppositions are acquired earlier than implicated presuppositions. We add to the literature that the types or the amount of implicated presuppositions matter in acquisition.

Keywords: implicated presupposition, pragmatic inference, pronoun, personal reference, acquisition, deixis, Thai

1. Introduction

While certain types of pragmatic inferences have been widely studied in the acquisition literature, implicated presuppositions have received much less attention, with some exceptions such as Yatsushiro (2008) and Legendre et al. (2011). Sauerland (2008b) adopted Heim's (1991) MAXIMIZE PRESUPPOSITION maxim to explain the semantic markedness of ϕ -features in pronouns. Since first and second persons possess a person ϕ -feature, they trigger the lexical presuppositions, referring to the speaker and addressee/participant, respectively. The lack of such a ϕ -feature on third person gives rise to an implicated presupposition that the referent is not the speaker nor the addressee/participant on this account. This study extends the contexts of pragmatically-derived inferences to the issue on deictic and person interpretations of pronouns in Thai, a language that is rich in personal reference terms and consists of not only over 50 personal pronouns, but also kin terms, occupational titles, and personal names (Bandhmedha 2011; Cooke 1968; Iwasaki and Ingkapirom 2009). The populations under examination include both typically-developing children (TD) and children with autism spectrum disorders (ASD),

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a population group which has long been observed to have difficulties with pronouns, such as pronoun reversal errors between ‘I’ and ‘you’ in English (Chiat 1982; Fay 1979).

The present paper begins with two main topics for the background literature on the semantics and pragmatics of pronouns (§2) and on pronouns and autism (§3). Section 4 presents the methods of the study. Results of the experiment are described in Section 5 and discussed in 6. Section 7 concludes.

2. Semantics and pragmatics of pronouns

Distinctions between personal pronouns can be made along various dimensions. In the person dimension, the 1st and 2nd persons are cross-linguistically observed to be different from the 3rd person in various ways, such as their associative plural generalization (See Greenberg 1988; Noyer 1992; Cysouw 2003.) and their bound interpretations (See Heim 1994; Kratzer 2009; Sudo 2012, etc.). While the 1st and 2nd persons are generally defined as referring to the speaker and the hearer respectively, the 3rd person is described as referring to neither (Lyons 1977). This fact led to different proposed sets of features for 1st and 2nd person versus 3rd person pronouns. Sauerland (2008b) proposed that the 3rd person is the most unmarked among the three persons. The verb agreements in Czech (1) is an example of how the 1st and 2nd persons dominate the 3rd person. Further similar evidence was presented in Sauerland (2008b) to support that the 1st person is more marked than the 2nd person as seen in their dominance relationship, e.g., in English (2) and in German (3).

- (1) a. bratr a já se uč-íme hrát na klavír
brother and 1.SG self.acc teach-**1PL** play on piano
‘My brother and I are learning to play the piano.’
b. tvůj otec a ty jste si podobni
your father and you be.**2PL** self.DAT alike
‘Your father and you are alike.’ (Corbett 1991, pp. 262)
- (2) You and I, **we**, are special. (Sauerland 2008b, pp. 26)
- (3) Du und ich sind/*seid etwas besonderes.
you and I be.**1/3PL**/*be.**2PL** something special
‘You and I are something special.’ (Corbett 1991, pp. 262)

For languages without inclusive/exclusive distinctions, e.g., English, Sauerland (2008b) proposed that the 1st person has the most marked feature specifications, containing [participant] and [speaker]. The specification for the 2nd person is only [participant]. For languages with inclusive/exclusive distinctions, including Thai², Sauerland (2008b) proposed the features [speaker]

²Cysouw (2013), basing on the data from Noss (1964), did not list Thai as a language with inclusive/exclusive distinctions. Instead, Cysouw (2013) listed Thai as another category having identical ‘we’ and ‘I’. While this may be true for the pronoun *raw*, which can mean both, it is not representative of the entire Thai personal reference system. The forms /*raw*/ or, with the plural marker, *p^hûak-raw* have no inclusive/exclusive distinctions, just like English ‘we’. However, in Thai, there are also other pronouns that can only mean ‘I’ and not ‘we’, such as *c^hân*. Combining this pronoun with the plural marker for pronouns forms *p^hûak-c^hân* which means ‘I and some others, but not you’. This is comparable to *wômen* in Mandarin, which was listed as a language with these distinctions.

and [addressee] instead, leaving exclusive 1st person pronouns and 2nd person pronouns undetermined on their rank on markedness scale. In both types of languages, however, the 3rd person lacks a person ϕ -feature altogether.³ The lexical presupposition is, thus, not triggered by the 3rd person. This is where Sauerland (2008b) adopted Heim's (1991) MAXIMIZE PRESUPPOSITION maxim, suggesting that the form with the strongest lexical presupposition must be chosen whenever its presupposition is felicitous. In other words, the use of 3rd person pronouns gives rise to another kind of presupposition: an '*implicated presupposition*' (Sauerland, 2003, 2008a, b) that the pronouns do not refer to either of the participants. Otherwise, according to the maxim, the 1st or 2nd person pronouns would have been used. In sum, instead of having a lexical presupposition for the features [speaker] or [addressee], the 3rd person only has an implicated presupposition of being '*anti-participant*'.

Apart from the person dimension, pronouns may contain other descriptive features, such as gender and number in English, to denote the properties of the referred individual. The relevant descriptive feature for this paper is gender. Sauerland (2008b) proposed that among all the languages with masculine/feminine distinctions in pronouns, the feminine distinction is cross-linguistically more marked than the masculine. This can be seen in the dominance of the masculine gender over the feminine gender on agreement, e.g., in French (4) and Czech (5). In contrast, the human/non-human gender distinction varies in its markedness across languages. For instance, in Luganda, although not fully acceptable in all circumstances, the gender class 8 which agrees with non-human subjects is preferred over, i.e., dominates, the gender class 2 for human, when the subject consists of a mixed group of humans and non-humans (6). While it seems that the non-human gender in Luganda and other languages, especially the Bantu languages, is more marked than the human gender, there are languages, e.g., Tamil (Corbett, 1991), which has a reversed dominance relationship between human/non-human genders.

(4) un père et une mère excellent-s
a.MASC father and a.FEM mother excellent-MASC.PL
'an excellent father and mother' (Corbett 1991, pp. 279)

(5) Jan a Věra šl-i do biografu
Jan and Vera go-PST-MASC.PL to movies
'Jan and Vera went to the movies.' (Vanek 1977, pp. 31)

(6) a. ? omu-sajja ne em-bwa-ye bi-agwa
1-man and 9-dog-his 8-fall-PST
'The man and his dog fell down.'
b. * omu-sajja ne em-bwa-ye ba-agwa
1-man and 9-dog-his 2-fall-PST
'The man and his dog fell down.' (Corbett 1991, pp. 274)

In this paper, we assume that Thai is a language with inclusive/exclusive distinctions. Certain pronouns, such as *raw*, might be underspecified for the feature [addressee], resulting in the seeming lack of such distinctions.

³Kratzer (2009) had a similar proposal that 1st and 2nd person pronouns contain the features [1st] and [2nd] respectively, while 3rd person pronouns only contain the feature [def] as they merely are definite descriptions, i.e., containing no inherent meanings as other persons. The difference in their proposal is that the features [1st] and [2nd] in Kratzer's (2009) proposal pick out an individual, while Sauerland's (2008b) person features are of the type $\langle e, t \rangle$. To avoid unnecessary complications, Sauerland's system is employed throughout the paper.

Although Sauerland (2008b) proposed that the [female] gender is crosslinguistically marked, we argue that the fact only holds true in 3rd person. In Thai, there are masculine/feminine distinctions in 1st and 2nd person pronouns as well. The epistemic status of male pronouns is restricted such that the referred individuals must only be male, while that of female ones does not. Therefore, we argued that for *1st and 2nd* persons in Thai, the feature [*male*] is marked, while for *3rd person*, the feature [*female*] is marked.

As mentioned above, human/non-human gender distinctions vary across languages. Two markedness tests, namely the dominance test and the epistemic status test, were then applied to Thai 3rd person pronouns. The coordination of a human and a non-human subject in (7) shows the dominance of the non-human gender. The ‘it’-equivalent pronoun *man* is chosen to be a resumptive pronoun for the entire coordination. Note that when this pronoun is used to refer to a person, it is implied that the speaker does not respect him/her. The 3rd person human pronoun *kháw*, on the other hand, cannot be used to refer to a coordination where one of the components is non-human. The epistemic status test in (8) confirms that the non-human gender is less marked as reference to a human is not ruled out as impossible by the use of the pronoun *man*. It is then concluded that the [human] feature in Thai is marked, while the [non-human] feature is not, giving rise to an implicated presupposition.

- (7) a. * câw-k^hɔ̃:ŋ kàp mǎ: *kháw* dɯ:n ma: d̩uaj-kan
owner and dog 3.HUM walk DEI together
- b. câw-k^hɔ̃:ŋ kàp mǎ: *man* dɯ:n ma: d̩uaj-kan
owner and dog 3.NH walk DEI together
‘The owner and the dog walked (towards the speaker) together.’
- c. * mǎ: kàp câw-k^hɔ̃:ŋ *kháw* dɯ:n ma: d̩uaj-kan
dog and owner 3.HUM walk DEI together
- d. mǎ: kàp câw-k^hɔ̃:ŋ *man* dɯ:n ma: d̩uaj-kan
dog and owner 3.NH walk DEI together
‘The dog and the owner walked (towards the speaker) together.’
- (8) a. *man* kam-laŋ kin k^hâ:w jù:
3.NH PROG eat rice PROG
‘It is having a meal.’
i) ✓ referring to an animal ii) ✓ referring to a person
- b. *kháw* kam-laŋ kin k^hâ:w jù:
3.HUM PROG eat rice PROG
‘He/she is having a meal.’
i) * referring to an animal ii) ✓ referring to a person

With regards to the traditional taxonomy, personal pronouns may be inherently deictic, meaning that they have varied referents depending on the extralinguistic contexts of who the speakers and the addressees are in a particular speech event. This property is referred to as ‘person deixis’, a subtype of a broader term ‘deixis’, which covers a range of references that varies by the context of an utterance based on certain important elements: person (e.g., ‘I’ and ‘you’), time (e.g., ‘now’ and ‘later’), place (e.g., ‘here’ and ‘there’), discourse (e.g., ‘this’ and ‘that’),

and social (e.g., honorifics) (Fillmore 1971, 1975; Lyons 1977; Levinson 1984). In addition to involving person deixis, personal pronouns may also be socially deictic, i.e., the choice of a pronoun points to the social status of the participants in the context. This aspect is closely related to their politeness distinctions. Typologically, second person pronouns in 71 languages out of 207 investigated languages encode politeness distinctions in some way (Helmbrecht, 2013). Among these languages, 49 of them encode a binary politeness distinction (e.g., German *du/Sie*, Russian *ty/vy*, French *tu/vous*, etc.), while 15 encode multiple politeness distinctions (e.g., Marathi). The rarest type of politeness distinctions, found in merely 7 languages, is when second person pronouns are avoided for politeness. These languages are all spoken in East and Southeast Asia, including, Burmese, Indonesian, Japanese, Khmer, Korean, Thai, and Vietnamese. Southeast Asian languages, instead, employ other kinds of personal reference terms to politely address the hearer.

This paper focuses on Thai, a language with a highly complex personal reference system. Personal reference system in Thai involves not only personal pronouns, but also kin terms, occupational titles, and personal names (Bandhmedha 2011; Iwasaki and Ingkapirom 2009, among others). According to the list by Cooke (1968), personal pronouns alone comprise 27 first-person pronouns, 22 second-person pronouns, and 8 third-person pronouns. The other three categories combined consist of countless items. Choosing pronouns among these abundant choices requires considering different factors, such as age, sex, societal status. Kin terms, for instance, can be used in an amicable fashion to refer to people *outside of one's family*, depending on the referent's age and relationship with the speaker.

Certain personal reference terms in Thai can refer to more than one person with different pragmatic effects. For instance, in child-directed speech, a female adult can use the male first-person pronoun *p^hǒm* to refer to the hearer who is a boy. This reverses the values between speakers and hearers and the relationship between them; instead of the speaker being male, the hearer is male. This kind of person syncretism is derived from deictic-center shifting. This does not only reverse the values of features between the speaker and the hearer but also the change in the deictic center as seen in abundant cases of other terms in Thai. For example, talking to their younger child, parents can refer to their older child as *p^hî*: 'older sibling'. This is a case where parents shift the deictic center to their younger child who would refer to their older child using that term. Had the parents themselves been the deictic center, the older child would be referred to as *lû:k* 'child'. Since such use of personal reference terms involves stylistic usages, this paper assumes that for certain terms where deictic-center shifting is possible, their features are not underspecified nor unmarked. We, therefore, claim that their meaning is not derived through an implicated presupposition.

The acquisition of implicated presuppositions and pronouns. The acquisition of implicated presuppositions has received much less attention than other pragmatic inferences, with some exceptions such as Yatsushiro (2008) and Legendre et al. (2011). Yatsushiro (2008) investigated the acquisition of lexical presupposition, implicated presupposition, and scalar implicature. She examined the German universal quantifier *jeder* 'every', which both lexically presupposes existence and implicates a presupposition of anti-uniqueness. Consider the sentences in (9): Since the definite determiner *the* lexically presupposes both existence and uniqueness, its use

is felicitous. On the other hand, the universal quantifier *every* has an implicated presupposition of anti-uniqueness. Our encyclopedic knowledge that one can only have one biological father makes the sentence infelicitous.

- (9) a. # I interviewed every biological father of the victim.
 b. I interviewed the biological father of the victim. (Yatsushiro 2008, pp. 667)

Yatsushiro (2008) conducted an experiment with 120 German-speaking children and 21 adult controls. The task is to choose the felicitous sentence(s) from a choice of two sentences for describing the picture that is shown. For instance, sentences in (10) were presented as choices for describing the picture of a girl playing soccer.

- (10) a. Das Mädchen hier spielt Fussball
 the girl here plays soccer
 ‘The girl here is playing soccer.’
 b. Jedes Mädchen hier spielt Fussball
 every girl here plays soccer
 ‘Every girl here is playing soccer.’ (Yatsushiro 2008, pp. 671)

The results show that 6-year-old children accepted (10b) significantly more than other groups of children and adults. This suggests that they have acquired lexical presuppositions, but have not fully acquired implicated presuppositions of anti-uniqueness. Yatsushiro (2008) then argued that implicated presuppositions are acquired later than lexical presuppositions, while having their acquisition path of implicated more similar to that of scalar implicatures.

Legendre et al. (2011) examined the acquisition of pronouns in French by testing the comprehension of 3 singular and 3 plural French pronouns by sixteen 30-month-old toddlers. They found that the comprehension of 3rd person *elle* was at chance level, in contrast with a good performance on 1st person *je* and 2nd person *tu*. All the plural pronouns seem to yield below-chance performance across all persons. They concluded that the results support Heim’s (1991) theory on presuppositions and Sauerland’s (2008b) markedness scale. The result is also in accordance with Yatsushiro’s (2008) claim that implicated presuppositions are acquired later than lexical presuppositions.

3. Pronouns and autism

Autism spectrum disorders (ASD) are characterized with three core features: social deficits, language and communication deficits, and repetitive behaviors (American Psychiatric Association 2000). Since language abilities among children with autism are largely heterogenous, researchers have divided them into autism with language impairment (ALI) and autism with normal or above average linguistic abilities (ALN) (Boucher 2012; Kjelgaard and Tager-Flusberg 2001; Rapin et al. 2009; Tager-Flusberg 2006; Whitehouse et al. 2008; Williams et al. 2008). It is still unclear, however, what the pattern of language impairments in the ALI subgroup is.

Pragmatics and discourse are generally accepted in the autism literature to be central to language deficits in autism (for reviews, see Lord and Paul 1997; Tager-Flusberg 1999; Wilkinson 1998). More recent studies (e.g., Eigsti et al. 2011; Tager-Flusberg and Joseph 2003) have found more fundamental impairments in other areas of language. Current hypotheses (See Walenski et al. 2006; Boucher 2012; Boucher et al. 2008) propose that the grammatical domains of language are impaired in ASD, while the lexical domains are still intact. Further research on language and autism is needed to support or challenge such a claim.

Among pragmatic deficits, difficulties in personal pronoun use have been observed since the beginning of the study of autism by Kanner (1943). Such difficulties with pronouns in ASD were also reported in many of the later studies (see, for instance, Bartak and Rutter 1974; Charney 1980; Chiat 1982; Fay 1979; Loveland 1984). Recent work by Mizuno et al. (2011) explored the neural basis of the personal pronouns *I* and *you*, in comparison with names which denote fixed identity in adults with high-functioning autism. The results show slower and less accurate responses when the task involves personal pronouns rather than names. Moreover, for questions containing the second person pronoun, this study detected an underconnectivity between right anterior insula, primarily involved in self-awareness and self-consciousness, and precuneus, essentially involved in spatial attention. The underconnectivity did not, however, appear with the questions containing first person pronouns.

Interestingly, errors in pronoun usage in autism are not restricted to deixis and the reversal of person features (11), but also involve errors in case markings (12). This leads to further questions on where the difficulties actually lie when it comes to the processing of pronouns in autism.

- (11) a. “You want candy.”
 b. “Hurt yourself.”
 c. “Help you please.” (Tager-Flusberg 1994, pp. 185)
- (12) a. “My get it.”
 b. “Me cool off.”
 c. “Do down me arm.” (Tager-Flusberg 1994, pp. 184-5)

As for Thai personal reference terms and autism, Chanchaochai (2013) observed three children with ASD over a three-month period and found that personal reference terms with lower deictic level, including kin terms, occupational titles, and personal names, were preferred over the ones with higher deictic levels like pronouns. Person deixis avoidance is thus another phenomenon that may play a role in the production of Thai personal reference terms in autism.

This project investigates the performance in both production and comprehension of a subset of common Thai personal reference terms. The goal is to compare between the two groups of participants, ASD and TD, and also between different groups of personal reference terms. The main differences within the personal reference terms include person and gender ϕ -features, deictic level, and deictic-center shifting.

4. Methods

4.1. Participants

Children with ASD ($N=29$; Male $N=24$; Age Range = 6;7-12;2 $M=9;10$ $SD=21.56$) and their age-, gender-, and non-verbal-IQ (NVIQ) matched TD controls⁴ ($N=67$; Male $N=55$; Age Range = 6;1-12;8 $M=9$ $SD=21.42$) were recruited from (1) Kasetsart University Laboratory School, Center for Educational Research and Development and (2) La-or Utis Demonstration School. One ASD participant was classified in his medical records as having Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS), while the remaining are all classified as having Autistic Disorder (AD). The Ravens Standardized Progressive Matrices (Raven et al. 2000) were administered to both groups of participants for the assessment of NVIQ (ASD $M=97.8$ $SD=22.24$; TD $M=112.95$ $SD=15.46$). The scores were converted using the norms in the 1979 British Standardisation of the Standard Progressive Matrices (Raven 2000, pp. 39-40). Children in both groups had normal hearing and normal or corrected-to-normal vision. This study was approved by the Institutional Review Board at the University of Pennsylvania. Having been informed about the study and their rights, the parents of all the participants provided written consent for their child to participate in the study.

4.2. Materials

The main design of the experiment adapts the Fishing Task (Girouard et al. 1997; Legendre et al. 2011). The speech context comprises five participants, including the experimenter (E), the child (C; tested individually), and 20-inch-tall cardboard figures of a boy (B), a girl (G), and a monkey (M; See Figure 1.). The blank space, which each of the cardboard figures are holding, was left for attaching 58 cards with the pictures of different objects using a reusable adhesive.

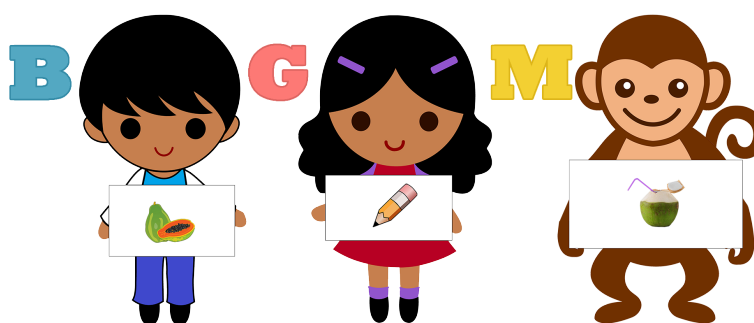


Figure 1: Extra *participants* in the experiment

⁴We attempted to subgroup the TD children into the age-matched group and the NVIQ-matched group. However, the results from different ways of subgrouping remain very similar to those from the entire group. Therefore, this paper only presents the data from the entire group of the TD children.

4.2.1. Tested personal reference terms

For the comprehension task, all of the personal reference terms that are applicable to the context of our experiment were chosen. The test phase included 8 personal reference terms: 1 first-person, 4 second-persons (3 pronouns for each child depending on the child's gender, i.e., *nũ:* for girls and *p^hõm* for boys as highlighted in Table 1), and 3 third-persons. The selected terms are personal pronouns, except for two terms: *p^hî:* 'older sibling' and *nô:ŋ* 'younger sibling', which are kin terms. The order of pronouns in question was pseudo-randomized such that the possible answers of each phase do not refer to all the speech participants, so that they do not leave later referents predictable. The randomization methods make the amount of trials per each pronoun different. Each targeted pronoun was, however, repeated at least twice.

Based on the literature discussed in Section 2, below we provide tentative semantic denotations for the personal reference terms that were used in the experiment in Table 1. The denotations of each pronoun are merely semi-formal so as to clearly illustrate their possible feature bundles to the readers. This table summarizes all the possible denotations of each personal reference term whose target is restricted to only one referent by the context of the experiment. For instance, the first term in the table *p^hî:* 'older sibling' can be used to refer to either the speaker or the addressee as long as the referent is the older one in the situation. Therefore, in the setting of this experiment, when I, the experimenter, used this term to talk to a child, this term always referred to me, the older participant. Likewise, if the child used this term in this situation, it would still refer to me, the older experimenter. This is different from the pronouns *p^hõm* and *t^hγ:*, which have more complex dimensions while being used as different persons. In Section 2, we proposed that deictic-center shifting does not involve unmarked person features. Thus, even though the pronoun *p^hõm* is technically a 1st-person pronoun for men of any age, it is also marked with 2nd as a separate entity since it can be used only in child-directed speech, where deictic-center shifting is employed. As for the pronoun *t^hγ:*, it is generally a 2nd-person pronoun when the addressee is of an equivalent age or social status. The addressee can be younger or in a lower social status as well but that is only used in an unfriendly and distant (almost degrading) sense. Since the experimenter is not the children's peer and also ended each sentence with a polite final particle, the 2nd person reading should not be applicable in this context.

4.3. Procedure

In the beginning of each block, the children were first asked to name pictures of commonly known animals and objects. The pictures were then distributed across participants. Before the production task, no pronouns were used so to avoid priming the children. In the test phase, each participant in the production task or each term in the comprehension task was randomly

⁵Social-deictic features are normally listed in the encyclopedic (non-linguistic) knowledge. It may be possible that in certain languages, some social descriptive features are encoded in the grammar. It is beyond the scope of this paper to discuss the claim. The social descriptive features are only included for the reader's understanding of these pronouns.

⁶Its reduced form *k^háw* (more frequently used) are underspecified for gender. Only the full form was tested.

Table 1: Tested personal reference terms

Participant					
Term	Person		Gender	Social-deictic ⁵	Target
p ^{hi} :	participant	{1st, 2nd}	-	older sibling	E
nǔ:	participant	{1st, 2nd}	-	younger participant	C
p ^h ǒm	speaker	{1st}	male	-	C
	addressee	{2nd}	male	younger participant	
k ^h un	addressee	{2nd}	-	formal	C
nó:ŋ	participant	{1st, 2nd}	-	younger sibling	C
Anti-participant					
Term	Person		Gender/ Social-deictic	Implicated Presup	Target
k ^h ǎw ⁶	-		human	anti-participant, non-feminine	B
t ^h y:	addressee	{2nd}	peer	-	G
	-		human, female	anti-participant	
man	-		-	anti-participant, non-human	M

selected as the expected target at least twice. A different set of 5 objects was changed after every 3 trials. Below are the instructions in the order as they appeared in the experiment.

Preparatory Phase:

E: 'What's (your) name?'⁷

E: 'What is this?' (Repeat for 5 objects per block.)

Production Task:

TEST PHASE:

E: 'Who is holding X?' (Twice for each target.)

C: '___ (is holding X.)'

Comprehension Task:

FAMILIARIZATION PHASE:

E: 'What is Y_{the boy/girl/monkey/child's name} holding?'

C: '(Y is holding) X.'

TEST PHASE:

E: 'What is Y_{tested pronoun} holding?'

C: '(Y is holding) ___.'

⁷Thai is a pro-drop language so pronouns can be avoided here.

5. Results

5.1. Overall accuracy

One ASD child was withdrawn from the experiment because he did not answer to any of the questions. His results were excluded from the calculations. An answer was marked as accurate when it referred to the right referent. The accuracy rate for production is near ceiling for both the ASD (94.6%) and the TD (90.6%) groups with ASD children performing significantly more accurately (Mann-Whitney $U=97595$, $p=0.04$). The accuracy rate for comprehension dropped for both groups (60.4% for ASD; 82.3% for TD) with a much sharper drop for ASD (Figure 2). The comprehension task accuracy thus yields a highly significant difference between participant groups (Mann-Whitney $U=658640$, $p<0.001$).

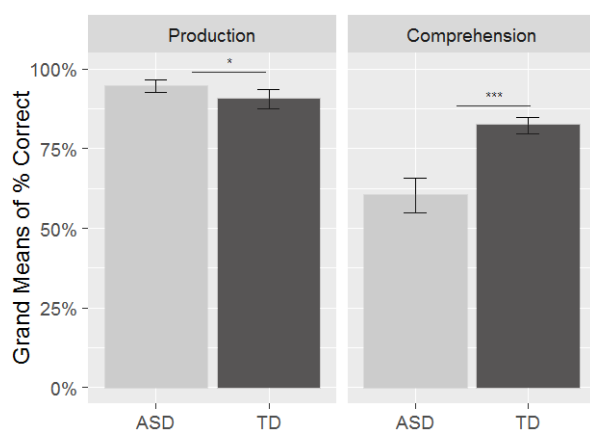


Figure 2: Overall accuracy across tasks

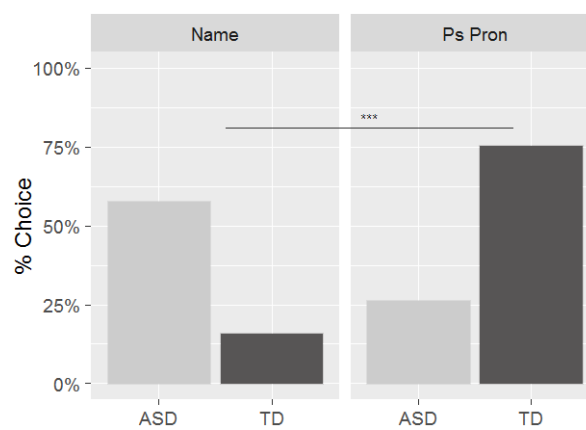


Figure 3: Choices of terms the children used to refer to themselves

5.2. Production

The most common personal reference terms that the children in both groups used to refer to themselves are personal names and personal pronouns. However, they were found in a reversed preferred pattern (Figure 3). In the ASD group, personal names were used 57.4% of the time versus 25.9% for personal pronouns, compared to 15.7% versus 75.2%, respectively, for the TD group. The proportion of counts for the two most commonly-chosen categories for self-reference showed a very significant difference across participant groups (Fisher's Exact, $p<0.001$).

As for the reference to the experimenter, children with ASD used the occupational title k^hru : 'teacher' to refer to the experimenter the most (51.95%), followed by the use of kin term $p^h\hat{i}$: 'older sibling' (42.3%). TD children, on the other hand, preferred the kin term (55%), over the occupational title (44.15%). However, the proportion of the choices for referring to the experimenter was not significantly different across groups (Fisher's Exact, $p=0.23$). As for the reference to the cardboard figures, both of the groups mainly used common nouns (boy, girl, monkey) to refer to them (92.1% for ASD; 97.1% for TD). Thus, the two participant groups are not significantly different from each other (Fisher's Exact, $p=0.19$).

5.3. Comprehension

Overall, third person yields the poorest performance for the ASD group (See Figure 4). As for the TD group, only the male third person yields poorer performance among the third persons. The only form where ASD children outperformed TD children is the formal second-person pronoun *k^hun* with a non-ambiguous referent. A fixed effect logistic regression model (Accuracy \sim Group + Gender + zAge + zNVIQ) was run on the comprehension task. It reveals that the accuracy is significantly different across participant groups ($z=10.736$, $p<0.001$), age ($z=12.294$, $p<0.001$), and NVIQ ($z=10.167$, $p<0.001$). The gender of the participants is not a significant factor for their performance ($z=-0.015$, $p=0.99$).

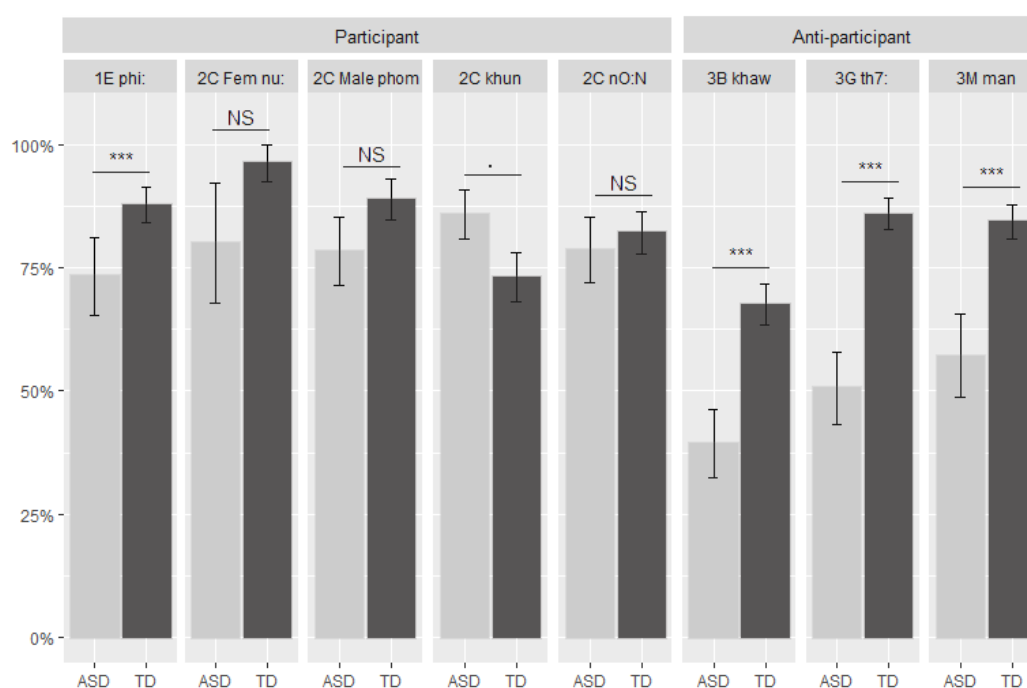


Figure 4: Accuracy in comprehension task by item

5.3.1. Error analysis

This section explores the pattern of errors in the comprehension task. Figure 5 shows the percentages of errors among all trials. This is to examine the choices the children opted for, instead of the expected referents.

Experimenter-Targeted: Instead of choosing the experimenter as the target for the pronoun *p^hi*: ‘older sibling’, a subgroup of both ASD and TD children mistook the term for referring to the cardboard figures (Figure 5a). The ASD children made more mistakes answering that they themselves were the referent to the term ‘older sibling’, while in fact, they were not older (ASD 8%; TD 1.5%).

Child-Targeted: A similar pattern was observed in the comprehension of the term *nó:n* ‘younger

sibling’ where the children chose the cardboard figures as the referent, instead of choosing themselves (Figure 5e). Some ASD children also chose the experimenter as the referent for the terms *nũ*: (1st/2nd younger female) (10%; Figure 5b), *p^hõm* (1st male deictic-center shifted) (8.7%; Figure 5c), *k^hun* (2nd formal) (1.8%; Figure 5d), and *nó:ŋ* ‘younger sibling’ (1.8%; Figure 5e). As for the TD children, regardless of the number of errors they made in the comprehension of the formal second person pronoun *k^hun*, the experimenter was never one of the wrong targets for any of the tested second person pronouns.

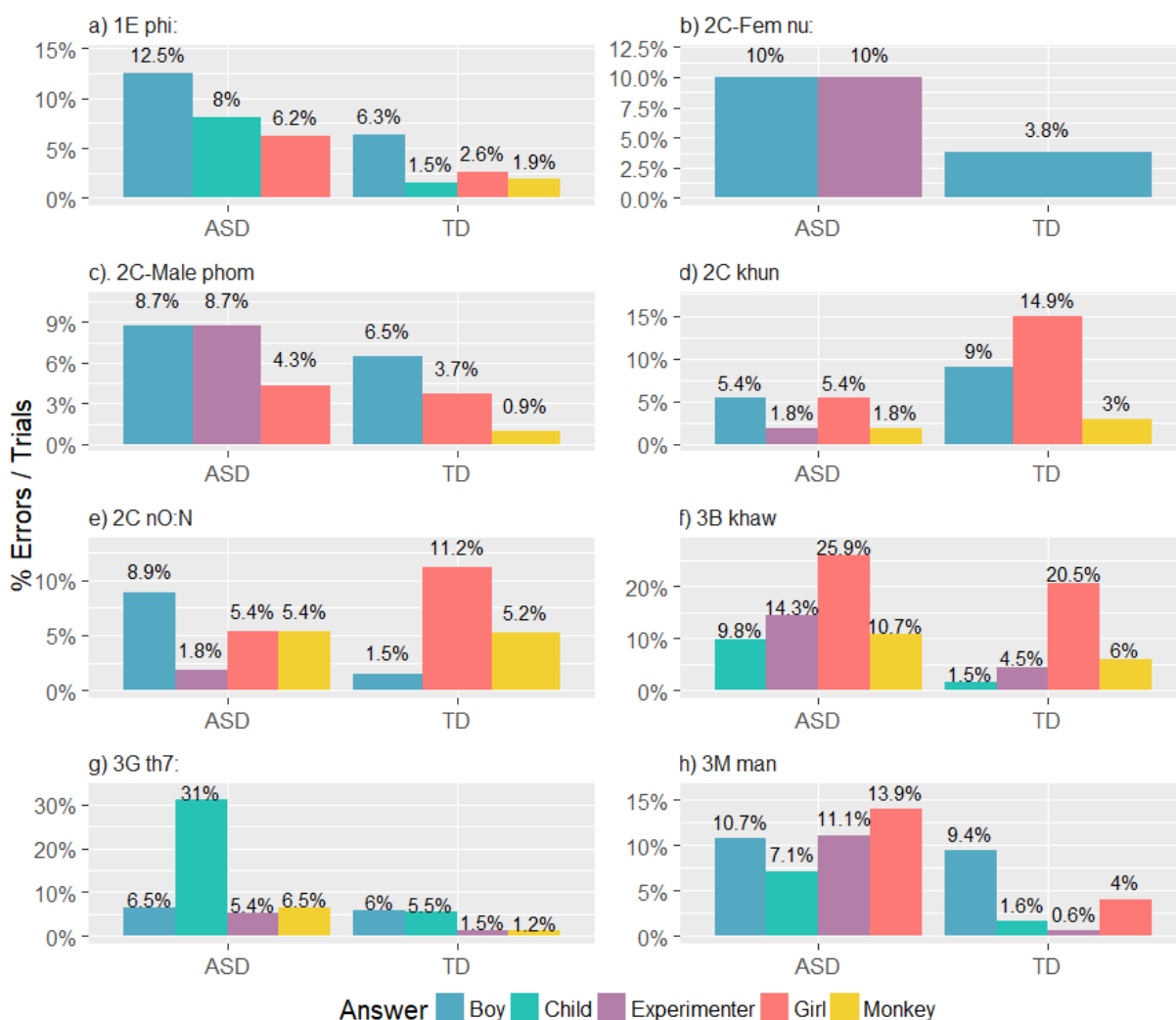


Figure 5: Errors in comprehension task by item

Boy-Targeted: The majority of mistakes made by both ASD and TD was related to gender, where they chose the cardboard girl figure instead (ASD 25.9%; TD 20.5%). With regards to the person feature, the ASD children chose more non-third-person targets than the TD group (24.1% versus 6%; see Figure 5f).

Girl-Targeted: The pronoun used for targeting the girl is *t^hɣ:*. As noted earlier, this pronoun is generally used to refer to a second person, with underspecified gender. Although the usage as a second person is very common, it is only used among people of the same age or status.

It is highly likely that the participants were referred to by their peers using this pronoun. If the speaker of the pronoun is an older person, the addressee and the speaker must be close to each other (stylistic use), otherwise, the term would sound very unfriendly and pragmatically inappropriate. The results seem to show that the sensitivity to this social dimension of the pronoun was largely ignored by the ASD children, choosing themselves as the target 31% of the time (Figure 5g).

Monkey-Targeted: The errors for *man* covered all four other choices (Figure 5h). The ASD children made mistakes with regards to person features, choosing the experimenter or themselves (11.1% and 7.1%, respectively) at a much higher rate than the TD children (0.6% and 1.6%).

6. Discussion

Not only do the results present many interesting aspects of the data, but they also show a coherent picture of the acquisition pattern of personal reference terms in TD and ASD children. The performance on production and comprehension was asymmetrical in both participant groups, with the ASD children performing significantly poorer than the TD children in the comprehension tasks, regardless of their significantly more accurate production. Lexical presuppositions seemed to be easier to comprehend than implicated presuppositions for both groups of children as well. Even though their overall accuracy is lower than TD children, ASD children are, to a large extent, able to comprehend the second person lexical presupposition suggested by the person ϕ -feature, when the person feature is not underspecified. This was suggested by the fact that *k^hun* (2nd formal) is the only pronoun which the ASD group outperformed the TD group. The TD group's performance, on the other hand, seems to be suppressed by the social awkwardness of using the formal pronoun to refer to a child, while the ASD children solely paid attention to the person ϕ -feature as they largely ignored the social deictic dimension of the formal second-person pronouns.

A similar result was found in the errors in the comprehension of the pronoun *t^hɔː*, targeting the cardboard girl figure. The ASD children made significantly more mistakes than the TD children even though the [female] feature is marked, suggesting that person ϕ -features are the most prominent cue for them, not gender or social descriptive features. This is in accordance with the overall results that the ASD children could correctly detect the marked person feature of a pronoun, instead of the unmarked 3rd person, but failed to take into account the social descriptive features (that the term is mostly used among peers) or to recognize the social relationship in a particular context (that the experimenter is not his/her peer).

However, given the freedom of production, ASD children avoid person deixis by choosing fixed referential terms (names) rather than terms with a higher level of person deixis (i.e., pronouns) to refer to themselves. To refer to the experimenter, both of the groups mainly chose to use either kin terms or occupational titles. Recall that Thai is among the seven languages that omit 2nd person pronouns for politeness. If a relationship between the speaker and the addressee is known, the term denoting that relationship, rather than a 2nd person pronoun, should be used. As for the terms used for cardboard figures, children in both groups chose to use common

nouns, rather than any personal reference terms. This can be explained by the fact that the use of pronouns also presupposes salience (Roberts 2004). The children preferred the full form over the pronouns because the referent was not salient or not as salient as other possible referents in the context. If the experiment had been conducted in English, the same results should still be expected, as can be seen in the examples below where a weakly familiar referent does not guarantee salience (13). It is, therefore, not possible to conclude that the choice of less deictic terms for the 2nd and 3rd person referents in the experiment is the case of person deixis avoidance or not.

- (13) a. * In Amsterdam, if a bicyclist isn't very careful, it'll be stolen.
b. In Amsterdam, if a bicyclist isn't very careful, her bicycle will be stolen.
(Roberts 2004, pp. 517)

Regardless of the fact, the choice for the 2nd person across the participant groups still yielded interesting results. Although the proportion of the choice between kin terms and occupational titles by the ASD group and the TD group is not statistically significant, the ASD group preferred to use more occupational titles than kin terms. It is worth noting that kin terms and occupational titles contain different levels of social deixis. The use of occupational titles is more fixed. It is possible to refer to someone using occupational titles even though the terms are not applicable to one's relationship with that person. For instance, the owner of a restaurant near a school may refer to his/her customer using the term 'teacher' without having to be the student of that person if he/she knows the customer's occupation. This is in contrast with kin terms which could vary by age and relationship between the speaker and the addressee.

In terms of implicated presuppositions across populations, challenges arise in the resolution of implicated presuppositions when certain ϕ -features are unspecified. For the ASD group, person unmarkedness alone could decrease their performance, as can be seen in the lower performance in all the third-person forms. The further pragmatic inference that has to be made for gender unmarkedness of male pronouns had an additive decreasing effect for the ASD group. The implicated presupposition from the unmarked non-human feature seemed to be easier than that from the unmarked masculine feature across participant groups. The TD group's performance was only affected in male third-person pronouns, but not any other third-person forms. This suggests either that the TD group may only be affected when two implicated presuppositions (from person and gender unmarkedness) appear simultaneously or that the gender unmarkedness is particularly difficult for them. Such performance on different kinds of implicated presuppositions and deixis might correspond to the order of acquisition.

As for the case where adult native speakers of Thai seem to, *prima facie*, reverse 'I' and 'you' while talking to young children, pronouns with deictic-center shifting seemed to yield results similar to those with unmarked person features as kin terms and other 1st and 2nd person pronouns. This supports our hypothesis that person syncretism as a result of deictic-center shifting is not the same as the one which involves person underspecification.

7. Concluding remarks

In terms of types of presuppositions as proposed by Heim (1991), our results support Yatsushiro (2008) and Legendre et al. (2011) that lexical presuppositions are acquired earlier than implicated presuppositions. We add to the literature that the types or the amount of implicated presuppositions matter in the acquisition. The implicated presuppositions of non-human seemed to be relatively easier than those of masculine gender for children in both groups. The evidence lies in the lowest performance by both groups on the 3rd person male pronouns, which lack both their person ϕ -feature and their masculine gender feature. With regards to the difference between the two groups of participants, the ASD children avoided terms with higher person deictic level when they had free choice in production. In general, the TD children made fewer and different types of errors than the ASD children. The ASD children were shown to generally be able to detect the person features, but they seemed to struggle the most with the pragmatic aspects of personal reference terms that involve implicated presuppositions and person and social deixis. A smaller group of the ASD children had difficulties with marked ϕ -features, resulting in the pronoun-reversal type of errors. These grammatical mistakes with regards to ϕ -features may hint on more fundamental language deficits. ASD children who made such mistakes after a certain age may belong to the ALI subgroup.

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Context updates in head-final languages: Linear order or hierarchy?¹

WooJin CHUNG — *New York University*

Abstract. This paper argues that extant approaches to presupposition projection that either rely on strict linear order (Schlenker, 2009) or hierarchy (Romoli and Mandelkern, 2017) cannot provide a uniform account of data drawn from head-final languages. While building on Schlenker’s theory, this paper resolves the issues by restricting the calculation of local contexts to specific points in the parsing process. The consequence is that the theory makes a prediction robust to the head directionality parameter.

Keywords: presupposition projection, local context, parsing, linear order, hierarchy.

1. Introduction

Schlenker (2009, 2010, 2011a, 2011b) proposes a parsing-based account of presupposition projection that derives the local context of an expression on the basis of classical truth-conditional semantics. Schlenker argues that there is a pragmatic requirement that a presupposition must be entailed by a local context calculated according to the following definition:

- (1) Local context (Schlenker 2011, incremental version)
The local context of an expression d of propositional or predicative type which occurs in a syntactic environment $a _ b$ in a context C is the strongest proposition or property x which guarantees that for any expression d' of the same type as d , for all strings b' for which $a d' b'$ is a well-formed sentence,

$$C \models^{c' \rightarrow x} a (c' \text{ and } d') b' \leftrightarrow a d' b'$$

The key aspect of Schlenker’s theory is that local context is calculated *incrementally*: the interpreter traverses a string of expressions from left to right. Upon encountering E , it only has access to the expressions that *linearly precede* E . Given those expressions, the interpreter calculates the strongest but innocuous restriction. This left-to-right bias is built into the formulation of local context. In (1), the interpreter is completely agnostic to what follows the expression the local context of which is to be calculated (b' in this case). Thus, it needs to take into account every possible continuation of the sequence $a d'$ that results in a well-formed sentence.

Schlenker claims that his theory of local contexts achieves explanatory adequacy in the sense that it predicts how presuppositions project based on syntax and classical truth-conditional semantics. On the other hand, extant dynamic approaches (Stalnaker, 1974; Heim, 1983) fail to do so because they encode such behavior in the lexical specification of words. For instance, Heim specifies ‘Context Change Potentials’ in the semantics of operators so that they can update the context in a specific order. However, as Schlenker points out, such a system would be

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too strong to be sufficiently explanatory because one can encode an arbitrary update behavior to any given operator. For instance, one can come up with a deviant conjunction *and** which updates the context in the opposite order of ordinary conjunction *and*. The dynamic approaches in principle cannot rule out this possibility.

While maintaining Schlenker's view that presupposition projection behavior is closely related to the left-to-right bias inherent in parsing, this paper points out that local contexts cannot be calculated in a strictly incremental fashion. Evidence comes from head-final languages where predicates typically follow their arguments. An alternative parsing-based solution is to apply the algorithm to syntactic trees (Romoli and Mandelkern, 2017). It will be shown that the hierarchy-based account has difficulties explaining the presupposition projection behavior of coordinated structures.

I suggest that Schlenker's algorithm should not be run word-by-word, but rather *domain-by-domain*, possibly *postponing* the computation of local context. The proposed analysis resolves the problems encountered in Schlenker's original algorithm and the hierarchy-based account, while reproducing the correct predictions.

2. Issues in the linear order-based approach

2.1. Attitude context

Let's first take a look at an English example in which a presupposition trigger is embedded under an attitude verb, and see how the incremental version of Schlenker's algorithm makes the right prediction. In (2), the attitude verb *believes* embeds the presupposition trigger *continues*.

- (2) John believes that Mary smoked in high school, and he believes that she continues to smoke.

According to the incremental version of Schlenker's algorithm, the target expression and whatever follows it cannot be foreseen. It must be the *strongest yet innocuous* restriction that can be made regardless of what comes after the embedded clause. The point at which such calculation takes place in (2) is marked with • in (3a).

- (3) a. he **believes** that she ~~continues~~ to smoke •
 b. Corresponding equivalence:
 For any expression d' of a propositional type,

$$C \models^{c' \rightarrow x} \text{he believes } (c' \text{ and } d') \leftrightarrow \text{he believes } d'$$

Note that the matrix verb *believe* has already been encountered at the point of local context calculation and the interpreter already has it on its workspace. Thus, the context set is restricted to John's doxastic worlds, and the algorithm correctly predicts that the presupposition of (2) is 'John believes that Mary smoked'. What is crucial in this account is that the attitude verb *precedes* the embedded clause. Despite the success in accounting for the English data, we are led to question what the theory would predict for a language where an attitude verb *follows* the

embedded clause. Korean is such a language, and the default word order is SOV. An example is provided in (4).

- (4) John-un [Mary-ka (cikum-to) keysokhayse tambay-lul pi-n-tako]
 John-TOP [Mary-NOM (now-also) continuously cigarette-ACC smoke-PRES-COMP]
mit-nun-ta.
believe-PRES-DECL
 ‘John believes that Mary continues to smoke.’ (embedded clause > believe)

In the above example, the incremental version of Schlenker’s algorithm cannot restrict the local context of the embedded clause to John’s doxastic worlds. How the local context is computed is provided in (5). Here, the only information available to the interpreter is *John*. Unless the only possible sentence completion (*b*’ in the posited equivalence) is *mit* ‘believe’, the interpreter would fail to restrict the local context to John’s doxastic worlds. However, there are numerous ways to complete the sentence. One possible completion is *malha(y)* ‘say’ as in (6). So the algorithm predicts that the local context includes the set of worlds that are not John’s doxastic worlds and the example does not presuppose that John believes that Mary used to smoke.

- (5) a. John-TOP [~~Mary-NOM continuously~~ smoke-PRES-COMP] • **believe**
 b. Corresponding equivalence:
 For any expression *d*’ of a propositional type, and for all strings *b*’ for which *John d*’ *b*’ is a well-formed sentence,

$$C \models^{c \rightarrow x} \text{John } (c' \text{ and } d') b' \leftrightarrow \text{John } d' b'$$

- (6) John-un [Mary-ka (cikum-to) keysokhayse tambay-lul pi-n-tako]
 John-TOP [Mary-NOM (now-also) continuously cigarette-ACC smoke-PRES-COMP]
malhay-ss-ta.
say-PAST-DECL
 ‘John says that Mary continues to smoke.’

Contrary to the prediction, the example does presuppose that John believes that Mary used to smoke. We would want the local context of the embedded clause to be restricted just as much as in the English example. The issue arises because the algorithm strictly relies on linear order.

2.2. Scrambling

The naive version of Schlenker’s algorithm cannot account for the Korean scrambling example in (7). The entire embedded clause linearly precedes the matrix clause, so the interpreter does not have access to the matrix subject and the attitude verb.² In fact, as shown in (8), the interpreter does not have access to any information at all. It is predicted that the local context

²It is possible that Schlenker’s original algorithm can be improved by letting the embedded clause *reconstruct* before calculating its local context. However, it requires *delaying* the computation of the local context until the complete syntax structure is constructed and reconstruction takes place. As a result, it would weaken the theory’s main argument that local contexts are calculated in a strictly incremental fashion.

of the embedded clause is the global context and the sentence presupposes that Mary used to smoke in the actual world.

- (7) [Mary-ka keysokhayse tambay-lul pi-n-tako] John-un *t*
 Mary-NOM continuously cigarette-ACC smoke-PRES-COMP John-TOP *t*
 mit-nun-ta.
 believe-PRES-DECL
 (Lit.) ‘That Mary continues to smoke, John believes.’
- (8) [~~Mary-NOM—continuously—cigarette-ACC—smoke-PRES-COMP~~] • John-TOP
t believe-PRES-DECL

Contrary to the prediction, the sentence presupposes that Mary used to smoke in John’s beliefs.

2.3. Relative clause

Ingason (2016) raises another issue based on Japanese relative clause constructions. The Japanese examples in (9) show that the context is first updated with respect to a head noun, then with respect to its relative clause.

- (9) a. Taro-ga [[yamome-dearu] zyosei-ni] atta.
 Taro-NOM [[widow-COP] woman-DAT] met
 ‘Taro met a woman who is a widow. (widow > woman)
- b. # Taro-ga [[zyosei-dearu] yamome-ni] atta.
 Taro-NOM [[woman-COP] widow-DAT] met
 ‘Taro met a widow who is a woman. (woman > widow)

Example (9a) is felicitous because *zyosei* ‘woman’ updates the context first, then *yamome-dearu* ‘who is a widow’. Since ‘widow’ entails ‘woman’, updating ‘widow’ after ‘woman’ is felicitous. In contrast, (9b) triggers the redundancy effect because the head noun *yamome* ‘widow’ is more restrictive than the relative clause *zyosei-dearu* ‘who is a woman’. Ingason suggests that this is evidence that the order of context update mirrors syntactic hierarchy, but not linear order.

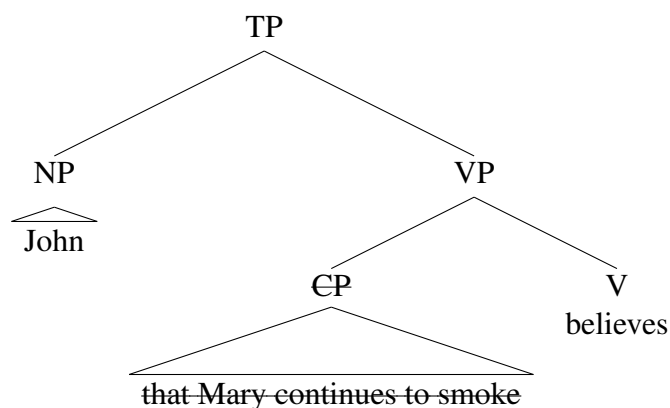
3. The hierarchy-based account

Romoli and Mandelkern (2017) reform Schlenker’s algorithm in a way that the local contexts are calculated on LF: when calculating the local context of *E* within a full clause *S*, the interpreter considers *only the expressions that c-command S at LF*, instead of considering the expressions that linearly precede it. Formally, the hierarchy-based version of local context is defined as follows:

- (10) Good-completion (Romoli and Mandelkern, 2017)
 A *good-completion* of L at α is any well-formed LF which is identical to L except that any clause dominated or asymmetrically c-commanded by α may be replaced by new material. For any sub-tree Y , a *Y-good-completion* of L at α is any good completion of L at α such that α is replaced by a subtree beginning with $[Y [\text{and } _]$.
- (11) Hierarchical Transparent Local Contexts (Romoli and Mandelkern, 2017)
 The local context of expression E in LF L and global context C is the strongest $\llbracket Y \rrbracket$ s.t., where α is the lowest node which dominates a full clause containing E , for all good-completions D of L at α , and for all Y -good-completions D^Y of L at α , $\llbracket D \rrbracket \cap C = \llbracket D^Y \rrbracket \cap C$.

The net effect is that the expressions higher in the structure update the context first. The hierarchy-based account makes the right prediction for the Korean attitude verb example in (4), the syntax of which is provided in (12). The embedded clause is c-commanded by *John* and *mit* ‘believe’, thus the two items are taken into account and the interpreter can restrict the attention to John’s doxastic worlds.

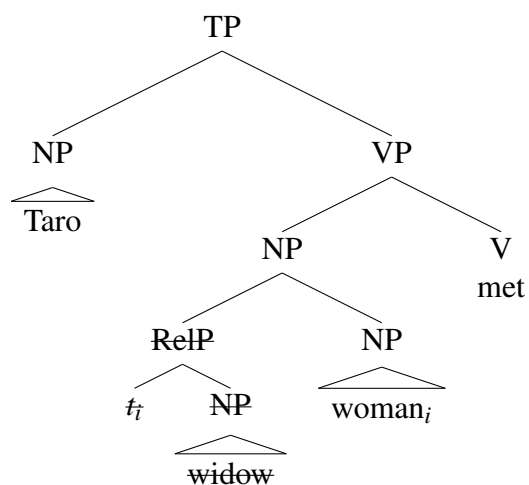
- (12) (= (4))



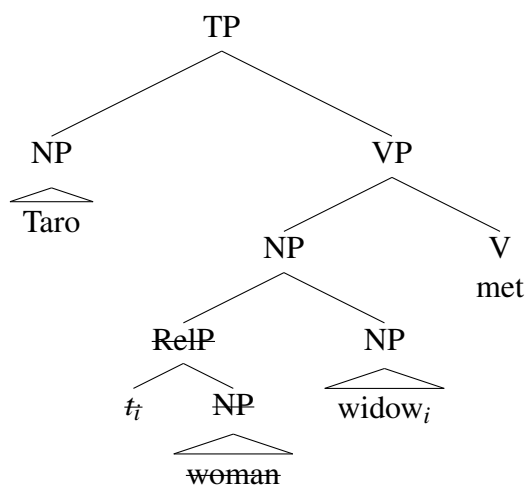
As for the scrambling data in (7), the hierarchy-based account can assume that the scrambled embedded clause reconstructs at LF. This would yield the LF structure in (12). Since the local context is calculated on LF, the prediction is no different from the example that does not involve scrambling.

The hierarchy-based account also correctly predicts that the redundancy effect arises in (9b), but not in (9a). The syntax of (9a) and (9a) are provided in (13a) and (13b), respectively. In calculating the local context of the relative clause in (9a), only the expressions that c-command it are taken into account, hence *Taro*, *met*, and *woman*. So its local context can be restricted to the set of women that Taro met. Further updating the context with *widow* is informative, so the redundancy effect does not arise. On the other hand, the local context of the relative clause in (9b) is the set of widows that Taro met. Thus, it would be redundant to further update the context with *woman*.

(13) a. (=9a))



b. (=9b))



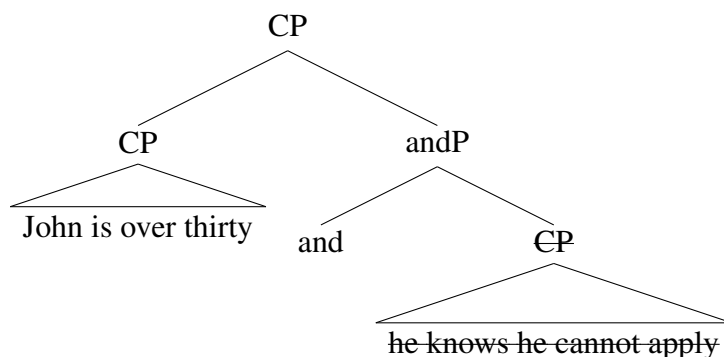
4. The problem of the hierarchy-based account: coordination

Romoli and Mandelkern (2017) cannot explain why contexts are invariably updated left-to-right in coordinated structures, despite the cross-linguistic variation in constituency. Let's first take a look at the English example in (14). Applying the incremental version of Schlenker's algorithm, the local context of the right conjunct is $C \wedge \mathbf{john-is-over-thirty}$, where C refers to the global context.

(14) John is over thirty and he knows he cannot apply.

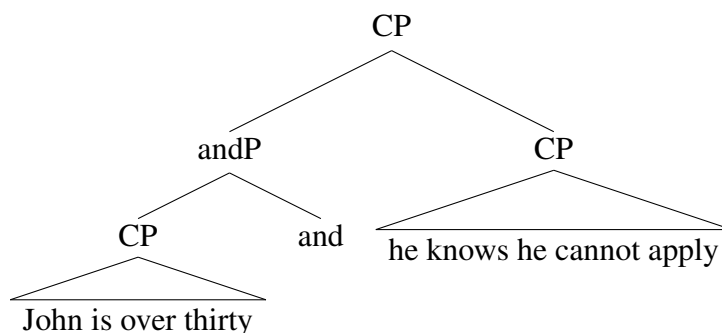
The hierarchy-based account makes the same prediction. In calculating the local context of the right conjunct, only the items that c-command it are considered: the left conjunct and the coordinator *and*.

(15) The hierarchy-based account: prediction borne out



The issue arises in Korean (as well as other head-final languages), where the left conjunct and the conjunction operator form a constituent. In (16), the right conjunct c-commands the left conjunct.

- (16) [John-un selun-i nem-ess-ko] caki-ka ciwenha-ci mosha-n-ta-nun
 [John-TOP thirty-NOM over-perf-and] self-NOM apply-CI cannot-PRES-DECL-REL
 kes-ul al-n-ta.
 thing-ACC know-PRES-DECL
 ‘John is over thirty and he knows he cannot apply.’
- (17) The hierarchy-based account: prediction not borne out



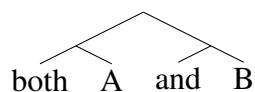
Given the structure in (17), the hierarchy-based account predicts that the right conjunct is updated before the left conjunct because the former c-commands the latter. However, just as in English, the entire sentence intuitively presupposes that ‘if John is over thirty, he cannot apply’. The same problem arises in disjunction because its structure is identical to that of conjunction in many languages. The coordination data call for an algorithm that makes a robust prediction despite the variation in syntactic structure.

It is noteworthy to mention an alternative view: Chierchia (2009) argues that context update takes place in the order of semantic composition. He introduced the notion of *f*-command which is defined in terms of function/argument relation. Informally speaking, given two arguments of a function, the argument that first composes with the functor *f*-commands the other argument. Chierchia’s analysis provided in (18) amounts to saying that the argument that *f*-commands the other updates the context first.

- (18) *f*-command (Chierchia, 2009)
- a. If *A* and *B* are co-arguments of *f*, *A* *f*-commands *B* iff the functional complex *f*(*A*) containing *A* does not contain *B*. (= *A* is closer to *f* than *B*)
 - b. *A* provide the local context for *B* iff *A* immediately *f*-commands *B*.

For example, as for the conjunction operator *and*, its first argument gets to update the context before the second argument. This analysis makes the right prediction for the Korean conjunction example in (16), but then something more has to be said about (14): the right conjunct is the first argument of English *and*. Chierchia suggests that English has a null operator, *both*, that forms a constituent with the left conjunct. The overt *and* is meaningless and the null operator carries the semantics of conjunction.

- (19) Silent *both* as the conjunction operator



Postulating the null operator makes the right predication, however, it requires further evidence that the null operator forms a constituent with the left conjunct. To my knowledge, the overt counterpart of *both* cannot undergo movement together with the first conjunct, while stranding *and* and the right conjunct. There is no positive evidence that the two form a constituent.

Moreover, *both* can appear after the two conjuncts, as in (20a). If (20a) is in fact derived from (20b), it is reasonable to assume that *John and Mary* form a constituent, because they can be fronted while stranding *both*.

- (20) a. John and Mary *both* went home.
 b. *Both* John and Mary went home.

The discussion is not conclusive as the syntax and semantics of coordinated structures are controversial. In fact, Ingason (2016) makes the same point and claims that the coordination data is not a serious counterexample to the hierarchy-based account. But it is worthy of mention that the left-to-right bias naturally follows from linear order-based accounts.

5. Proposal

I maintain Schlenker's view that sentences are parsed from left to right. In addition, I assume that the interpreter constructs the syntactic structure of a given sentence during parsing (cf. Phillips 1996). Given these assumptions, I make one adjustment to Schlenker's algorithm based on considerations from the syntax-semantics interface.

I propose that the interpreter computes the local context of expressions only at certain points in the parsing process. Specifically, the equivalence in (1) is calculated only when the semantic value of the parsed expressions can be retrieved.

- (21) **Adjustment: Domain-by-domain interpretation**

The interpreter parses a sentence from left to right, but the local context of an expression (either propositional or predicative) can be calculated only at points where the interpreter has access to the semantic values of the parsed expressions.

The reasoning is that the equivalence posited in (1) is semantic in nature. Entailment is a semantic notion which should operate on semantic values rather than strings. And it is commonly assumed that access to semantic values of expressions is limited to certain points in the derivation. The phase theory (Chomsky, 2008) is more or less the standard view, where the semantic information of syntactic items is shipped to the interface upon construction of either vP or CP (i.e., phases). Independently, continuation semantics (Barker and Shan, 2014; Charlow, 2014)

assumes that the semantic value of an expression can be retrieved by *evaluating* it, and only clauses are suitable targets for evaluation.

I assume along with continuation semantics that a clause is the domain of semantic evaluation. The net effect is that the interpreter needs to *postpone* the calculation of local context if the parsed expressions altogether do not constitute a clause; semantic information can only be retrieved from a clause. The analyses offered in the following section do not require the technical details of continuation semantics. It suffices to assume that the semantic value of an expression can only be fetched when the parsed expressions constitute a full clause.

6. Analysis

6.1. Attitude context

The proposed analysis forces the interpreter to postpone the computation of local context until the attitude verb has been parsed. Example (4) is repeated below as (22), and the table in (23) illustrates the parsing process.

- (22) John-un [Mary-ka (cikum-to) keysokhayse tambay-lul pi-n-tako]
 John-TOP [Mary-NOM (now-also) continuously cigarette-ACC smoke-PRES-COMP]
mit-nun-ta.
believe-PRES-DECL
 ‘John believes that Mary continues to smoke.’

- (23) Derivation of (22)

Step	State	Evaluate?	Target local context
1	John • [that Mary continues to smoke] believes	No	
2	John [that Mary continues to smoke] • believes	No	
3	John [that Mary continues to smoke] believes •	Yes	Embedded clause

The bullet points in (23) mark the positions of interest, at which the interpreter attempts to calculate the local context of the embedded clause. All expressions following the bullet points are ignored in computing the local context. The interpreter can only evaluate (i.e., retrieve the semantic value of the parsed expressions) at step 3, whereas doing so at step 1 or 2 is blocked. At step 1, the interpreter has only parsed *John*, which is not a full clause. Similarly, at step 2, the interpreter has encountered *John that Mary continues to smoke*. But again, the expressions do not form a clause. Thus, the calculation of the local context is delayed until step 3, the point at which the interpreter has access to the sentence-final *believes*.

6.2. Coordination

This section shows that the proposed analysis is robust to cross-linguistic variation in coordinated structures. The Korean conjunction example in (16) is repeated below as (24). The full derivation is provided in (25).

- (24) [John-un selun-i nem-ess-ko] caki-ka ciwenha-ci mosha-n-ta-nun
 [John-TOP thirty-NOM over-perf-and] self-NOM apply-CI cannot-PRES-DECL-REL
 kes-ul al-n-ta.
 thing-ACC know-PRES-DECL
 ‘John is over thirty and he knows he cannot apply.’

- (25) Derivation of (24)

Step	State	Evaluate?	Target local context
1	John is over thirty • and he knows he cannot apply	Yes	Left conjunct
2	John is over thirty and • he knows he cannot apply	No	
3	John is over thirty and he knows he cannot apply •	Yes	Right conjunct

Just as in Schlenker’s original formulation, the interpreter parses the sentence from left to right. At step 1, the interpreter has parsed the left conjunct. Since *John is over thirty* is a full clause, it can be evaluated. The general prediction is that cross-linguistic variation in coordinated structure is irrelevant to the order of context update. The left expression always updates the context before the right one.

6.3. Scrambling

The scrambling data is a challenge to any theory that relies on left-to-right bias. Since the scrambled embedded clause in (7), repeated below as (26), precedes the matrix clause, the interpreter first parses the embedded clause no matter what. On the other hand, the hierarchy-based account can assume that the embedded clause reconstructs before its local context is calculated.

- (26) [Mary-ka keysokhayse tambay-lul pi-n-tako] John-un *t*
 Mary-NOM continuously cigarette-ACC smoke-PRES-COMP John-TOP *t*
 mit-nun-ta.
 believe-PRES-DECL
 (Lit.) ‘That Mary continues to smoke, John believes.’

Having tied the points of semantic access to that of evaluation, it naturally follows from continuation semantics that the local context of the scrambled embedded clause is calculated after the matrix clause has been parsed. Barker (2009) develops a mechanism which handles recon-

struction effects without actually requiring to reconstruct, namely *delayed evaluation*. Barker claims that English wh-phrases can be interpreted in-situ and do not require reconstruction. Specifically, *delaying* the evaluation of a wh-phrase and evaluating the remaining expressions beforehand replicates the reconstruction effect. For example, despite the fact that the wh-phrase *who* in (27) linearly precedes the rest of the sentence, it is evaluated after *does John like t*. The technical details of delayed evaluation is offered in appendix B.

(27) Who does John like?

I extend Barker's analysis and claim that scrambled embedded clauses are also subject to delayed evaluation. In other words, the scrambled embedded clause is evaluated after the matrix clause has been processed. Since the local context of an expression can be calculated only when its semantic value can be retrieved, the interpreter has full access to the matrix clause when the local context of the scrambled embedded clause is calculated. The table in (28) depicts this process.

(28) Derivation of (26)

Step	State	Evaluate?	Target local context
1	Mary continues to smoke • John believes <i>t</i>	No	
2	Mary continues to smoke John believes <i>t</i> •	Yes	
3	Mary continues to smoke John believes <i>t</i> •	Yes	Embedded clause

At step 1, the interpreter does not evaluate the scrambled embedded clause and waits for the matrix clause to be processed. At step 2, *John believes t* is evaluated but the evaluation of the embedded clause is delayed. Only at step 3 can the embedded clause be evaluated, and this is when its local context can be calculated as well. At this point, the interpreter is aware that the sentence is about John's beliefs.

I would like to emphasize that delayed evaluation is not a special mechanism invented to explain how presuppositions project in scrambling constructions. It merely offers an in-situ account of reconstruction effects. Nevertheless, the order in which the derivation unfolds provides a natural explanation of the presupposition projection behavior of such constructions.

6.4. Relative clause

The redundancy effect in (9b), repeated below as (29), is also accounted for. The derivation is provided in (30).

(29) # Taro-ga [[**zyosei**-dearu] **yamome**-ni] atta.
 Taro-NOM [[**woman**-COP] **widow**-DAT] met
 'Taro met a widow who is a woman.'

Only after step 4 can the interpreter evaluate the parsed expressions. At step 5, all of the parsed expressions except the ReIP will be taken into account. In other words, the following items are considered: *Taro*, *widow*, and *met*. This means that the local context of the ReIP is the set of individuals x such that *widow*(x) and *met*(x)(*John*) are true. As in the hierarchy-based account, updating the local context with *that is woman* is redundant.

(30) Derivation of (29)

Step	State	Evaluate?	
1	Taro • [NP [ReIP that is woman] widow] met	No	Target local context
2	Taro [NP [ReIP that is woman] • widow] met	No	
3	Taro [NP [ReIP that is woman] widow] • met	No	
4	Taro [NP [ReIP that is woman] -widow] met •	Yes	NP
5	Taro [NP [ReIP that is woman] widow] met •	Yes	ReIP

7. Conclusion

This paper presents a novel parsing-based account of presupposition projection which is robust to certain crosslinguistic variations in word order. While maintaining Schlenker's view that presupposition projection behavior is closely related to the left-to-right bias inherent in parsing, I hypothesize that local context is computed domain-by-domain, as opposed to word-by-word, and that clauses are such domains. The proposed analysis resolves the issues in Schlenker's original algorithm and the hierarchy-based variation.

A. Formal analysis

This section fleshes out the technical details of the proposed algorithm built on continuation semantics. The reader is referred to Barker and Shan (2014) for the interpretation of tower notations.

- (31) Algorithm for computing the local context of an expression E
- a. The interpreter traverses a given sentence from left to right. The syntactic structure is constructed on the way.
 - b. Upon parsing the expression E , check whether the sequence $A E$ can be evaluated (i.e., constitutes a clause), where A is the sequence of all of the expressions that precede E .
 - c. If the sequence $A E$ can be evaluated, the local context of E which occurs in a context C is the strongest restriction c such that for any proposition p or predicate P , the following equivalence holds:
 - (i) For proposition p :

$$C \models \text{EVALUATE} \left(\mathbf{A} \frac{[]}{c' \text{ and } p} \right) \leftrightarrow \text{EVALUATE} \left(\mathbf{A} \frac{[]}{p} \right)$$

(ii) For predicate P :

$$C \models \text{EVALUATE} \left(\mathbf{A} \frac{[\]}{c' \text{ and } P} \right) \leftrightarrow \text{EVALUATE} \left(\mathbf{A} \frac{[\]}{P} \right)$$

where \mathbf{A} is the semantic tower of A and **and** is the generalized conjunction Op

- d. If the sequence $A E$ cannot be evaluated, continue traversing until the interpreter can evaluate the sequence $A E B$, where B is the sequence of all expressions which follows E and was parsed by the interpreter.
- e. When the parsed expressions can be evaluated, the local context of E is the strongest restriction c such that for any proposition p or predicate P , the following equivalence holds: (i) For proposition p :

$$C \models \text{EVALUATE} \left(\mathbf{A} \frac{[\]}{c' \text{ and } p} \mathbf{B} \right) \leftrightarrow \text{EVALUATE} \left(\mathbf{A} \frac{[\]}{p} \mathbf{B} \right)$$

(ii) For predicate P :

$$C \models \text{EVALUATE} \left(\mathbf{A} \frac{[\]}{c' \text{ and } P} \mathbf{B} \right) \leftrightarrow \text{EVALUATE} \left(\mathbf{A} \frac{[\]}{P} \mathbf{B} \right)$$

where \mathbf{A} and \mathbf{B} are the semantic tower of A and B , respectively, and **and** is the generalized conjunction Op

Sample derivations for the Korean attitude verb example (ex (22)) and the coordination example (ex (24)) are provided in (32) and (33), respectively.

(32) Derivation of (22)

- a. The interpreter parses the sentence from left to right and reaches the end

$$\left(\frac{\text{John}}{\mathbf{j}} \left(\frac{\text{that Mary continues to smoke}}{\text{continues_to_smoke}(\mathbf{m})} \frac{\text{believes}}{\text{believes}} \right) \right) \bullet$$

- b. Replace the embedded clause with $\frac{[\]}{c' \text{ and } p} \equiv \frac{[\]}{c' \wedge p}$

$$\left(\frac{\text{John}}{\mathbf{j}} \left(\frac{\text{that Mary continues to smoke}}{c' \wedge p} \frac{\text{believes}}{\text{believes}} \right) \right) \bullet$$

- c. Corresponding equivalence:

$$C \models \text{EVALUATE} \left(\frac{[\]}{\text{believes}(c' \wedge p)(\mathbf{j})} \right) \leftrightarrow \text{EVALUATE} \left(\frac{[\]}{\text{believes}(p)(\mathbf{j})} \right)$$

$$\Leftrightarrow C \models \forall w \in \text{DOX}(\mathbf{j}) : c'(w) = 1 \wedge p(w) = 1 \leftrightarrow \forall w \in \text{DOX}(\mathbf{j}) : p(w) = 1$$

(33) Derivation of (24)

- a. The interpreter parses the sentence from left to right and reaches the end of the left conjunct. The expressions that follow the bullet point are ignored.

$$\left(\left(\frac{\text{John is over thirty}}{\frac{[]}{\text{over-30}(\mathbf{j})}} \bullet \frac{\text{and}}{\lambda p \lambda q. p \wedge q} \right) \frac{\text{he knows he cannot apply}}{\frac{[]}{\text{knows}(\text{cannot-apply}(\mathbf{j}))(\mathbf{j})}} \right)$$

- b. Compute LC of the left conjunct: replace the left conjunct with $\frac{[]}{c' \text{ and } p} \equiv \frac{[]}{c' \wedge p}$

$$\left(\left(\frac{\text{John is over thirty}}{\frac{[]}{c' \wedge p}} \bullet \frac{\text{and}}{\lambda p \lambda q. p \wedge q} \right) \frac{\text{he knows he cannot apply}}{\frac{[]}{\text{knows}(\text{cannot-apply}(\mathbf{j}))(\mathbf{j})}} \right)$$

- c. Corresponding equivalence:

$$\begin{aligned} C \models \text{EVALUATE} \left(\frac{[]}{c' \wedge p} \right) &\leftrightarrow \text{EVALUATE} \left(\frac{[]}{p} \right) \\ &\Leftrightarrow C \models c' \wedge p \leftrightarrow p \end{aligned}$$

- d. The interpreter continues to parse and reaches the end of the sentence

$$\left(\left(\left(\frac{\text{John is over thirty}}{\frac{[]}{\text{over-30}(\mathbf{j})}} \quad \frac{\text{and}}{\lambda p \lambda q. p \wedge q} \right) \frac{\text{he knows he cannot apply}}{\frac{[]}{\text{knows}(\text{cannot-apply}(\mathbf{j}))(\mathbf{j})}} \right) \bullet \right)$$

- e. Compute LC of the right conjunct: replace the right conjunct with $\frac{[]}{c' \text{ and } p} \equiv \frac{[]}{c' \wedge p}$

$$\begin{aligned} &\left(\left(\left(\frac{\text{John is over thirty}}{\frac{[]}{\text{over-30}(\mathbf{j})}} \quad \frac{\text{and}}{\lambda p \lambda q. p \wedge q} \right) \frac{\text{he knows he cannot apply}}{\frac{[]}{c' \wedge p}} \right) \bullet \right) \\ &= \left(\frac{\text{John is over thirty and he knows he cannot apply}}{\frac{[]}{\text{over-30}(\mathbf{j}) \wedge (c' \wedge p)}} \right) \bullet \end{aligned}$$

- f. Corresponding equivalence:

$$\begin{aligned} C \models \text{EVALUATE} \left(\frac{[]}{\text{over-30}(\mathbf{j}) \wedge (c' \wedge p)} \right) &\leftrightarrow \text{EVALUATE} \left(\frac{[]}{\text{over-30}(\mathbf{j}) \wedge p} \right) \\ &\Leftrightarrow C \models \text{over-30}(\mathbf{j}) \wedge (c' \wedge p) \leftrightarrow \text{over-30}(\mathbf{j}) \wedge p \end{aligned}$$

B. Scrambling as delayed evaluation

Delayed evaluation can be schematized as in (34). Given two expressions, the right one is first evaluated. The semantic value of the right expression is fed into the left expression, yielding the composed value of the two expressions.

(34) Schema: delayed evaluation

	Tower convention	Lambda formula
a. Initial setup	$\frac{g[\]}{f} \quad \frac{h[\]}{i}$	$\lambda k.g(k(f)) \quad \lambda k.h(k(i))$
b. Evaluate the right.exp	$\frac{g[\]}{f} \quad h(i)$	$\lambda k.g(k(f)) \quad h(i)$
c. Feed the right.exp to the left.exp	$g(h(i)(f))$	$g(h(i)(f))$

A sample derivation of the sentence *Who does John like?* is provided in (35).

(35) Sample derivation of *Who does John like?*

a. Initial set up

$$\left(\frac{\text{Who}}{\mathbf{who}(\lambda x.[\])} \right) \left(\frac{\text{John}}{\mathbf{j}} \left(\frac{\text{like } t}{\lambda y.[\]} \right) \right)$$

b. Reduce the right.exp

$$\left(\frac{\text{Who}}{\mathbf{who}(\lambda x.[\])} \right) \left(\frac{\text{John like } t}{\lambda y.[\]} \right)$$

c. Evaluate the right.exp

$$\left(\frac{\text{Who}}{\mathbf{who}(\lambda x.[\])} \right) \left(\frac{\text{John like } t}{\lambda y.\mathbf{like}(y)(\mathbf{j})} \right)$$

d. Feed the right.exp to the left.exp (function application)

$$\left(\frac{\text{Who (does) John like } t}{\mathbf{who}(\lambda x.\mathbf{like}(x)(\mathbf{j}))} \right)$$

Scrambling constructions receives a similar treatment. The evaluation of the scrambled embedded clause (ex (26)) is delayed.

(36) Derivation of (26)

a. The interpreter parses the fronted embedded clause, but delays the evaluation

$$\left(\frac{\text{that Mary continues to smoke}}{[\]} \right) \cdot \left(\frac{\text{John}}{\mathbf{j}} \left(\frac{t}{\lambda p.[\]} \right) \right)$$

- b. The interpreter reaches the end of the sentence

$$\left(\frac{\text{that Mary continues to smoke}}{[\]} \right) \left(\frac{\text{John}}{\mathbf{j}} \left(\frac{t}{p} \frac{\text{believes}}{\text{believes}} \right) \right) \bullet$$

- c. Reduce the right.exp

$$\left(\frac{\text{that Mary continues to smoke}}{[\]} \right) \left(\frac{\text{John } t \text{ believes}}{\lambda p. [\]} \right) \bullet$$

- d. Evaluate the right.exp

$$\left(\frac{\text{that Mary continues to smoke}}{[\]} \right) \left(\frac{\text{John } t \text{ believes}}{\lambda p. \text{believes}(p)(\mathbf{j})} \right) \bullet$$

- e. Replace the embedded clause with $\frac{[\]}{c' \text{ and } p} \equiv \frac{[\]}{c' \wedge p}$

$$\left(\frac{\text{that Mary continues to smoke}}{c' \wedge p} \right) \left(\frac{\text{John } t \text{ believes}}{\lambda p. \text{believes}(p)(\mathbf{j})} \right) \bullet$$

- f. Evaluate the entire sentence: Feed the right.exp to the left.exp

$$\begin{aligned} & \left(\frac{\text{that Mary continues to smoke, John } t \text{ believes}}{\text{believes}(c' \wedge p)(\mathbf{j})} \right) \\ &= \left(\frac{\text{that Mary continues to smoke, John } t \text{ believes}}{\forall w \in \text{DOX}(\mathbf{j}) : c'(w) = 1 \wedge p(w) = 1} \right) \end{aligned}$$

- g. Corresponding equivalence

$$C \models \forall w \in \text{DOX}(\mathbf{j}) : c'(w) = 1 \wedge p(w) = 1 \leftrightarrow \forall w \in \text{DOX}(\mathbf{j}) : p(w) = 1$$

The equivalence derived in (36) matches that of (32). This is indeed the desired consequence.

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Interpreting presuppositions in the scope of quantifiers: *Every* vs. *at least one*¹

Ava CREEMERS — *University of Pennsylvania*

Jérémy ZEHR — *University of Pennsylvania*

Florian SCHWARZ — *University of Pennsylvania*

Abstract. This paper experimentally investigates presupposition projection from the scope of the quantifiers *every* and *at least one*, as triggered by the factive verb *be aware* and the iterative adverb *again*. The first issue we are concerned with is whether presuppositions project universally or existentially from quantified sentences. Different theoretical accounts endorse opposing views here (e.g., Heim, 1983; Geurts, 1999; Beaver, 2001; Schlenker, 2008, 2009; Fox, 2012), while recent experimental work (Chemla, 2009; Tiemann, 2014) suggests that the force of the projected presupposition varies by quantifier. The second issue we look at is how the descriptively observed readings arise—in particular, as a direct result output from the projection mechanism, or via additional, independent mechanisms such as domain restriction (e.g., Geurts and van Tiel, 2016): if the domain of the quantifier is restricted, this can yield what looks like non-universal inferences in light of the overall, unrestricted domain, even if the projection mechanism itself yields a universal presupposition. Finally, we test whether the presupposed content also forms part of the entailed content, at least for certain triggers (Sudo, 2012; Klinedinst, 2016; Zehr and Schwarz, 2016). Our results yield clearly different patterns for *every* and *at least one*, with *every* giving rise to universal presuppositions, which, to a very limited extent, can be weakened by domain restriction, and *at least one* overwhelmingly giving rise to non-universal presuppositions. Our results also indicate the availability of presupposition-less readings for both triggers in the task at hand, apparently more prevalent than domain restriction. Thereby, we present novel evidence that helps to pinpoint which of the theoretical options can be substantiated experimentally.

Keywords: Presupposition projection, quantifiers, domain restriction, entailment.

1. Introduction

One of the core properties of presuppositions is that they generally project out of a variety of embedding environments which cancel entailed content. For example, (1a-c), with the factive verb *be aware* as a presupposition trigger, uniformly presuppose that *the alien is blue*, despite being embedded under negation or in a question, both of which cancel the entailed content of the embedded material (Karttunen, 1973).

- (1) $\left\{ \begin{array}{l} \text{a. } \underline{\text{The alien}} \text{ is } \mathbf{aware} \text{ that } \underline{\text{he is blue}} \\ \text{b. } \underline{\text{The alien}} \text{ is not } \mathbf{aware} \text{ that } \underline{\text{he is blue}} \\ \text{c. } \text{Is } \underline{\text{the alien}} \mathbf{aware} \text{ that } \underline{\text{he is blue?}} \end{array} \right\} \rightsquigarrow \text{The alien is blue}$

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However, when the presupposition trigger appears in the scope of a quantifier, there are opposing views as to whether presuppositions project universally or existentially (cf. Chemla, 2009). Some argue that quantified sentences as in (2) give rise to a universal presupposition (Heim, 1983; Schlenker, 2008, 2009), i.e., that every alien is in fact blue (3a). In contrast, others argue that semantic presuppositions of all quantified sentences are existential (Beaver, 2001, 1994); in our example that there exists at least one alien that is blue (3b).

- (2) a. Every alien is aware that he is blue
 b. At least one alien is aware that he is blue
- (3) a. $\rightsquigarrow^? \forall x \in D_{alien} blue(x)$ (\forall presupposition)
 b. $\rightsquigarrow^? \exists x \in D_{alien} blue(x)$ (\exists presupposition)

Recent experimental work (Chemla, 2009; Tiemann, 2014) suggests that the force of the projected presupposition varies by quantifier. Chemla (2009) uses an inference paradigm to investigate projection from the scope of quantifiers in French. The results indicate a significant difference in the availability of universal presuppositions, depending on the quantifier used: he finds evidence for universal projection from the scope of the universal quantifier *each*, but not from the scope of existential quantifiers (*less than 3, more than 3, exactly 3*). The perhaps most contested case is the negative quantifier *no*: Chemla argues that his data support universal projection, but more recent work by Zehr et al. (2016) provides evidence for (at least the possibility of) existential projection. Similarly, Tiemann (2014), in an eye-tracking experiment, shows that reading measures differ significantly depending on whether a universal or an existential quantifier is used. Together, these studies suggest that presuppositions do not uniformly project universally or existentially—rather, the projection behavior changes with the quantifier.

In this paper, we report data on how presuppositions triggered by *be aware* and *again* project from the scope of the quantifiers *every* (2a) and *at least one* (2b). Moreover, we test whether the descriptively observed existential projection readings are derived directly via the projection mechanism, or whether they are derived from the output of the projection mechanism through other processes. Candidates that could be at play include (implicit) Domain Restriction (Geurts and van Tiel, 2016) and the inclusion of presupposed content at the assertive level (Sudo, 2012). Our results confirm previous results in that the quantifiers *every* and *at least one* pattern differently, with *every* giving rise to universal readings of the presupposition, which only can be weakened by domain restriction to a limited extent, and *at least one* giving rise to non-universal readings of the presupposed content. This provides support for theories that tie different projection behavior to the nature of the quantifier at play, rather than treating all quantifiers as having uniform projection behavior. Furthermore, our results indicate that, at least within our task paradigm, presupposition-less readings are available for both triggers, and this option seems to be more prevalent than domain restriction.

The paper is structured as follows. Section 2 presents the background on additional mechanisms that force what seems like an existential presupposition: domain restriction and (non-)entailment. Section 3 presents the methods of our experiment, and Section 4 gives the results. Section 5 discusses the theoretical implications of the results, and Section 6 concludes.

2. Background

This section discusses two important factors that can affect whether presupposed content under quantifiers give rise to universal or existential inferences: implicit Domain Restriction (Section 2.1) and (non-)entailment of the presupposition (Section 2.2). Section 2.3 proceeds to lay out the rationale for the experiments in the present study.

2.1. (Implicit) Domain Restriction

Presuppositions triggered within the scope of a quantifier may restrict the domain of individuals considered in evaluating the quantificational claim, a mechanism known as (implicit) Domain Restriction (henceforth DR). In the presence of DR, a presupposition may be universally satisfied relative to the restricted domain, while appearing non-universal in light of the unrestricted domain. Let us illustrate with the sentence in (2a). A universal presupposition gives rise to the notion that all aliens are in fact blue. This would necessarily be incompatible with a case in which there are non-blue aliens, as in Figure 1.

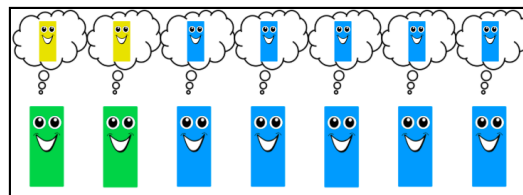


Figure 1: Illustration of Domain Restriction yielding seemingly non-universal inferences

However, with implicit DR, the quantifier's domain could be restricted to those aliens that are in fact blue (i.e., the five blue aliens on the right, but crucially not the green aliens on the left in Figure 1). If such a DR is available, it should be possible to judge the sentence compatible with situations with non-blue aliens, like that in Figure 1. Therefore, if DR can come into play in the relevant sentences, it becomes non-trivial to determine whether or not the projection mechanism indeed gives rise to a universal presupposition, as what looks like a non-universal reading relative to the full domain in fact could result from interpreting the relevant presupposition universally relative to a restricted domain (Schlenker, 2008; Rothschild, 2011; Sudo, 2012). Schematically, our sentence in (2a) can effectively be understood as in (4), resulting in the inference pattern represented in (5).

(4) Every alien [**that is blue**] is aware that he is blue.

(5) $\forall + \mathbf{DR}: \forall x \in D_{\mathbf{blue-alien}} [blue(x)] \approx \exists: \exists x \in D [blue(x)]$

In a recent experimental study, Geurts and van Tiel (2016) investigate the effects of presuppositions on DR. Specifically, they investigate the possibility of restricting the domain of universal quantification to those individuals that satisfy the presupposition of the scope of the quantifier. In a series of truth value judgment tasks, they paired simple geometrical figures (as illustrated

in Figure 2) with quantified sentences of the form *Each of these circles has the same color as the square to which it is connected*, in which “the square to which...” is the critical presupposition trigger. Crucially, the results show that sentences of this type are judged true 87% of the time when paired with a picture in which only four out of five circles were connected to a square (and have the same color as the square). The authors argue that this substantial amount of acceptances shows that the domain of quantification can be restricted by contextual factors. (In addition, their results also suggest, rather surprisingly, that even with numeral restrictors such as *Each of these five circles...*, as indicated in Figure 2, participants can tolerate a proper subset satisfying the presupposition in other visual arrangements.)

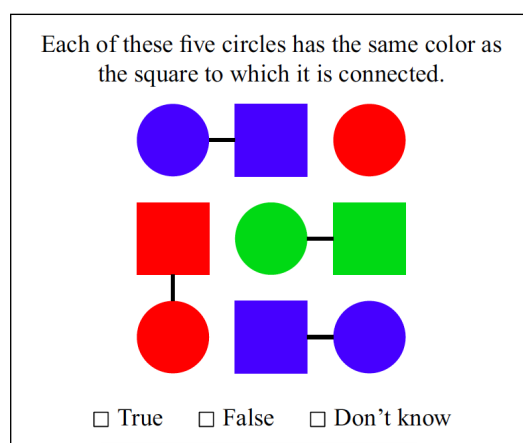


Figure 2: Illustration of item used in Geurt and van Tiel's (2016) Experiment 1

In conclusion, DR forms an important factor that affects which inferences result from sentences involving projection from a quantificational context. This constitutes an important possible confound in assessing whether a given sentence gives rise to existential or universal projection, since a seemingly non-universal inference may in fact be the result of DR. Our experimental design is set up to allow for a differentiation of genuine existential projection from universal projection weakened by DR.

2.2. Entailed vs. non-entailed presuppositions

A second confound in distinguishing an existential from a seemingly non-universal inference is introduced if we allow for the possibility that presupposed content is also part of the conventionally entailed content (Sudo, 2012; Klinedinst, 2016). Let us illustrate with (6), which presupposes that the alien was blue at an earlier stage. However, with respect to the assertive meaning of this sentence, things are less clear. If the presuppositional content is simultaneously part of the entailed content, the conventional entailment would be as in (6a). In contrast, if the presupposition is not part of the entailed content, the conventional entailment is as in (6b).

- (6) On Planet B, the alien turned blue *again*. CONVENTIONAL ENTAILMENT:
- a. **Presupposition also entailed:** the alien turned blue & *was blue at an earlier stage*
 - b. **Presupposition entirely separate:** the alien turned blue

Note that, while (6b) and (6a) are contextually equivalent given the presupposition, the contrast between entailment versus non-entailment of the presupposition could interact with projection. In particular, universal quantifiers yielding a universal *reading* for a presupposition that is also entailed would simply be the result of assessing the quantificational claim relative to the entailed content (which, by hypothesis, includes the presupposition) and thus does not necessarily indicate universal *projection*. A key question is how we settle the issue of whether a given trigger simultaneously introduces its presupposition as an entailment as well. Indeed, Sudo (2012) argues that presupposition triggers can differ precisely in this regard, and Zehr and Schwarz (2016) provide some initial evidence from non-monotonic quantifiers (where the predictions come apart most clearly, as observed by Sudo). Our working hypothesis, building on prior work, is that *aware* is a good candidate for entailing its presupposition (Djäv et al., 2017), while *again* does not seem to entail its presupposition (Zehr and Schwarz, 2016).

A further complication arises when considering the possibility of presupposed content forming part of the entailments as well is that most theories of presupposition allow for some version of local accommodation (Heim, 1983), which effectively turns presupposed content into entailed content, while cancelling its contribution qua presupposition. This is distinct from the notion of entailed presuppositions we just introduced, but not easy to tease apart empirically. Different types of triggers are commonly thought to differ in how easily available local accommodation is, with triggers like *again* showing more resistance to such readings. See Klinedinst (2016) for a discussion of local accommodation vs. entailed presuppositions.

2.3. The design of the present study

Putting the various factors together (universal vs. existential projection, DR, and (non-)entailment), there is a total of five different logically possible readings for the presupposed content in a given quantifier-trigger combination. The first possible reading is a universal reading that is derived directly from universal presupposition projection (\forall in Table 1) and that yields an unrestricted universal inference throughout. The second reading is an existential reading that is derived directly from existential presupposition projection and in which the presupposition features in the entailed content (\exists + EntPS), and which yields universal inferences for universal quantifiers only. The third reading is an apparent existential reading (relative to the full domain) that is derived from universal projection by DR. The fourth reading is an existential reading that is derived from existential presupposition projection and in which the presupposition does not feature in the entailed content (\exists + no EntPS). And finally, the fifth reading is a presupposition-less reading (PS-LESS in Table 1), as presuppositions are well-known to be subject to suspension or cancellation. These readings are illustrated in Table 1 with the factive trigger *aware* (left) and the iterative trigger *again* (right).²

We designed an experiment to further investigate the projection behavior of presuppositions in the scope of quantifiers, and, specifically, to tease apart the different readings in Table 1 within a single design. The question we aim to answer is whether, in case of an existential

²The schematic pattern used in the table is shorthand for (based on the example with *aware* in row 1) ‘all aliens in fact ARE blue, and Q aliens THINK they are blue’, where Q is the relevant quantifier.

	<i>Q</i> alien is aware that he is blue	<i>Q</i> alien turned blue again
1. \forall	all are, <i>Q</i> thinks blue	all were, <i>Q</i> is blue
2. \exists +Entailment	one ⁺ is, <i>Q</i> is & thinks blue	one ⁺ was, <i>Q</i> was & is blue
3. DR	<i>Q</i> blue thinks blue	<i>Q</i> previously blue is blue
4. \exists -Entailment	one ⁺ is, <i>Q</i> thinks blue	one ⁺ was, <i>Q</i> is blue
5. PS-LESS (-Ent.)	<i>Q</i> thinks blue	<i>Q</i> is blue

Table 1: The five different possible readings for the interpretation of presuppositions in the scope of quantifiers, in which *Q* stands for *every* or *at least one*.

presupposition, the presupposition is derived directly via presupposition projection or via the predicted presupposition in combination with some other mechanism (DR, (non-)entailment). Moreover, we use two different triggers (*aware*, *again*) and two quantifiers (*every*, *at least one*) to test whether projection behavior differs across triggers and/or quantifiers.

3. Methods

3.1. Materials & Design

We use a picture-matching task with a (partially) covered box (Huang et al. 2013). In a covered box task, subjects are asked to select a match for a given sentence among various pictures, one of which is hidden. The covered box allows for a choice that better fits with subjects' expectations without making it salient, thereby avoiding a situation in which they must give either a direct *yes* or *no* response when neither seems quite appropriate, as is often the case due to presuppositional requirements.

The experiment consists of two sub-experiments: one with the factive trigger *aware*, and one with the trigger *again*. Each sub-experiment includes the quantifiers *every* and *at least one*. For the sub-experiment with *aware*, sentences of the form *Q* alien is aware that he is color were used (in which *Q* stands for either *every* or *at least one*, and the specific color differed per trial). To establish a plausible context, participants were told that the aliens cannot directly perceive their own skin color, and that they can only find out what color they have through the use of a machine, which sometimes may malfunction, leading to wrong ideas about their own color. Written sentences were presented along with two pictures of seven aliens (see Figure 3). The aliens' actual color represents the presuppositional dimension and the thought bubble-renderings of the aliens' beliefs represent the assertive dimension. In the 'covered box' picture, the aliens and thought bubbles were hidden by black squares.

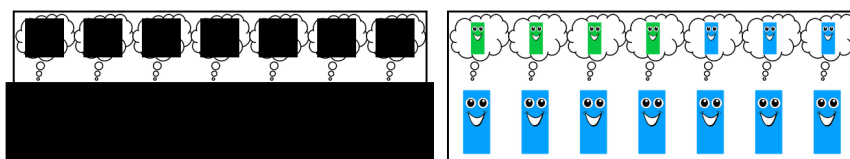


Figure 3: Example item for a sentence like *Every/at least one alien is aware that he is blue*.

In the sub-experiment with the trigger *again*, sentences like *Q* alien turned color again were

used. These sentences were paired with pictures showing aliens traveling from a home planet on which they had a certain color (the presuppositional dimension) to a planet that we called Planet A on which they all lost their color, indicated by showing them as gray, and finally to a third planet (Planet B) on which they turned a color (other than gray) again. Planet B represents the assertive dimension. In the covered box picture, the aliens on the home planet and on Planet B are covered with black boxes. This is shown in Figure 4.

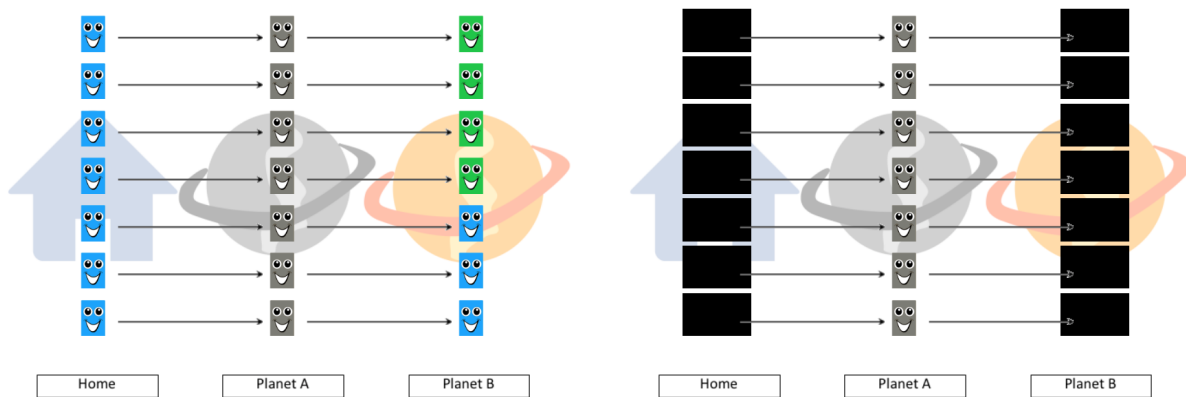


Figure 4: Example item for a sentence like *Every/at least one alien turned blue again*.

We included 6 conditions for each quantifier, of which 3 were critical conditions (\exists PS1, \exists PS2, and FALSEPS) and 3 were control conditions (FALSEASSERTION, ALLTRUE, and ALLFALSE).

In addition to the types of materials introduced in detail, a block of sentences with the negative quantifier *no* was included, both to see whether it exhibited a pattern closer to *at least one* or *every* and also whether the effects for *every* and *at least one* would be affected by seeing the block of sentences with *no* before or after the block that included *every* or *at least one*. However, the results for *no* were complex in a way that goes beyond what we have space for in the present paper, and as there was no significant impact of *no*-blocks preceding either one of the other quantifiers, we will collapse the data for those quantifiers from subjects seeing different block orders, yielding one group of subjects that saw trials with *at least one* (either before or after a *no*-block) and another that saw trials with *every* (again, in either order with the *no*-block). There were 5 items per condition per quantifier, so that every subject saw 30 items with *at least one* or *every* and 30 items with *no*, counterbalanced so that each item was only seen in one condition. The next section lays out the conditions that were used in the experiment in detail.

3.2. Conditions & Predictions

The conditions consist of picture-variations using different color distributions, which in turn yield varying compatibility with the candidate interpretations as defined in Table 1 above. The color distributions are equivalent in the two sub-experiments with *aware* and *again*: rotating the pictures for *again* 90° counter-clockwise shows the similarity with the pictures for *aware*. Each condition displays different pictures for the quantifiers *at least one* and *every*, to account for the interplay of quantifier and the various factors affecting the resulting presupposition reading.

The predictions in terms of compatibility with the candidate interpretations that were defined in Table 1 are given in Table 2 for *at least one* and in Table 3 for *every*.

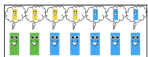
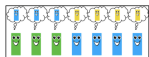
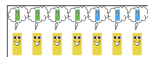
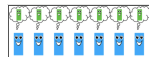
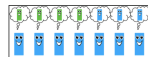
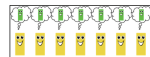






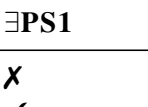
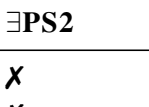
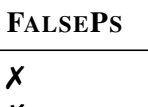
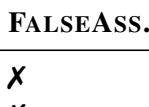
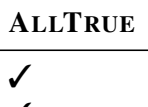
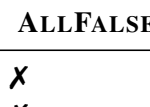
						
Aware						
Again						
PS reading	\exists PS1	\exists PS2	FALSEPS	FALSEASS.	ALLTRUE	ALLFALSE
\forall	✗	✗	✗	✗	✓	✗
\exists +ENT.	✓	✗	✗	✗	✓	✗
DR	✓	✗	✗	✗	✓	✗
\exists -ENT.	✓	✓	✗	✗	✓	✗
PS-LESS	✓	✓	✓	✗	✓	✗

Table 2: Predictions for the quantifier *at least one* in a sentence like **At least one** alien {is *aware* that he is blue / turned blue *again*} in the 6 conditions for the triggers *aware* (top row of images) and *again* (bottom row of images).

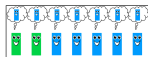
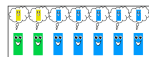
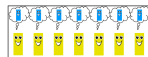
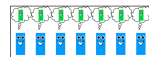
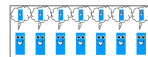
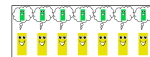






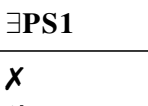
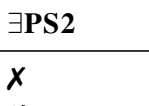
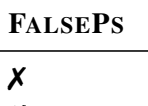
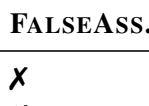


						
Aware						
Again						
PS reading	\exists PS1	\exists PS2	FALSEPS	FALSEASS.	ALLTRUE	ALLFALSE
\forall	✗	✗	✗	✗	✓	✗
\exists +ENT.	✗	✗	✗	✗	✓	✗
DR	✓	✓	✗	✗	✓	✗
\exists -ENT.	✓	✗	✗	✗	✓	✗
PS-LESS	✓	✗	✓	✗	✓	✗

Table 3: Predictions for the quantifier *every*, in sentence like **Every** alien {is *aware* that he is blue / turned blue *again*} in the 6 conditions for the triggers *aware* (top row of images) and *again* (bottom row of images).

The critical conditions for *at least one* are set up as follows: (i) \exists PS1 is incompatible with a universal reading, since there are aliens that are not blue, but it is compatible with all other readings. (ii) \exists PS2 is only compatible with two readings: an existential reading where the presupposition is entirely separate from the entailed content, as there is no alien that both is blue and thinks that they are blue, and a presupposition-less reading, which merely requires there to be at least one alien that thinks that they are blue. (iii) FALSEPS is only compatible with a presupposition-less reading, since there are no aliens that actually are blue. The comparison between the latter two thus will be indicative of the existence of an existential reading without an entailed presupposition (and there is no independent requirement for the presupposition and

entailed content to hold of the same individual(s); cf. the ‘Binding problem’ for presuppositions), as higher levels of acceptance in \exists PS2 could only be due to the availability of such a reading. The comparison between \exists PS1 and \exists PS2 will indicate to what extent either DR or an entailed presupposition is at play.

The pattern of compatibility with the conditions for *every* is slightly different. (i) In addition to being incompatible with the universal reading, as for *at least one*, \exists PS1 is incompatible with existential projection and an entailed presupposition, since *every* requires all entailed content to hold universally. (ii) \exists PS2 can only be accepted under a DR reading, since not all aliens are blue, and not all aliens think that they are blue. Only if the sentence is evaluated relative to a domain restricted to blue aliens can it be accepted. (iii) As before, FALSEPS is laid out so that the overt picture can only be accepted under a presupposition-less reading, as there are no blue aliens, but all aliens think they are blue.

Control items implement the same conceptual manipulation with adjustments as necessary for whichever quantifier is used: (iv) For FALSEASSERTION, the assertion is false since none of the aliens think that they are blue, but the presupposition is universally met, since all aliens actually are blue. (v) ALLTRUE completely fits with both universal presupposition and the respective asserted requirements (regardless of entailment). Finally, (vi) for ALLFALSE, neither the presuppositional requirements (on any variant) nor the assertive ones are met. These control items serve to assess participants’ understanding of the task and provide points of reference at both the ceiling and floor levels.

3.3. Participants & Procedure

160 undergraduate students at the University of Pennsylvania took part in the experiment for course credit. Half of them took part in the sub-experiment with *aware*, and the other half with *again*. Both sub-experiments varied the quantifiers *every* and *at least one* as a between-subjects factor. The experiment was implemented in Ibex. The presentation order and whether the covered box appeared on the left or on the right was randomized in Ibex.

Participants were seated in front of a computer and were told that they have to determine which of two pictures corresponds to a sentence description. The experiment started with instructions that showed participants the aliens they would be seeing. For *aware*, participants were told that the aliens are not able to directly perceive their skin color. Rather, a sometimes dysfunctional machine informs the aliens about their color. For *again*, participants were told that the aliens change color going from planet to planet. They travel from their home planet to planet A (where they turn gray), and on to planet B. Participants were instructed to press the F key on their keyboard to accept the left picture, and the J key to accept the picture on the right. We included a couple of practice trials with feedback, after which the actual experiment started.³

³Archive versions of the experiment can be found at <http://spellout.net/ibexexps/SchwarzLabArchive/AvaQPsAgain/> (**Again**) and <http://spellout.net/ibexexps/SchwarzLabArchive/AvaQPsAware/> (**Aware**).

4. Data analysis & results

We used logistic regression mixed effect models to predict the choice of the visible picture, using the `lme4` package (Bates et al., 2015: version 1.1 – 13) in the R environment (version 3.3.3). We computed models on each pair of conditions for which different readings make different predictions, for the quantifiers *at least one* and *every* (see Tables 2 and 3). In addition to Condition, all the models whose outputs we report here included another two-level predictor: Trigger (*aware* = -1 vs. *again* = 1). In our reports below, we always mention the condition coded as -1 first, and the condition coded a 1 second. The models tested both for simple effects and for interactions between the two factors. Following the procedures for model simplification in Bates et al. (2015), we fitted models with a maximal random-effect structure (random slopes for Condition per Subject and random intercepts for items) and proceeded to an iterative reduction. As a result, when appropriate, we report models that forced a zero correlation on Condition per subject (using the ‘||’ syntax of `lmer()`). Whenever both types of models would converge, their outputs were qualitatively equivalent. Goodness of fit was reported to significantly decrease in all models dropping the random slope for Condition per Subject.

Besides the unfiltered data set, we ran models with data sets that excluded subjects with an accuracy of under 65% (excluding 4 participants), under 70% (excluding 6 participants), and under 75% (excluding 11 participants) on the ALLTRUE and ALLFALSE items. Since this filtering on accuracy hardly ever made a difference in terms of eliciting significant contrasts, we report the outputs of the models run on untrimmed data sets, except when the models failed to converge in which case we report the next most conservative converging model.

The results are presented in Figure 5 for the quantifier *at least one* and in Figure 6 for *every*. We start by discussing the results for *at least one*, after which we discuss the results for *every*. In Section 4.3, we discuss the data in terms of different sub-groups, which indicates that individual participants (consistently) adopted different strategies.

4.1. Results *at least one*

The results for *at least one* are presented in Figure 5. As expected, target acceptance rates for the ALLFALSE, FALSEPS, and ALLTRUE conditions are at floor and ceiling, respectively, for both triggers. Note further that the results on the different conditions are very similar for the different triggers. In our analysis, we first compared the choice of visible picture in the conditions \exists PS1 and ALLTRUE. A contrast here would be indicative of unrestricted universal projection (\forall) (see the \forall row in Table 2). Neither the full model nor the zero-correlation model converged. The next most conservative converging and parsimonious model is a zero-correlation model with the data set that is filtered for 65% accuracy. The model does not reveal a significant difference ($\beta = 0.0811, SE = 0.2620, p = 0.7571$), indicating that unrestricted universal presupposition readings were not at play for our participants in responding to the *at least one* items. Second, we compared \exists PS1 and \exists PS2. Both of these should be accepted across the board if (‘unbound’) \exists -ENTAILED or PS-LESS readings are widely available. A contrast between the two would point to \exists +ENTAILED or DR

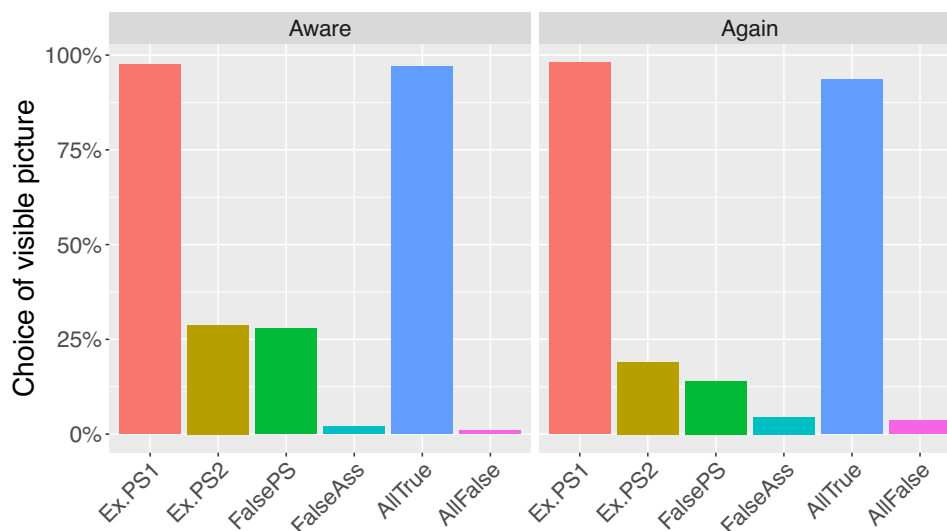


Figure 5: Results for the items with the quantifier *at least one*, for sentences like: **At least one** alien {is aware that he is blue / turned blue again} with the triggers *aware* and *again*.

readings being available. The model shows a significant difference between \exists PS1 and \exists PS2 ($\beta = -9.7324, SE = 1.1360, p < 0.001$). This suggests that \exists -ENTAILED and PS-LESS readings are at most available to a limited extent, while \exists +ENTAILED or DR are responsible for ceiling level acceptance of the target in condition \exists PS1. Third, we compared the choice of visible picture in \exists PS2 and FALSEPS. A contrast between these conditions would point to the availability of \exists -ENTAILED readings (which allow acceptance of \exists PS2). The model shows a significant contrast ($\beta = -0.5742, SE = 0.2828, p = 0.0423$), indicating that \exists -ENTAILED readings might have been at play for our participants, though apparently only to a limited extent, given the small size of the effect, which also is numerically more pronounced for *again* (though note that there is no significant interaction between triggers). Fourth, we compared the choice of visible picture in \exists PS2 and ALLFALSE. Here, both \exists -ENTAILED and PS-LESS readings predict a difference between the two conditions (acceptance for \exists PS2, rejection for ALLFALSE). While the numeric difference is quite large, the model does not reveal such a contrast ($\beta = -0.1937, SE = 0.2870, p = 0.4998$), thereby not providing direct evidence for a \exists -ENTAILED or a PS-LESS reading (see below for discussion of relevant differences in individual subjects' response patterns). Finally, we compared FALSEPS and ALLFALSE, for which only a PS-LESS reading predicts a contrast. As with \exists PS2, the model does not reveal a significant contrast ($\beta = -0.1131, SE = 0.3652, p = 0.7569$), despite a fairly large numerical difference (*again*, see discussion of individual differences below).

To summarize, the only significant differences our models detected were between the \exists PS1 and \exists PS2 conditions and between the \exists PS2 and FALSEPS conditions. The contrast between \exists PS1 and \exists PS2 suggests that for both triggers, either a reading where the presupposition is also part of the entailed content is available, or else one based on DR (though this seems less likely, given the results for *every* below). As was noted above, presuppositions can wind up contributing to entailed content directly in at least two ways, as local accommodation can render a comparable

result (while removing the presuppositional component altogether), and our results here do not differentiate between these possibilities. The contrast between \exists PS2 and FALSEPS suggests that, to a limited extent, subjects accepted \exists PS2 under a reading where the presupposition is not part of nor bound to the entailed content. Numerically, the difference seems to be bigger for *again* than for *aware*. We will discuss the availability of \exists -ENTAILED and \exists +ENTAILED readings in more detail in Section 4.3, after discussing the results for *every* in the next section.

4.2. Results *every*

The results for *every* are presented in Figure 6. Again, the target acceptance rates for the ALLFALSE, FALSEPS, and ALLTRUE conditions are at floor and ceiling, respectively, for both Triggers. Similar to the data for *at least one*, the results on the different conditions pattern similarly for the two triggers. However, for \exists PS1, the results are quite different from those for *at least one*, pointing to clear differences in descriptive projection patterns between quantifiers.

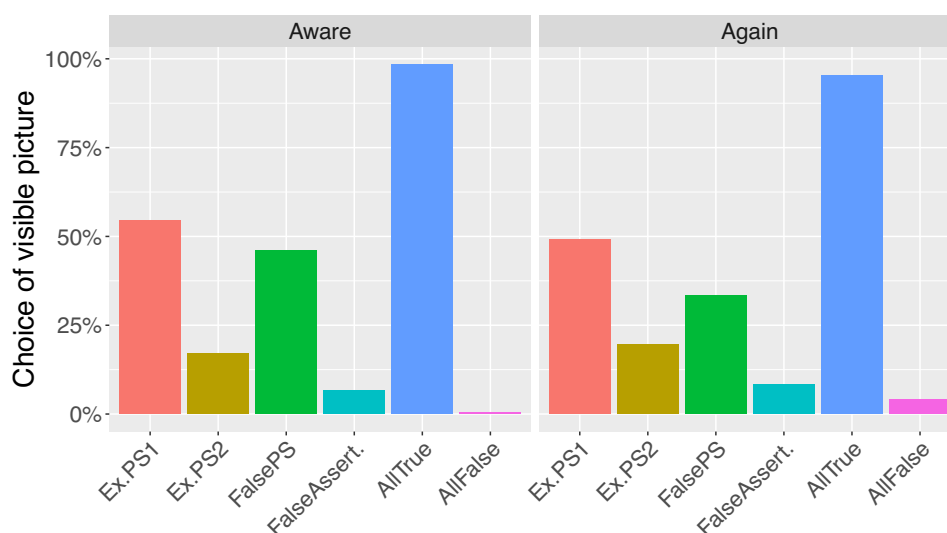


Figure 6: Results for the items with the quantifier *every*, for sentences like: **Every** alien {is aware that he is blue / turned blue again} with the triggers *aware* and *again*.

The first model we ran compared the \exists PS1 and ALLTRUE conditions, for which generally available unrestricted \forall projection and \exists +ENTAILED both predict a difference (with either predicting rejection of \exists PS1). Indeed, our model shows a significant contrast between the two conditions ($\beta = 1.0712, SE = 0.2402, p < 0.001$). Second, we compared \exists PS1 and ALLFALSE, for which DR, \exists -ENTAILED, and PS-LESS readings predict a difference (acceptance for \exists PS1). The model reveals a significant contrast between the conditions ($\beta = -1.0887, SE = 0.2164, p < 0.001$). Third, we compared \exists PS1 and \exists PS2. If there is no significant contrast between these conditions, this would show that Domain Restriction accounts for all of the acceptances in \exists PS1. However, the model shows a significant contrast ($\beta = -4.3254, SE = 0.7970, p < 0.001$), which suggests that DR cannot account for all of the difference between \exists PS1 and \exists PS2. Rather, some of the acceptances of \exists PS1 must be based

on a \exists -ENTAILED or a PS-LESS reading. Fourth, we compared \exists PS1 and FALSEPS to assess the extent to which acceptance in the former is driven by a PS-LESS reading. We find a significant contrast ($\beta = -0.7489$, $SE = 0.1899$, $p < .001$), suggesting that not all such responses are based on this reading. Fifth, we compared the \exists PS2 and ALLFALSE conditions, for which only a reading that follows from DR predicts a difference. No such contrast was revealed by our model ($\beta = -0.1761$, $SE = 0.2788$, $p = 0.5276$), suggesting that DR does not play a role. However, in the next section we will discuss the individual results, which show that, even though DR might be limited, there are some subjects with high acceptance rates for \exists PS2. Finally, we compared the acceptances of the overt picture for FALSEPS and ALLFALSE, for which only a PS-LESS reading predicts a difference. Again, the model did not reveal a significant contrast ($\beta = -0.2736$, $SE = 0.3923$, $p = 0.4855$). However, again, even though the model does not show a significant contrast, there appears to be a proportion of the subjects with high acceptance rates for FALSEPS. We will discuss this in the next section.

To summarize, the results for *every* show a significant difference between \exists PS1 and ALLTRUE and between \exists PS1 and ALLFALSE. The first finding provides clear evidence that presuppositions triggered from the scope of *every* have a universal projection (and/or a \exists +ENTAILED projection; see discussion below). The second contrast could be driven by a DR reading, a \exists -ENTAILED reading, or a PS-LESS reading. Clearly, these results require closer inspection. Several additional aspects of the data indicate that a closer look at the distribution of the answers of the different participants is in order. First, the results on most critical conditions (in contrast to the control conditions) for both *at least one* and *every* do not show 100% acceptances or rejections. This could be caused by a bimodal distribution in the acceptance rates (inter-subject differences). Moreover, the comparison between \exists PS1 and \exists PS2 and between FALSEPS and ALLFALSE does not provide a significant difference, although we see quite large numerical differences as well as some individuals who have high acceptances on \exists PS2 and on FALSEPS. Finally, note that we found a much greater fit for models allowing for random slopes for Condition per Subject. This shows that the slopes capture significant variation in effect size per subject; the models with random slopes therefore reduce the residual variance. However, the models that drop the random slopes (which we fit to arrive at the most parsimonious model in terms of the random-effects structure) indicate significant differences where conditions descriptively appear to contrast. This is for instance the case with the two final comparisons that we discussed in this section: between \exists PS2 and ALLFALSE and between FALSEPS and ALLFALSE. We need to further inspect the data to see whether the variance that is captured by the slopes actually comes from a “real” difference that is masked by the random slope. In the next section, we therefore explore the individual participants’ profiles, and we show that there are different speaker populations.

4.3. Participants’ profiles

Based on the results, this section further inspects the different participants’ profiles, first for *at least one*, and then for *every*.

4.3.1. At least one

While statistical comparisons of \exists PS2 and ALLFALSE and of FALSEPS and ALLFALSE did not reveal significant contrasts, we found fairly large numerical differences. We inspected individual participants' profiles on the FALSEPS and \exists PS2 conditions to better understand the source of the numerical contrasts, in particular with regards to participants' consistency in responses as well as the individual response patterns across relevant conditions. Recall that FALSEPS can only be accepted under a PS-LESS reading, and that \exists PS2 can be accepted under a PS-LESS reading as well as a \exists -ENTAILED reading. Figure 7 plots the mean acceptance on FALSEPS on the y-axis and the mean acceptance on \exists PS1 on the x-axis. While most participants reject the overt picture in both conditions, there is a small but not insubstantial number of subjects who consistently accept the overt picture, especially for *aware*. Furthermore, the roughly linear increase in the distribution suggests a correlation between accepting FALSEPS and \exists PS2, which is expected if acceptance is based on their ability to access a PS-LESS reading. There are a few subjects that diverge from this distribution. This is clearer for *again* than for *aware*: these subjects consistently accept the overt picture in \exists PS2 but not in FALSEPS, suggesting that they access a \exists -ENTAILED reading.

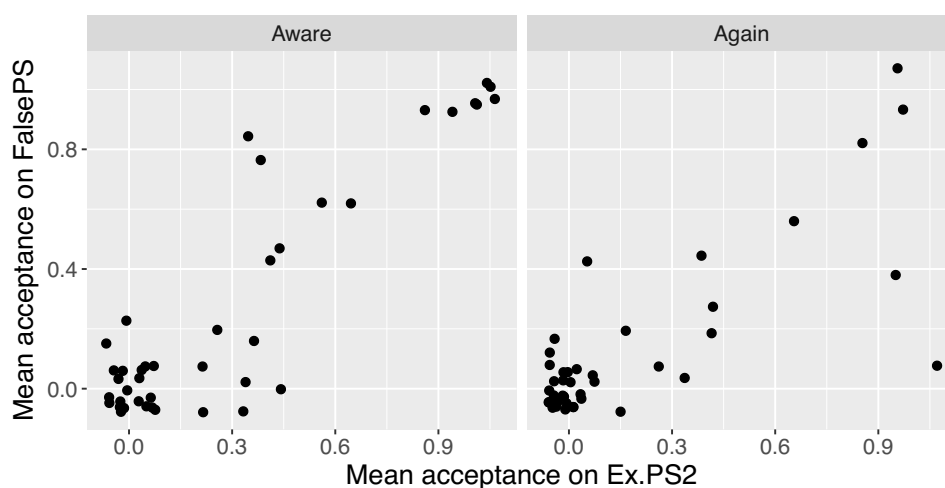


Figure 7: By-subject plot on the conditions \exists PS2 and FALSEPS with the quantifier *at least one* and the triggers *aware* (left) and *again* (right).

4.3.2. Every

For *every*, our models similarly failed to find a significant contrast between ALLFALSE and \exists PS2 on the one hand and FALSEPS on the other, despite non-negligible-seeming numerical contrasts. The former contrast would indicate the availability of DR, and the latter a PS-LESS reading. We inspected individual response distributions to assess the source of the sizable numerical effects as well as potential individual response patterns.

Starting with FALSEPS, the y-axis distribution in Figure 8 shows that a large proportion of

subjects—close to half—accepts the target in this condition quite consistently, often at ceiling levels. This suggests that PS-LESS readings are systematically available for some subjects. While the significant contrast with \exists PS1 reported above suggests that not all acceptances in that condition are due to PS-LESS readings, it is still possible that a large portion of them are. Indeed, comparing the x-axis to the \exists PS1-response distribution on the y-axis in Figure 8 suggests a strong correlation between these two conditions for *aware*, as participants who accept \exists PS1 also accept FALSEPS, while participants who reject \exists PS1 also reject FALSEPS, with only a couple of exceptions. This indicates that a PS-LESS reading of *aware* is consistently available for at least some of the participants, and furthermore that to a large extent, acceptance in \exists PS1 is also driven by this reading (rather than DR or an \exists -ENTAILED reading).

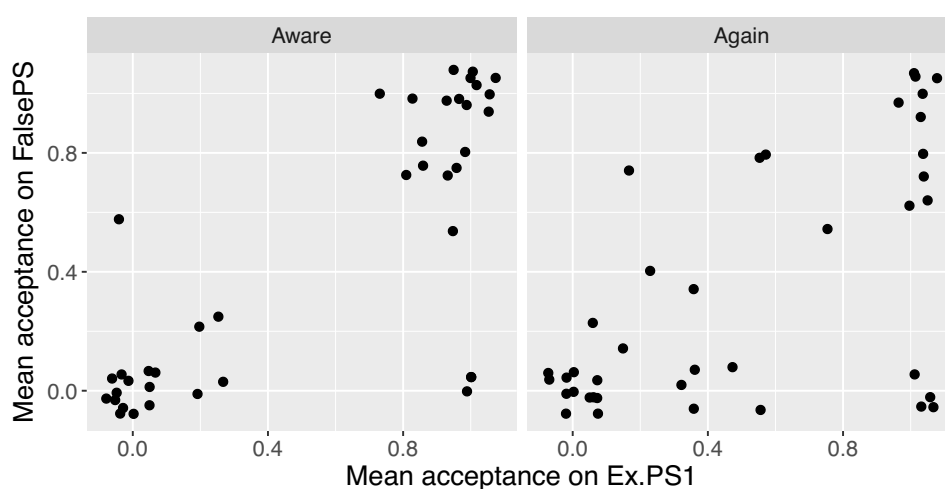


Figure 8: By-subject plot on the conditions \exists PS1 and FALSEPS with the quantifier *every* and the triggers *aware* (left) and *again* (right).

Interestingly, it is less clear that there exists such a correlation for *every* with the trigger *again*. As can be seen on the right side in Figure 8, with *again*, there are some participants who systematically reject the overt picture for FALSEPS while still accepting \exists PS1 in at least a portion of the cases. Note that \exists PS1 could be accepted under a reading that comes from DR, from a \exists -ENTAILED reading, or from a PS-LESS reading. It is safe to conclude that those people who reject FALSEPS do not accept \exists PS1 under a PS-LESS reading. Note further that \exists PS2 can only be accepted under a DR reading, and that we see a much higher acceptance of \exists PS1 compared to \exists PS2 in Figure 6. Therefore, it is likely that an explanation for the difference between the presupposition triggers should be sought in the idea that triggers can differ with regards to whether or not their presupposition also features in the entailed content (Sudo, 2012). In line with results from previous studies (Djäv et al., 2017; Zehr and Schwarz, 2016), our results suggest that *aware* entails its presupposition (unless one has a PS-LESS interpretation of *aware*), while *again* does not entail its presupposition.

Finally, Figure 9 plots the distribution of results across participants for \exists PS2, to further investigate the role of DR, which our overall statistical results suggest is quite limited. The histogram shows that, while the overwhelming majority of the subjects never accept the overt picture for \exists PS2, there are some subjects who (sometimes) accept the picture and, thus, necessarily apply

DR. In total, there are 4 subjects who have high acceptance rates ($>80\%$) for \exists PS2 with *aware* and 7 subjects with *again*. This indicates that, although very limited, DR is an available reading for some of the subjects in our study.

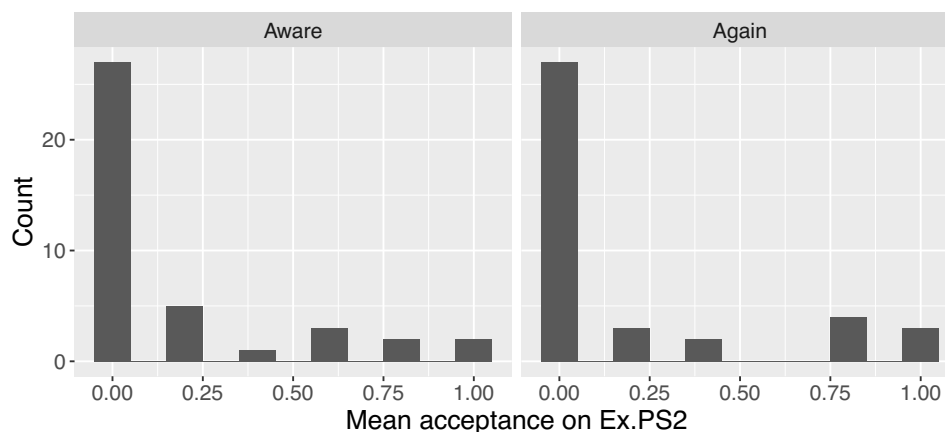


Figure 9: Histogram of the mean acceptance rate on \exists PS2 with the quantifier *every* and the triggers *aware* (left) and *again* (right).

5. Discussion

The experiments in this paper were set up to address a) whether presupposed content under quantifiers gives rise to universal or existential presupposition-based inferences and b) whether the observed reading(s) arise(s) as a direct result of the projection mechanism or via additional mechanisms such as Domain Restriction and (non-)entailment of the presuppositional content. We used two different triggers (*aware*, *again*) and two quantifiers (*every*, *at least one*) to test whether projection behavior differs across triggers and/or quantifiers.

Our data provide clear confirmation that presupposition-based inference patterns vary by quantifier, in line with previous results by Chemla (2009) and Tiemann (2014): targets with non-universally met presuppositions are readily accepted for *at least one* but much less often so for *every*. Moreover, the results show that the overall results pattern is quite comparable across the two triggers, although we do observe subtle differences in terms of entailment for the different triggers.

As for determining how the descriptively universal and existential readings for the two quantifiers should be accounted for in theoretical terms, a detailed consideration of the various factors at play is required. The rejections of \exists PS1 for *every*, reflecting a descriptively universal inference, can be accounted for either in terms of universal projection (\forall) or via existential projection plus an entailed presupposition. However, if we assume that *again* does not entail its presupposition, as suggested by prior work as well as by some aspects of our results, then this finding is indeed supportive of \forall -projection from the scope of *every*.

Importantly, the extent to which responses indicating non-universal readings for *every* can be attributed to DR in our data seems to be extremely limited, as we find no general statistically significant effects directly attributable to DR. This is in contrast to previous findings by Geurts

and van Tiel (2016). At the same time, however, there are some individual participants who show consistent acceptance of targets that are only compatible with universal projection relative to a restricted domain, suggesting that this interpretative option is in principle available but only accessible to few speakers in our experimental context.

In addition to the variation in presupposition-based inference patterns between quantifiers, we also find variation between readings that incorporate presupposed content as part of the entailed content and readings that do not. This is the case for both triggers, although there are some indications of differences between triggers as well. For the quantifier *at least one*, we find that a fair number of participants accept overt pictures that are only compatible with a \exists -ENTAILED reading or a PS-LESS reading. The former would be expected, to some extent, for *again*, based on results from prior work arguing it to be a non-entailing trigger. For *aware*, the availability of either reading is more surprising. However, it is quite plausible that in this case, the result is attributable to the specific nature of the task at hand rather than a lexical property of *aware*. In particular, given the context provided in the instructions, where the aliens rely on sometimes faulty machines to form beliefs about their own color, there may be a notion of *aware* that takes into account a perspectival shift of sorts: as far as the alien in question is concerned, they may perfectly well have reasonably justified belief about their color based on the machine-feedback, even if that feedback could be faulty, as that is the only source of information at their disposal. It is in light of this justification from the perspective of the alien that one could describe them as ‘aware’ of their color, even if they wind up getting the color wrong.⁴ What appear to be ‘presupposition-less’ readings in descriptive terms might then be regular presuppositional readings with some shift in perspective.

Turning to *again*, we find some evidence for both types of readings, but these may need to be accounted for in different terms. First, if we assume (following previous work) that *again* does not entail its presupposition, the observation of \exists -ENTAILED is straightforwardly accounted for.⁵ A non-entailed representation of *again* also accounts for the responses of participants who, at the same time, rejected overt pictures only compatible with PS-LESS readings, and leaves open the possibility of local accommodation to account for the responses of the participants who showed no evidence of accessing \exists -ENTAILED or PS-LESS readings of *again*. However, it is in principle possible that in certain circumstances, the presupposition of *again* can simply be ignored, which accounts for observations of PS-LESS readings.

6. Conclusions

Presuppositions give rise to different inference patterns from different quantifiers, as documented here for universal and existential ones. Theoretical accounts of these differences are complicated by a variety of factors, such as Domain Restriction and (non-)entailment of presuppositions. In light of previously proposed differences between types of triggers, our results suggest that the projection mechanism itself yields universal and existential readings from the respective quantifiers and that Domain Restriction at best plays a very limited role. At the same

⁴Thanks to Jeff Lidz for first spelling out this possibility for us in fully explicit terms.

⁵Though note that Sudo (2012) proposes cross-dimensional anaphora to account for *exactly one* binding its quantified variable in the presuppositional as well as in the assertive dimension, thus predicting rejection in \exists -ENTAILED, where no alien satisfies *both* dimensions at the same time.

time, there is substantial variation in the types of readings that are possible for these presupposition triggers, and, ultimately, further work is needed to pin down which theoretical properties the various interpretative effects should be attributed to. This will also require the investigation of a wider range of triggers and quantifiers.

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A new kind of epistemic indefinite¹

Virginia DAWSON — *University of California, Berkeley*

Abstract. Tiwa (Tibeto-Burman; India) has two series of epistemic indefinites: one whose epistemic effects arise via an anti-singleton constraint similar to Spanish *algún* (Alonso-Ovalle and Menéndez-Benito, 2010), and another, wide-scope indefinite whose epistemic effects must be derived differently. I propose that for these latter indefinites, ignorance arises not through domain constraints, but as a result of their choice functional nature through competition with other indefinites. Tiwa's wide scope indefinites then constitute a new kind of epistemic indefinite, showing that ignorance implicatures for indefinites can arise through different sorts of competition.

Keywords: epistemic indefinites, wide scope indefinites, choice functions, implicature, Tiwa.

1. Introduction

Epistemic indefinites are indefinite pronouns and determiners that convey that the speaker is ignorant with respect to the witness to that indefinite (Alonso-Ovalle and Menéndez-Benito, 2015). An example of this is Spanish *algún* (Alonso-Ovalle and Menéndez-Benito, 2010).² When speakers use *algún* in non-downward-entailing environments, they convey that they are ignorant with respect to the identity (or number) of the witness. Alonso-Ovalle and Menéndez-Benito (2010) attribute these epistemic effects to a conversational implicature that arises due to the domain requirements of *algún*. Specifically, *algún* places an anti-singleton requirement on its domain: it cannot range over a singleton set. Adopting the neo-Gricean analysis that Kratzer and Shimoyama (2002) propose for similar effects with German *irgendein*,³ Alonso-Ovalle and Menéndez-Benito derive the epistemic effects of *algún* as a quantity implicature that arises through avoidance of a false exhaustivity inference. Specifically, in using an indefinite that ranges over a non-singleton domain, the speaker makes a weaker statement than if she used a singleton competitor. From this, the hearer reasons that the speaker did so to avoid implying that she believes some of the alternatives are false (through an exhaustivity inference). The hearer concludes that the speaker does not know that some of these alternatives are false, which

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²Other epistemic indefinites that have been discussed in the literature include German *irgendein* (Kratzer and Shimoyama, 2002), Italian *un qualsiasi* (Aloni and van Rooij, 2004; Chierchia, 2006) and *un qualche* (Zamparelli, 2007), French *quelque* and *un quelconque* (Jayez and Tovena, 2006, 2007), the Russian *-to* series (Kagan, 2011), Romanian *vreun* (Farkas, 2002; Fălăuş, 2014), the Japanese *-ka* series (Alonso-Ovalle and Shimoyama, 2014), and the Czech *-si* series (Šimík, 2015). Note that not all epistemic effects associated with indefinites have been analyzed as conversational implicatures.

³German *irgendein* conveys speaker ignorance or indifference with respect to the witness. The domain requirements *irgendein* places are different from those of *algún*: instead of simply requiring a non-singleton domain, *irgendein* is a domain widener. This difference manifests in its epistemic component: *irgendein* requires that the speaker be ignorant with respect to the entire domain, while *algún* allows for ignorance with respect to a subset of the domain.

results in the ignorance implicature.

Tiwa, a Tibeto-Burman language of India,⁴ has two distinct series of epistemic indefinites, whose epistemic effects, I will argue, arise pragmatically. These are the *-khi* series and the *-pha* series, illustrated in (1) and (2) respectively.⁵ In both cases, it is infelicitous for the speaker to use a *-khi* or *-pha* indefinite and then identify the witness: in using these indefinites, the speaker has conveyed ignorance.

(1) Shar-khí phi-dom. # Pe-do Mukton.
 who-KHI come-PST 3SG-TOP Mukton
 ‘Someone came. # Namely, Mukton.’ [2017.1.81]

(2) Shar-pha phi-dom. # Pe-do Mukton.
 who-PHA come-PST 3SG-TOP Mukton
 ‘Someone came. # Namely, Mukton.’ [2017.1.81]

These indefinites contrast with the plain, non-epistemic indefinite, the numeral “one”, which can be felicitously followed with an explicit identification of the witness. This is shown in (3).

(3) Sája líbing phi-dom. Pe-do Mukton.
 one.CL person come-PST 3SG-TOP Mukton
 ‘A person came. Namely, Mukton.’ [2017.1.81]

In this paper, I show that the epistemic effects associated with both *-khi* and *-pha* indefinites in Tiwa arise as conversational implicatures, but that they must arise in different ways. In particular, the epistemic effects associated with *-pha* arise as a consequence of its anti-singleton domain requirements, similar to Spanish *algún*. In contrast, the epistemic effects of *-khi*, a wide scope choice functional indefinite, arise not through domain requirements, but as a result of the indefinite’s choice functional nature. Tiwa’s *-khi* indefinites then constitute a new kind of epistemic indefinite, one whose epistemic effects are pragmatic, but do not arise as a consequence of domain requirements.

The paper is structured as follows. In §2 I show that the ignorance effects associated with *-khi* and *-pha* indefinites behave like a conversational implicature.⁶ In §3 I propose an analysis for *-pha* indefinites following that proposed by Alonso-Ovalle and Menéndez-Benito (2010) for

⁴Tiwa is spoken by approximately 27,100 people primarily in west Karbi Anglong district, Assam, India (2001 estimates; Simons and Fennig 2017). The data used here were collected by the author in Umswai, Karbi Anglong over the course of two summers (2016 and 2017).

⁵Examples are presented in the orthography used in Joseph’s (2014) dictionary. A reference to year, notebook number, and page are given to the right of each translation. Abbreviations are: ACC ‘accusative’, ADD ‘scalar additive’, AUX ‘auxiliary’, CF ‘counterfactual’, CL ‘classifier’, COM ‘comitative’, COMP ‘complementizer’, COND ‘conditional’, COP ‘copula’, DAT ‘dative’, GEN ‘genitive’, INF ‘infinitive’, IPFV ‘imperfective’, NEG ‘negation’, NEUT ‘neutral aspect’, NMLZ ‘nominalizer’, PFV ‘perfective’, PL ‘plural’, PST ‘past’, SG ‘singular’, TOP ‘topic’.

⁶Not every epistemic indefinite discussed in the literature has been analyzed as involving conversational implicature. Aloni and Port (2015), for example, argue that the epistemic component of such indefinites is better analyzed as a felicity condition. See Alonso-Ovalle and Menéndez-Benito 2013 for a summary and comparison of the two main approaches to epistemic indefinites.

Spanish *algún*. In §4 I turn to Tiwa's *-khi* indefinites, demonstrating that they show exceptional wide scope, and proposing a choice functional analysis with existential closure that accounts for this. I also show why Alonso-Ovalle and Menéndez-Benito's analysis cannot be extended to *-khi* indefinites. In §5 I discuss the range of epistemic readings available to *-khi* indefinites and suggest that their epistemic effects result from existential quantification over choice functions, through competition with indefinite and definite alternatives. I conclude in §6, and consider the crosslinguistic implications of this analysis.

2. Epistemic indefinites in Tiwa

Tiwa's two series of epistemic indefinites are formed through suffixation of either *-pha* or *-khi* to an indeterminate base, glossed as a *wh*-word throughout. (In its bare form, the indeterminate base functions as a *wh*-word.) These indefinites can function either as an article, or as an independent pronoun. For an analysis of the internal composition of these indefinites, and discussion of Tiwa's indeterminates more generally, see Dawson to appear.

(4) *Tiwa's epistemic indefinites*

base gloss	<i>-khi</i>	<i>-pha</i>
who	shar-khí ⁷	shar-pha
what	inda-khí	inda-pha
where	pajíng-khî	pajíng-phâ
where	pathô-khi	pathô-pha
when	pakhál-khî	pakhál-phâ
how	padi-khí	padî-pha
how much	pasí-khî	–
which	pakhâ-khi	pakhâ-pha

As shown in §1, both *-pha* and *-khi* indefinites cannot be felicitously followed by an identification of the witness (examples (1) and (2)), in contrast to the plain indefinite (example (3)). This infelicity is due to the fact that both *-pha* and *-khi* indefinites strongly convey speaker ignorance with respect to the witness. In both cases, this ignorance arises as a conversational implicature: the effects can be cancelled, reinforced, and, in the case of *-pha* indefinites, it disappears in downward-entailing environments.

2.1. Conversational implicature

The epistemic effects associated with both *-pha* and *-khi* indefinites behave like a conversational implicature. The first piece of evidence for this is that in both cases the implication of speaker ignorance can be canceled if there is some other reason to use an indefinite (e.g., if the speaker does not want to identify the witness). This is shown for *-pha* in (5) and (6). In both examples, the speaker follows an assertion with a *-pha* indefinite by explicitly stating that she can identify the witness.

⁷In addition to the morphologically transparent form *shar-khí*, there are various allomorphs for the human *-khi* indefinite, including *sharkhíne*, *shargíne*, *sharkhídi*, and *shagídi* (see Joseph 2014).

- (5) Maria shar-pha-go lak mán-ga, arô shar-go ang si-w.
 Maria who-PHA-ACC meet-PFV and who-ACC 1SG know-NEUT
 ‘Maria met someone, and I know who.’ [2016.1.88]
- (6) Shar-pha phi-dom. Ang *pro*_i si-w, thêbo ná *pro*_i si-ya.
 who-PHA come-PST 1SG 3SG know-NEUT but 2SG 3SG know-NEG
 ‘Someone came. I know him, but you don’t.’ [2016.2.41]

Cancelation for *-khi* is shown in (7) and (8). In (7), the speaker knows who she will marry, but does not want to tell the addressee who it is. The preceding context of (8) is that there is a man who is constantly bothering the speaker, which includes always asking her invasive questions about her recent activities. The speaker replies to a question about when she went to Guwahati, with the sentence in (8): she is explicitly withholding information.

- (7) Ang shar-khí-na-rê phadé-w, thêbo ang sóng-ya shar-a-re.
 1SG who-KHI-DAT-COM marry-NEUT but 1SG tell-NEG who-DAT-COM
 ‘I’m going to marry someone, but I won’t tell you who.’ [2017.1.84]
- (8) Pakhál-khî lí-dom. Ang si-w pakhál, thêbo nága sóng os-ya.
 when-KHI go-PST 1SG know-NEUT when but 2SG.DAT tell AUX-NEG
 ‘I went sometime. I know when, but I won’t tell you.’ [2017.2.7]

Note that the ignorance implicature for *-khi* indefinites is harder to cancel than it is for *-pha* indefinites. While the ignorance component of *-pha* can be canceled by simply adding “I know who” as shown in (5), this same strategy is judged infelicitous for *-khi*:

- (9) Maria shar-khí-gô lak mán-ga, # arô shar-go ang si-w.
 Maria who-KHI-ACC meet-PFV and who-ACC 1SG know-NEUT
 ‘Maria met someone, # and I know who.’ [2016.1.88]

In addition to cancelation, the ignorance component of both series of indefinites can be reinforced without redundancy, showing that ignorance is not part of the asserted content. Reinforcement is shown for *-pha* in (10) and for *-khi* in (11).

- (10) Maria shar-pha-go lak mán-ga, thêbo shar-go ang si-ya.
 Maria who-PHA-ACC meet-PFV but who-ACC 1SG know-NEG
 ‘Maria met someone, but I don’t know who.’ [2016.1.88]
- (11) Maria shar-khí-gô lak mán-ga, thêbo shar-go ang si-ya.
 Maria who-KHI-ACC meet-PFV but who-ACC 1SG know-NEG
 ‘Maria met someone, but I don’t know who.’ [2016.1.88]

A type of evidence for conversational implicature comes from behavior in downward-entailing contexts: when an epistemic indefinite scopes under negation or a conditional operator, for example, the epistemic effect is lost. This is shown for negation in (12) and for a conditional in (13). In these two sentences, which feature *-pha* indefinites, there is no epistemic effect.

(Indeed, it is difficult to imagine what an epistemic effect would look like when the indefinite is in a downward-entailing context, such as embedded under negation or a conditional operator.)

- (12) [CP Shar-pha phi-dom honmandé] thángane cha.
 who-PHA come-PST COMP correct NEG
 ‘It’s not correct that someone came.’ [2016.2.42]
 ✓: Nobody came.
- (13) Chidî shar-pha sister lak mán-a phi-gaido, Saldi khúp khâdu-gam.
 if who-PHA sister meet-INF come-COND Saldi very happy-CF
 ‘If Saldi meets some nun, she would be very happy.’ [2016.1.131]
 ✓: Meeting any nun will make Saldi happy.

Note, though, that this test cannot be applied to *-khi* indefinites, since they necessarily take wide scope over all other operators, including from inside islands. I return to this point in §4.

3. *-pha* indefinites

In the previous section, I showed that the speaker ignorance component associated with both *-khi* and *-pha* indefinites behaves like a canonical conversational implicature: it is cancelable and reinforceable, and, in the case of *-pha* indefinites, disappears in downward-entailing environments. In this section, show that just like Spanish *algún*, *-pha* indefinites must range over a non-singleton domain. I propose that Alonso-Ovalle and Menéndez-Benito’s (2010) analysis be extended to *-pha* indefinites.

3.1. *-pha* indefinites have an anti-singleton constraint

Tiwa’s *-pha* indefinites have an anti-singleton constraint, similar to the one described for Spanish *algún* (Alonso-Ovalle & Menéndez-Benito 2010). This is most clearly illustrated in the contrast between (14) and (15), in which an indefinite combines with the restrictor ‘pope’. There is only one pope; the extension of *Pha Khûmur* is a singleton. The plain indefinite, which has no domain restrictions, is felicitous in such cases, as shown in (14), while *-pha* indefinites are infelicitous, as shown in (15).

- (14) Ang sája Pha Khûmur-go lak mán-a lí-do.
 1SG one.CL father holy-ACC meet-INF go-IPFV
 ‘I’m going to meet a pope.’ [2017.1.29]
- (15) #Ang shar-pha Pha Khûmur-go lak mán-a lí-do.
 1SG who-PHA father holy-ACC meet-INF go-IPFV
 Intended: ‘I’m going to meet some pope.’ [2017.1.29]
 Comment: Because Pha Khûmur is only one.

Note the absence of an anti-uniqueness effect for the plain indefinite (and also *-khi* indefinites; see §4), which we might have expected to arise through Maximize Presupposition in competi-

tion with the definite (Heim, 1991). If *-pha* indefinites carry an anti-singleton presupposition, as I propose below, the absence of this effect is expected: in using the plain indefinite, rather than the definite, the speaker has failed to presuppose that there is a unique referent. However, the speaker has also failed to employ the anti-singleton presupposition associated with the *-pha* indefinite. These presuppositions effectively cancel each other out, leaving the plain indefinite neutral with respect to its likely domain.

Further evidence for an anti-singleton constraint on *-pha* indefinites comes from examples like (16). This example was deemed infelicitous in an out of the blue context, where the extension of *Indiane PM* is understood to be the singleton set {Modi}. It becomes grammatical, however, in a context in which all living Indian prime ministers, past and present, are relevant: the domain is no longer a singleton.

- (16) Ang shar-pha India-ne PM-go lak mán-a lí-do.
 1SG who-PHA India-GEN PM-ACC meet-INF go-IPFV
 ‘I’m going to meet some Indian Prime Minister.’ [2016.2.101]
 #: Out of the blue (there is only one PM: Modi)
 ✓: All past and present Indian PMs are contextually relevant (Modi, Singh, ...)

An anti-singleton constraint on *-pha* also straightforwardly explains the only gap found in the *-khi* and *-pha* series as outlined in the table in (4). Specifically, there is no *-pha* indefinite corresponding to the indeterminate *pasí* ‘how much’. If *pasí* picks out the maximal degree to which some property holds of an individual, this gap is explained: as there can only be one maximal degree, it follows that anti-singleton *pasí-phâ* would be an anomaly.

3.2. Deriving *-pha*’s epistemic effect

Tiwa’s *-pha* indefinites are similar to Spanish *algún*, which likewise has an anti-singleton constraint, and whose epistemic effects are a conversational implicature (Alonso-Ovalle and Menéndez-Benito, 2010). Accordingly, I propose to treat *-pha* indefinites in the same way as *algún*. Specifically, *-pha* indefinites carry a condition that their domain is not a singleton, as formalized in (17) following Alonso-Ovalle and Menéndez-Benito 2010.

- (17) $[[\text{Wh-pha}]] = \lambda f_{\langle et, et \rangle} . \lambda P_{\langle et \rangle} . \lambda Q_{\langle et \rangle} : \text{anti-singleton}(f) . \exists x[f(P)(x) \ \& \ Q(x)]$

When a speaker uses a *-pha* indefinite in an upward entailing environment, she necessarily makes a weaker statement than she would if she used a singleton alternative, such as a definite description, a name, or an indefinite that allows for a singleton domain. Consider the sentence in (18a).⁸

- (18) a. Maria shar-pha sister-go lak mán-ga.
 Maria who-PHA nun-ACC meet-PFV

⁸I follow Kratzer and Shimoyama (2002) and Alonso-Ovalle and Menéndez-Benito (2010) in assuming a covert assertoric operator represented by \square .

‘Maria met some nun.’ [2016.2.63]

- b. Assertion: $\Box[\exists x[f(\text{nun})(x) \ \& \ \text{meet}(\text{Maria})(x)]]$
 c. Presupposition: $|f(\text{nun})| > 1$

In using *sharpha sister*, the speaker has explicitly signaled that the domain is a non-singleton, perhaps consisting of a set of three individuals {Lily, Irene, Filina}. By using *sharpha sister* in this case, the speaker is asserting that Maria met someone in that domain, as in (19a). But she could have asserted that *Lily* came, or that *Irene* came, or that *Filina* came. The hearer reasons that she did so to avoid a false claim: it’s not the case that Maria must have met Lily, and so on. This gives rise to the implicature in (19b): the speaker cannot truthfully make a stronger assertion because she doesn’t know if it’s true.

- (19) a. $\Box[\text{met}(\text{Lily})(\text{Maria}) \vee \text{met}(\text{Irene})(\text{Maria}) \vee \text{met}(\text{Filina})(\text{Maria})]$
 b. $\neg\Box[\text{met}(\text{Lily})(\text{Maria})] \ \& \ \neg\Box[\text{met}(\text{Irene})(\text{Maria})] \ \& \ \neg\Box[\text{met}(\text{Filina})(\text{Maria})]$

Kratzer and Shimoyama (2002) and Alonso-Ovalle and Menéndez-Benito (2010) show that a different pragmatic reasoning must take place under possibility modals to derive the ignorance implicature, since one of the singleton alternatives is necessarily true. They propose that in these cases, the hearer reasons that the speaker has used the non-singleton alternative to avoid a false exhaustivity inference. Specifically, a stronger singleton alternative under a possibility modal would lead the hearer to draw an exhaustivity inference ($\Diamond p$ implies $\neg\Diamond q$). The hearer reasons that the speaker is avoiding this inference by using a non-singleton: neither $\Diamond p$ nor $\Diamond q$ are ruled out. Again this implicates speaker ignorance. See Kratzer and Shimoyama (2002) and Alonso-Ovalle and Menéndez-Benito (2010) for more detailed discussion of this analysis.

Importantly, the ignorance implicatures disappear in downward entailing environments such as negation and conditionals, because in using an indefinite with a non-singleton domain the speaker has made a stronger statement. The analysis sketched above derives the epistemic effects of *-pha* indefinites from an independent fact of their semantics (that they require a non-singleton domain), and explains why the effects are cancelable and disappear in downward entailing environments. The Tiwa data provides another clear example of an anti-singleton indefinite that has exactly the behaviors expected of such an indefinite.

4. *-khi* as a wide scope indefinite

Tiwa’s *-pha* indefinites are generalized existential quantifiers: they can scope above or below other operators, and resist scoping out of islands (possibly due to their antisingleton constraint (Schwarzschild, 2002)), as shown below in (26) and (27). Tiwa’s *-khi* indefinites, in contrast, take obligatory wide scope over all other operators, including from inside islands. Examples (20)-(23) show wide scope with respect to clausemate negation, a universal quantifier, a deontic necessity modal, and an attitude verb, respectively.

- (20) Maria inda-khí kashóng pre-ya-m.
 Maria what-KHI dress buy-NEG-PST
 ‘Maria didn’t buy some dress.’ [2016.1.130]
 \checkmark : There’s a particular unknown dress Maria didn’t buy. $\exists > \neg$

- #: There were no dresses. * ¬ > ∃
- (21) Sogól-lô inda-khí hat-a lí-ga.
 everyone-FOC what-KHI market-DAT go-PFV
 ‘Everyone went to some market.’ [2016.1.133]
 ✓: Everyone went to a particular, unknown market. ∃ > ∀
 #: Each person went to a different market. * ∀ > ∃
- (22) Maria shar-khí sister-go lak mán-a mán-o.
 Maria who-KHI sister-ACC meet-INF must-NEUT
 ‘Maria has to meet some nun.’ [2016.2.52]
 ✓: There is a particular nun, unknown to the speaker, that Maria has to meet. ∃ > □
 #: Maria needs to meet with any nun. * □ > ∃
- (23) Ang [shar-khí Delhi-jíng shó-wa mewâ-go]_{DP} pháde-na hal-do.
 1SG who-KHI Delhi-ALL reach-NMLZ man-ACC marry-INF want-IPFV
 ‘I want to marry some man that’s been to Delhi.’ [2016.2.120]
 ✓: The speaker saw him the other day, but hasn’t actually met him. ∃ > want
 #: The speaker wants to marry any man that’s been to Delhi. * want > ∃

Examples (24) and (25) show that *-khi* indefinites must scope out of islands, shown here with a finite embedded clause and a conditional antecedent, respectively.⁹

- (24) [Shar-khí phi-dom honmandé]_{CP} thángane cha.
 who-PHA come-PST COMP correct NEG
 ‘It’s not correct that someone came.’ [2016.2.42]
 ✓: There’s a particular person, unknown to the speaker, that didn’t come. ∃ > ¬
 #: Nobody came. * ¬ > ∃
- (25) Chidî shar-khí sister-go lak mán-a phi-gaido, Saldi khúp khâdu-gam.
 if who-KHI sister-ACC meet-INF come-COND Saldi very happy-CF
 ‘If Saldi meets some nun, she would be very happy.’ [2016.1.131]
 ✓: There is a particular nun, unknown to the speaker, that Saldi wants to meet. ∃ > if
 #: Meeting any nun will make Saldi happy. * if > ∃

That these environments are scope islands in Tiwa is evidenced by the fact that *-pha* indefinites cannot scope out of them, as shown in (26) and (27). They are also islands for overt syntactic movement (see Dawson to appear).

- (26) [Shar-pha phi-dom honmandé]_{CP} thángane cha.
 who-PHA come-PST COMP correct NEG
 ‘It’s not correct that someone came.’ [2016.2.42]
 ✓: Nobody came. ¬ > ∃

⁹Relative clauses, omitted here for reasons of space, are also scope islands and behave as expected: *-khi* indefinites must scope out of them.

- #: There's a particular person that didn't come. * $\exists > \neg$
- (27) Chidî shar-pha sister lak mán-a phi-gaido, Saldi khúp khâdu-gam.
 if who-PHA sister meet-INF come-COND Saldi very happy-CF
 'If Saldi meets some nun, she would be very happy.' [2016.1.131]
 ✓: Meeting any nun will make Saldi happy. if $> \exists$
 #: There is a particular nun that Saldi wants to meet. * $\exists > \text{if}$

This obligatory, island-violating wide scope that *-khi* exhibits brings to mind a definite or other referring expression. Examples like (28), however, show that *-khi* pronouns/articles are indefinite: this sentence is not a contradiction.¹⁰ Further evidence comes from *-khi*'s acceptability in sluicing, as (11) shows in §2 above.

- (28) Shar-khí margî rojá-ga, arô shar-khí margî rojá-ya-m.
 who-KHI woman sing-PFV and who-KHI woman sing-NEG-PST
 'Some woman sang, and some woman didn't sing.' [2017.2.4]

To account for *-khi* indefinites' scope behavior, I adopt a choice functional analysis (Winter, 1997; Reinhart, 1997; Kratzer, 1998). I propose that *-khi* indefinites introduce a choice function which ranges over the property denoted by their restrictor, as shown in the denotation in (29).¹¹ This variable is subject to obligatory existential closure at the highest level (Matthewson, 1999).¹²

- (29) $\llbracket wh\text{-}khi \rrbracket = \lambda P. f(P)$, where f is a CF

Existential closure of the choice function variable derives widest scope. This is illustrated in (30a) for the sentence in (30b) (repeated from (20) above).¹³

- (30) a. $\exists f[\text{CH}(f) \ \& \ \neg \text{buy}(\text{Maria})(f(\text{dress}))]$
 b. Maria inda-khí kashóng pre-ya-m.
 Maria what-KHI dress buy-NEG-PST
 'Maria didn't buy some dress.' [2016.1.130]
 ✓: There's a particular unknown dress Maria didn't buy. $\exists > \neg$
 #: There were no dresses. * $\neg > \exists$

¹⁰By contrast, a bare noun in this sentence does result in a contradiction, as in (i). (Bare nouns in an external argument position in Tiwa are interpreted as definite.)

(i) #Korkhyá lukhâi thá-ga, arô korkhyá lukhâi thá-ya-m.
 child hide AUX-PFV and child hide AUX-NEG-PST
 'The child hid, and the child didn't hide.' [2017.2.5]

¹¹I assume that *-khi* indefinites that appear without an overt NP have an implicit restrictor.

¹²For the sake of simplicity I abstract away from whether this is a Skolemized choice function or not, and assume that this closure takes place at the highest level (cf. Chierchia 2001 and Schwarz 2001). The data that would bear on these questions are unclear at this stage. As far as I can tell, if necessary, these modifications would not make a difference to the pragmatic account sketched here.

¹³In the remainder of this paper I omit the covert assertoric operator that was included in §3 since it is not directly bear on the analysis of *-khi* indefinites. If it were included, it would out-scope existential closure of the choice function variable.

Because this existential closure can occur at an arbitrary distance from the variable itself, this analysis captures *-khi* indefinites' island-violating scopal behavior.

4.1. Evidence for existential closure

Choice functional analyses do not always involve existential closure of the choice function variable. Kratzer (1998) proposes that instead the variable is left free: a seemingly wide scope indefinite is actually a specific indefinite, with the variable subject to a contextually determined assignment.¹⁴ Crucially, the value of the choice function variable does not need to be known to the hearer: instead, it is sufficient for the speaker to have a particular witness in mind. By contrast, Matthewson (1999) argues for wide existential closure of choice function variables based on data in St'át'imcets. She argues that speakers of St'át'imcets do not need to have a specific witness in mind when using a wide scope indefinite: sentences involving St'át'imcets indefinites are true and felicitous if there is any witness that fulfills the proposition. These data are explained if the variable is existentially closed.

The behavior of Tiwa's *-khi* indefinites favors an analysis that involves existential closure. As Matthewson argues for St'át'imcets, Tiwa speakers do not have to have a specific witness in mind in using a *-khi* indefinite. This is shown in the examples below. First, in (31), a *-khi* indefinite is used in a counterfactual conditional: Lastoi, who is unmarried, did not go to Spain, but the speaker believes that if she did, she would have married someone. The speaker does not have a particular individual in mind in making this existential claim.

- (31) Chidî Lastoi Spain-jíng lí-gaidôm, pe shar-khí-rê pháde-gam.
 if Lastoi Spain-ALL go-CF.COND 3SG who-KHI-COM marry-CF
 'If Lastoi had gone to Spain, she would have married someone.' [2017.1.55]
 = There is someone such that if Lastoi had gone to Spain, she would have married him.

In (32), the speaker conveys that there is a Mizo man she would like to marry, but she doesn't have a particular one in mind. Based on the fact that she generally finds Mizo men attractive, she knows that such a man exists.

- (32) Ang shar-khí Mizo mewâ-re pháde-na as hóng-do, thêbo ang sája Mizo
 1SG who-KHI Mizo man-COM marry-INF desire-IPFV but 1SG one.CL Mizo
 mewâ-go-bo lak mán-an' cha. Padî rí-w?
 man-ACC-ADD meet-NMLZ NEG how do-NEUT
 'I want to marry some Mizo man, but I've never met a Mizo man before. What will I do?' [2017.2.6]
 = There is a Mizo man such that I want to marry him, but I don't know which one.

These data show that, at the very least, Tiwa's *-khi* indefinites differ from indefinites like En-

¹⁴Under her analysis, indefinites that take local scope are generalized existential quantifiers. Apparent intermediate scope examples involving island violations are instances of pseudo-scope due to a covarying argument of the choice function that is bound by a higher quantifier.

glish *a certain*, for which the speaker does plausibly have a witness in mind. If indefinites like *a certain* are to be analyzed as free-variable choice functions (Kratzer, 1998; Schwarz, 2001), positing existential closure for Tiwa's *-khi* indefinites both captures their truth conditions and provides an explanation for their different readings. As discussed in §5 below, it is also crucial in explaining why speaker ignorance is implicated for *-khi* indefinites.

4.2. Singleton domains

The analysis of *-khi* indefinites provided in this section does not place any restrictions on the domain that a *-khi* indefinite can range over. Specifically, the choice function variable that the *-khi* indefinite introduces should be able to range over either a singleton or a non-singleton domain: if it ranges over a singleton, any value of *f* will simply select the same individual. This prediction of the analysis is borne out. Unlike *-pha* indefinites, *-khi* indefinites can range over singleton domains. This is shown for the inherently singleton restrictor 'pope' in (33). Contrast this with the *-pha* indefinite version in (15) in §3 above. Using *sharkhí* in this sentence does not yield the same infelicity that using *sharpha* does.

- (33) Ang shar-khí Pha Khûmur-go lak mán-a lí-do.
 1SG who-KHI father holy-ACC meet-INF go-IPFV
 'I'm going to meet some pope.' [2017.1.28]

Another example is given in (34). Here the *-khi* indefinite ranges over the set of countries called Zambia (presumably a singleton set, even for someone who has never heard of it before).

- (34) Mukton [pajíng-khî Zambia hon-a tes-a]_{DP} lí-ga.
 Mukton where-KHI Zambia say-NMLZ country-DAT go-PFV
 'Mukton went to some country called Zambia.' [2017.1.141]
 Context: Mukton went to Zambia. He told me, but I've never heard of Zambia before.

That *-khi* indefinites freely range over singleton sets rules out an analysis of their epistemic effects along the lines of that in Alonso-Ovalle and Menéndez-Benito 2010 and §3 above. Instead, these effects must be derived differently.

5. *-khi*'s epistemic effects

The epistemic effects associated with *-khi* indefinites are highly salient. While they can be canceled, given the right context (see examples (7) and (8) above), the sense that the speaker is ignorant about the witness in some way is extremely strong. Indeed, speaker translations of sentences containing a *-khi* indefinite frequently contain a reference to speaker ignorance. This ignorance, however, is not limited to whether the speaker can name (or otherwise clearly identify) the witness. Instead, *-khi* indefinites can convey speaker ignorance with respect to essentially any salient property. This range of ignorance readings is clearly shown in examples like (35). (35a) shows that this sentence cannot be felicitously followed simply with an indication that the speaker is familiar with the witness. This is expected, given *-khi*'s epistemic effect. However, (35b) shows the speaker can in fact follow a *-khi* indefinite with an indication

of familiarity, provided there is some other reason to use the epistemic indefinite. In this case, the speaker can't remember what color hair her friend has.

- (35) Ang shar-khí chor-go lak mán-a lí-do...
 1SG who-KHI friend-ACC meet-INF go-IPFV
 'I'm going to meet some friend (of mine) ...' [2017.2.6]
- a. #Pe ái kró-wa chor.
 3SG 1SG.GEN good-NMLZ friend
 'He's a good friend of mine.'
- b. Pe ái kró-wa chor, thêbo ang pe-ne khuní-ne ajâr-go
 3SG 1SG.GEN good-NMLZ friend but 1SG 3SG-GEN hair-GEN color-ACC
 plaw-ga. (Pegâne angá pe-go pishár-a sâsti hóng-o.)
 forget-PFV therefore 1SG.DAT 3SG-ACC search-NMLZ trouble COP-NEUT
 'He's a good friend of mine, but I forgot what color his hair is. (So I'm going to have trouble searching for him.)'

This freedom of what kind of ignorance *-khi* can convey is also evident in the singleton domain examples like (36). This sentence is felicitous in a case in which the speaker knows who the Indian Prime Minister is (in the sense that she knows he is the man called Narendra Modi), but she has never met him before.

- (36) Ang shar-khí India-ne PM-go lak mán-a lí-do.
 1SG who-KHI India-GEN PM-ACC meet-INF go-IPFV
 'I'm going to meet some Indian Prime Minister.' [2016.2.80]
 ✓: The speaker hasn't met him before, but she knows he's Narendra Modi.

A similar range of ignorance effects are conveyed with the inherently singleton examples in §4.2. The pope example in (33) conveys that the speaker is unfamiliar with the pope, whether that is because she has never met him, or because she doesn't know who he is. In (34), while the speaker clearly knows the name of the country Zambia, she is otherwise completely unfamiliar with it. The generalization in all the examples is that the speaker must be ignorant about some contextually relevant property of the witness, whether that's his hair color, his name, or something else.¹⁵

For Aloni and Port (2015), this variability in kinds of speaker ignorance is central to understanding epistemic indefinites. The key observation is that what it means to identify a witness will vary in different contexts. That is, in one context it might be sufficient to be able to name the witness without knowing anything else about it, but in another it might be sufficient to describe a witness, without knowing its name. Couched in conceptual covers (Aloni, 2001), such as naming, ostension, and description, Aloni and Port's analysis is that epistemic indefinites are indefinites that are only licensed when there is a shift in the conceptual cover being used to identify the witness. This style of analysis captures a key fact of Tiwa's *-khi* indefinites: in

¹⁵Like Japanese *-ka* indefinites (Alonso-Ovalle and Shimoyama, 2014), the *wh*-base of the indefinite plays a role in the kind of ignorance that is conveyed: for inanimates, *inda-khí* "what-KHI" conveys ignorance with respect to type of the witness, while *pakhâ-khí* "which-KHI" conveys ignorance with respect to token. This seems to be independent of the variation in what counts as speaker ignorance in a given context.

most cases, *-khi* indefinites convey that the speaker cannot identify the witness by some salient property. Aloni and Port's analysis treats the epistemic component of the indefinite as a felicity condition associated with the lexical item itself. Given the data in §2 above, I propose that we treat the epistemic effects associated with *-khi* indefinites as a conversational implicature, rather than a felicity condition, but draw on Aloni and Port's insights regarding how the witness is identified in a given context.

Instead of positing a felicity condition, I suggest that ignorance with respect to a salient property of the witness is implicated by means of the choice functional nature of *-khi* indefinites. A choice function is a function that picks out an individual from a set. That choice function could reflect any property. For example, as applied to the set of my friends, it could reflect the property of having red hair. It could also reflect the property of being named Narendra Modi. Depending on the set in question, the property that will uniquely select an individual will vary: in a set otherwise of black-haired individuals, the function $\lambda x.has-red-hair(x)$ will select my red-headed friend Monbor. But in a set of red-haired individuals, a different function will be needed. In §4, I proposed that *-khi* indefinites are choice functional in order to derive their scope facts. Here, I suggest that this choice functional nature, combined with existential closure of the choice function variable, is exactly how their epistemic effects arise.

In all the cases discussed here, the speaker could have used a definite (or other referring expression) in place of a *-khi* indefinite to make a stronger statement. She did not. In using an indefinite (that is, in existentially quantifying) she already potentially implicates ignorance, to the extent that any existential quantification does (including other non-epistemic indefinites like English *a*). But the epistemic effects that *-khi* gives rise to are stronger than this sort of weak ignorance. Crucially, a *-khi* indefinite is not the only way to existentially quantify in Tiwa. Instead, the speaker could have used either a plain indefinite or a *-pha* indefinite. Consider the following sentence, repeated in part from (1) above:

- (37) a. Shar-khí phi-dom.
 who-KHI come-PST
 'Someone came.' [2017.1.81]
 b. $\exists f[CH(f) \ \& \ \text{came}(f(\text{human}))]$

Instead of uttering (37a), the speaker could have uttered either (38a) or (39a), which would have resulted in (near) equivalent truth conditions.

- (38) a. Sája líbing phi-dom.
 one.CL person come-PST
 'A person came.' [2017.1.81]
 b. $\exists x[\text{human}(x) \ \& \ \text{came}(x)]$
- (39) a. Shar-pha phi-dom.
 who-PHA come-PST
 'Some person came.' [2017.1.81]
 b. $\exists x[f(\text{human})(x) \ \& \ \text{came}(x)]$, where $|f(\text{human})| > 1$

Both these alternate strategies involve existential quantification directly over individuals. (The difference between the two, recall, is that *-pha* presupposes a non-singleton domain, while the plain indefinite has no domain requirements.) Where these alternatives involve direct existential quantification over individuals, a *-khi* indefinite involves a higher order quantification: existential quantification over choice functions that range over individuals. A listener might wonder why the speaker has chosen this indirect route, where obvious alternatives were available.

Importantly, this reasoning holds in different scope scenarios: the plain indefinite can also (but need not) take island-violating wide scope, allowing it to serve as a competitor to *-khi* indefinites in all cases. This wide scope is shown in (40) for a conditional island (compare to the *-khi* indefinite in (25) and the island-bound *-pha* indefinite in (27)).

- (40) Lastoi sája ticher-go pasé-gaidô, lí-w.
 Lastoi one.CL teacher-ACC speak-COND go-NEUT
 ‘If Lastoi talks to a teacher, she will leave.’ [2017.1.156]
 ✓: Lastoi needs to get permission from a particular teacher in order to leave school early; no other teacher can grant her permission. $\exists > \text{if}$

I suggest that the use of a choice functional indefinite explicitly highlights different ways of selecting an individual from a set. That is, invoking choice functions brings up the various possible ways of selecting the individual: it could be by name, by ostension, or even by hair color. Importantly, the speaker existentially quantifies over the choice function variable introduced by *-khi*. A sentence containing a *-khi* indefinite literally asserts that there is a way of selecting an individual from the domain such that the predicate holds of that individual. Since the speaker didn’t use a definite (or otherwise specify how the individual can be selected), this implicates ignorance about not the witness itself, but the way that the witness is to be selected.

This account crucially relies on existential quantification over the choice function variable. In §5 I contended that there is evidence independent of epistemic effects to posit this closure in Tiwa, namely, the speaker does not have to have a particular witness in mind. This contrasts with another wide scope indefinite, English *a certain*, which Kratzer (1998) analyzes as choice functional without existential closure. The behavior of *a certain* fits with this analysis: in using *a certain* the speaker does indeed seem to have a particular individual in mind. *A certain* also does not result in the kinds of ignorance effects see above for Tiwa’s *-khi* indefinites. If *-khi* indefinites do involve obligatory existential closure, while the choice function variable introduced by *a certain* is left free, these differences are straightforwardly explained.¹⁶

The epistemic effects associated with *-khi* indefinites, then, plausibly arise as a natural consequence of their narrow semantics in competition with other elements in the system. The wide range of ignorance readings is a result of the choice function variable that *-khi* introduces. This type of competition does not, however, result in a more familiar quantity implicature: both *-khi* indefinites and their more direct indefinite alternatives result in equally strong statements. Instead, the result of this competition is closer to a manner implicature.

¹⁶This suggestion is related to Schwarz’s (2001) observation that not all wide scope indefinites behave the same way, and that a unified analysis is not necessarily desirable.

6. Conclusion

In this paper, I have provided a description of Tiwa's two series of epistemic indefinites. One of these series, the *-pha* indefinites, bears an anti-singleton constraint similar to Spanish *algún* and likewise shows similar, cancelable epistemic effects. Tiwa's *-pha* indefinites thus provide cross-linguistic support for Alonso-Ovalle and Menéndez-Benito's (2010) account of how the epistemic effects of Spanish *algún* arise (i.e., that they are related to domain requirements). Tiwa's other series of epistemic indefinites, the *-khi* series, always take widest scope, and are best analyzed as introducing a choice function that is existentially closed above other operators. I suggest that the epistemic effects associated with Tiwa's wide scope indefinites arise as a direct result of this quantification over choice functions, in competition with Tiwa's other indefinites (and with stronger, definite alternatives). This account relies on the understanding that *-khi* indefinites involve a higher order quantification over functions, rather than individuals, which leads to an ignorance implicature about the way an individual can be identified. There is a close connection between this higher order ignorance implicature, and Aloni and Port's (2015) felicity conditions which involve shifts in conceptual covers.

6.1. Crosslinguistic predictions

The account of *-khi* indefinites' epistemic component sketched in §5 makes a key crosslinguistic prediction. Namely, if the epistemic effects arise as a consequence of general Gricean reasoning, we would expect to find them in any language with a sufficiently similar system. In the remainder of this conclusion, I will provide an initial evaluation of this prediction.

Choice functional analyses of wide scope indefinites have been proposed for various languages. These include English *a certain* (Kratzer, 1998), the wide scope reading of English *a* (Reinhart, 1997; Kratzer, 1998),¹⁷ St'át'imcets indefinites (Matthewson, 1999), and the Russian *-to* series (Yanovich, 2005), among others. However, not every wide scope indefinite triggers the kind of salient epistemic effects found with Tiwa's *-khi* indefinites. Among the choice functional indefinites listed here, only the Russian *-to* series has been reported to convey speaker ignorance (Kagan, 2011). I will consider each of these in turn, beginning with English, and suggest how the presence or absence of epistemic effects is compatible with the account sketched above.

First, as discussed in §5 above, if English *a certain* is choice functional, but lacks existential closure of the choice function variable (Kratzer, 1998), we expect there to be no ignorance effect. The speaker has not existentially quantified over choice functions (which implicates ignorance about the witness to that quantification), but left the variable free. As Kratzer notes, it seems sufficient in this case for the speaker to have a specific witness in mind. If this is correct, we expect *a certain* to not give rise to speaker ignorance. The situation is more complicated for the plain English indefinite *a*. Under a Kratzer-style analysis, the choice function variable that *a* introduces (when it takes exceptional wide scope) is left free. If this is the case, then again we do not expect ignorance effects. If, however, the choice function variable is existentially closed

¹⁷Reinhart (1997) analyzes all instances of English *a* as choice functional, with existential closure occurring at different levels. Kratzer treats *a* as ambiguous between a generalized quantifier and choice functional indefinite.

in these cases (Reinhart, 1997), then we might expect ignorance effects to arise. It is however possible that wide scope English *a* is not a choice functional indefinite at all, but rather, as Schwarzschild (2002) proposes, that exceptional wide scope might arise solely through domain restriction to a singleton (i.e. exceptional scope *a* still involves quantification directly over individuals). If his account is correct, then the absence of ignorance effects with wide scope *a* are expected.

In contrast to English *a certain*, St'át'imcets choice functional indefinites do seem to involve existential closure of the choice function variable (Matthewson, 1999), but do not seem to give rise to speaker ignorance effects. Matthewson does not explicitly discuss epistemic effects associated with St'át'imcets wide scope indefinites. Such effects are also not reflected in the various speaker comments associated with example sentences, or in the contexts that allow for a felicitous use of the indefinites. While this in itself does not entail that such epistemic effects are not present, it is suggestive of a difference between Tiwa's *-khi* indefinites and St'át'imcets' wide scope indefinites. Exploring the scope and other properties of Tiwa's *-khi* indefinites lead to consistent consultant commentary (independently, by multiple consultants) on their epistemic effects, to the point where *sharkhídi* "someone" [2016.2.52] was offered as a translation for the English word "stranger". Further, Matthewson discusses data that suggest that the speaker does not convey ignorance with respect to the witness in using a choice functional indefinite in St'át'imcets, as in (41).

- (41) Context: Rose goes to the store and asks the salesperson for a copy of the book *False Crow*. The salesperson gives her a book in a bag, and Rose pays for it. When she gets home, she tells her daughter:
- a. *tecwp-kán [ta púkw-a]*
 buy-1SG.SUBJ [DET book-DET]
 'I bought a book.' (Matthewson, 1999: 124)

St'át'imcets wide scope indefinites then are both choice functional with existential closure, and seem not to convey speaker ignorance with respect to the witness. This, however, does not pose a problem for the account given above for Tiwa, which is based in general Gricean reasoning, due to differences in the overall system of determiners. Specifically, Tiwa's choice functional indefinites give rise to ignorance implicatures due to competition with the plain indefinite: a generalized existential quantifier that can occur in the same environments as *-khi* indefinites. St'át'imcets lacks such a competitor: the only non-choice functional determiner (*ku*) is licensed only under negation, a modal, a conditional operator, or a question operator (Matthewson 1999). It takes obligatory narrow scope with respect to these operators, and is not licensed in a plain declarative. Consequently, St'át'imcets choice functional indefinites are never in competition with a plain indefinite.¹⁸ St'át'imcets thus provides a case of a language which has the same kind of choice functional indefinite as Tiwa (i.e. one that involves existential quantification), but does not give rise to ignorance implications due to differences in the set of competitors.

Finally, we are left with the question of whether there are languages in addition to Tiwa that

¹⁸As Matthewson (1998) argues, St'át'imcets also lacks definite determiners.

have the necessary conditions (that is, both existentially closed choice functional indefinites, and suitable competitors) that show similar effects. While in-depth further research will be necessary to determine whether this is the case, I want to conclude by discussing a possible candidate. Russian has a series of wide scope indefinite determiners (the *-to* series) that are similar to those in Tiwa: they take exceptional wide scope. Yanovich (2005) analyzes these indefinites as choice functional (specifically providing a compositional account of the internal structure of the determiners in a Hamblin semantics). He adopts a Kratzer-style analysis in which the choice function variable is left free, rather than existentially closed. While this may be the correct analysis for *-to* indefinites, it's worth noting that these indefinites do give rise to a strong sense of speaker ignorance. Kagan (2011) provides a detailed description of these ignorance effects, framing them in terms of speaker identifiability: in using a *-to* indefinite, the speaker has signaled that she cannot identify the witness. Importantly, what counts as identifiability is highly context dependent, as Kagan (2011: 60) notes: "In some cases, knowing a person's name or how the person looks is sufficient. In others, knowledge of additional details is required." Kagan provides an analysis of the ignorance effects of *-to* pronouns as a conventional implicature in terms of scope relative to quantification over possible worlds. While a more detailed comparison between Russian *-to* indefinites, Tiwa *-khi* indefinites, and the two systems as a whole remains to be done, it is possible that Russian provides another instance of a Tiwa-like wide scope epistemic indefinite.

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Counterfactual donkeys don't get high¹

Michael DEIGAN — *Yale University*

Abstract. I present data that suggest the universal entailments of counterfactual donkey sentences aren't as universal as some have claimed. I argue that this favors the strategy of attributing these entailments to a special property of the similarity ordering on worlds provided by some contexts, rather than to a semantically encoded sensitivity to assignment.

Keywords: donkey sentences, counterfactuals, conditionals, similarity, simplification.

Many indicative donkey sentences have universal entailments by default. From the truth of an utterance of (1), for instance, we can normally infer the truth of sentences like those in (2).

- (1) If Balaam owns a donkey, he beats it.
- (2) a. If Herbert is a donkey Balaam owns, Balaam beats Herbert.
b. If Eeyore is a donkey Balaam owns, Balaam beats Eeyore.
c. If Platero is a donkey Balaam owns, Balaam beats Platero.

The natural way to account for this is to give a semantics for indefinites, pronouns, and indicative conditionals on which (1) has a reading semantically equivalent to (3).

- (3) $\forall x((\text{donkey}(x) \wedge \text{Balaam-owns}(x)) \rightarrow \text{Balaam-beats}(x))$

This paper is about *counterfactual* donkey sentences, like (4).

- (4) If Balaam owned a donkey, he would beat it.

Like their indicative counterparts, such sentences seem to have universal entailments. The truth of (4), for instance, seems to entail the following:

- (5) a. If Herbert were a donkey Balaam owned, Balaam would beat Herbert.
b. If Eeyore were a donkey Balaam owned, Balaam would beat Eeyore.
c. If Platero were a donkey Balaam owned, Balaam would beat Platero.

The natural way to account for this is to give a semantics for indefinites, pronouns, and counterfactual conditionals on which (4) has a reading—a 'high' reading—which is semantically equivalent to (6).²

- (6) $\forall x((\text{donkey}(x) \wedge \text{Balaam-owns}(x)) \Box \rightarrow \text{Balaam-beats}(x))$

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²Van Rooij (2006) is the first to pursue this strategy, as far as I know, though it's similar to various attempts to give a semantics which validates simplification of disjunctive antecedents. The terminology is from Walker and Romero (2015), who follow van Rooij in this approach.

I will argue against this approach and defend the view that these entailments arise as a byproduct of a special kind of similarity ordering on worlds which the counterfactual conditional takes as an input from context. Counterfactual donkey sentences don't get high readings, but only appear to because in many contexts, the default similarity ordering is of the relevant special kind.

We will proceed as follows. In §1, I lay out the relevant background, including the semantics to be defended (based on Wang (2009)), the criticism of it made by Walker and Romero (henceforth 'WR'), and the competing kind of semantics van Rooij offers that gives counterfactual donkey sentences a high reading. In §2, I rebut WR's criticism. I argue that even the amended semantics requires the kind of special ordering which they wish to reject. This undermines WR's argument in favor of the competing account and against the original proposal. Further, I propose an account of the similarity relation which predicts the special ordering. Its tenability shows WR's argument to be unpersuasive. Finally, in §3, I criticize the accounts that *do* allow high readings. Such accounts, I claim, make incorrect predictions in cases where the antecedent is actually satisfied—and only satisfied by things for which satisfy the consequent—but where the universal entailments do not hold for merely possible antecedent satisfiers. Intuitively, such sentences have no false readings, but on a high reading they would be false. Non-high-reading accounts which get high entailments through special ordering relations make the correct prediction in these cases. High reading accounts do not.

1. Background

There are various approaches to counterfactuals, indefinites, and donkey pronouns which we might try out in dealing with counterfactual donkey sentences. I will limit the current discussion to the ordering semantics approach to counterfactuals developed by Stalnaker and Lewis³ and dynamic binding approach to indefinites and donkey pronouns based on ideas in Groenendijk and Stokhof (1991) and Groenendijk et al. (1996).⁴ This is primarily because the extant explicit discussions of counterfactual donkey sentences in the literature—van Rooij (2006); Wang (2009); Walker and Romero (2015)⁵—all use such theories.⁶ I would expect most of the central points I will make to carry over to other frameworks, but will not explore this here.

Let's start with a review of ordering semantics. The basic components are a set of possible worlds W and for each world w a 'similarity' relation \leq_w over $W \times W$. Intuitively, $w_1 \leq_{w_0} w_2$ means that w_1 is more similar to w_0 than w_2 is (in a contextually relevant and currently theoretically underdetermined sense of 'similar') We'll treat this set of similarity orderings as an element \mathcal{S} of the model, which varies depending on the context of utterance.

³See, e.g., Stalnaker (1968) and Lewis (1973).

⁴As well as Heim (1982) and Kamp (1981), though less directly.

⁵Though Walker and Romero ultimately propose, for reasons orthogonal to those discussed here, that we move to a dynamic-strict account of counterfactuals, along the lines of von Stechow (2001). Except for the occasional footnote, I will ignore this revision. Most of their discussion proceeds independently of it.

⁶Other recent work on counterfactual donkey sentences includes Walker (2017) and Carter and Goldstein (ms), and came to my attention after I had written this paper. I hope to address these accounts in future work.

As we'll see, what determines the similarity orderings, given a context, will differ from theory to theory. But like most semanticists using this framework, we will hold that it induces a partial order on W —that it is reflexive, transitive, and anti-symmetric. Further, we will assume that it is strongly centered—that for all w, w' , if $w \neq w'$, $w <_w w'$; each world is strictly closest to itself. And for ease of exposition, we will assume that similarity relations satisfy the limit assumption, which says that for any world w and non-empty proposition P , there is a w' such that $w' \in P$ and $w' \leq_w w''$ for any $w'' \in P$.⁷

We give the semantics for a counterfactual conditional in two stages, first defining a selection function f , which given a sentence and a world will return the worlds closest to the given world at which the given sentence is true. Given similarity relations and an interpretation function $\llbracket \cdot \rrbracket$ which returns a set of worlds for any sentence (namely, those worlds at which the sentence is true in the relevant model),

$$(7) \quad f(A, w) = \{w' : w \in \llbracket A \rrbracket \wedge \neg \exists w'' (w'' \in \llbracket A \rrbracket \wedge w'' <_w w')\}.$$

Now we can state the truth conditions of a counterfactual conditional as follows:

$$(8) \quad \llbracket A \Box \rightarrow C \rrbracket = \{w : \forall w' (w' \in f(A, w) \supset w \in \llbracket C \rrbracket)\}$$

In other words: $A \Box \rightarrow C$ is true at a world when all the worlds closest to it (according to the similarity relation of the context of utterance) at which A is true are worlds at which C is true.

Clearly, the meaning assigned to counterfactuals by this theory is heavily dependent on what determines the similarity orderings for a given context. To make substantive predictions about the truth-conditions of an utterance of a counterfactual, some details of how these orderings get determined must be provided.

For the moment we will follow the authors under discussion (van Rooij, Wang, WR) in relying on an intuitive notion of similarity in all respects. But throughout we should keep in mind the fact it is well known that this approach is inadequate. For the ordering semantics to get right cases like the famous one from Fine (1975), an intuitive notion of similarity will have to be replaced by something else.

- (9) a. If Nixon had pressed the button, there would have been a nuclear holocaust.
 b. If Nixon had pressed the button, the wire would miraculously malfunction.

It's easy to imagine scenarios where we want (9a) to come out true rather than (9b), even though a world where the button was pressed but the world was saved by a miraculous wire malfunction would be intuitively more similar to the evaluation world.

For a view on similarity which accounts for our judgments about this case and is closer to being tenable overall, I refer the reader to Lewis (1979), who proposes a system of weighted factors

⁷For discussion, see Lewis (1973: §§1.3–1.4, 2.3, 2.7). Strong centering for the ordering of worlds, it's worth noting, is assumed by van Rooij, Wang, and WR.

that normally go into determining similarity. Roughly, the idea is that what's most important to determining similarity is the amount of widespread violation of physical laws (the fewer miracles, the better). Overall similarity in matters of fact may matter, but only a little. This should be enough to get us going, but we'll come back to this issue in §2.1, where we introduce a new proposal about how similarity is determined.

Now we'll briefly outline the dynamic binding theory of indefinites and donkey pronouns we'll be using. It's based on Dynamic Predicate Logic (DPL), developed by Groenendijk and Stokhof (1991), and its extension in Groenendijk et al. (1996).⁸ The approach is a dynamic one, so ultimately we'll be giving meanings in terms of an update function $[\cdot]$ which applies to an input information state from the context and returns an information state as output.

To define the notion of a state, we first need to introduce assignment functions: an assignment g is a partial function from variables to elements of the domain of individuals in the model. From this we define the notion of a possibility: a possibility i is a set of world-assignment pairs. And from this we define an information state: an information state s is a set of possibilities.

Now we'll give a partial definition of the update function $[\cdot]$ for a simple interpretation language based on FOL.⁹ There are only two syntactic differences. First, the dynamic versions of the logical symbols will be marked with a \sim above them, to distinguish them from the classical variants we are using in the metalanguage, and second, $\exists x$ is a well formed formula on its own. For our purposes, the important parts of the definition of the update function are the following, where \mathcal{D} is the domain of the model, F is a predicate, and ϕ and ψ are formulas:

- (10)
- a. $s[F(x)] = \{i : i \in s \wedge w_i \in \llbracket F(g_i(x)) \rrbracket\}$
 - b. $s[\phi \wedge \psi] = s[\phi][\psi]$
 - c. $s[\exists x] = \{i : \exists j \exists d (j \in s \wedge d \in \mathcal{D} \wedge w_i = w_j \wedge g_i = g_j^{x \rightarrow d})\}$

An update with an atomic formula tests each input possibility for whether the formula is true at that possibility and preserves only those possibilities which pass the test. A conjunctive update is just the sequence of updates with each conjunct. And an existential update adds to the input possibilities a new possibility for each way an input possibility's assignment can be extended to provide the relevant variable with a value.

Now we will introduce an account of counterfactual donkey sentences which is a straightforward combination of the ordering semantics for counterfactuals and the dynamic binding account of indefinites and pronouns. Essentially, this is the proposal given in Wang (2009), except where she moves to a test semantics based on Veltman (2005), we'll stick more closely to the traditional idea of a counterfactual being truth conditional (which, in our dynamic framework, amounts to being eliminative).

⁸These ideas are closely related to the file-change semantics given in Heim (1982).

⁹We defined the update function directly, but we could have instead given interpretations of formulas as pairs of possibilities (input and output), then defined updates derivatively, as in DPL. Furthermore, I do not take the use of an interpretation language here to be crucial—it is used for convenience. Ultimately I'd prefer to give the semantics in a directly compositional way.

The basic idea is this: $A \Box \rightarrow C$ is true at a possibility iff all the nearest A -possibilities verify C . To spell this out, we need to say what it is to be a nearest A -possibility and what it is to verify C . For any formula A , j is an A -possibility for i (or $j \in /A/i$) iff $\exists k(g_k = g_i \wedge j \in \{k\}[A])$. So the world of j may be any world where A is true on the relevant variable assignment, but the assignment must be the result of updating i 's assignment by A . A possibility is a *nearest* A -possibility (to a base possibility i) iff it is in the set that results from applying the selection function f to A and i , where

$$(11) \quad f(A, i) = \{j : j \in /A/i \wedge \neg \exists k(k \in /A/i \wedge w_k <_{w_i} w_j)\}.$$

This returns the set which includes a possibility iff it is an A -possibility (relative to i) whose world is as close to the world of i as the world of any A -possibility is. A possibility i *verifies* a formula C iff $\{i\}[C] \neq \emptyset$. That is, iff updating a state containing just that possibility with C does not lead to an empty state.

Using f to collect the nearest A -possibilities, we can give a simple dynamic ordering semantics for counterfactuals as follows:

$$(12) \quad s[A \Box \rightarrow C] = \{i : i \in s \wedge \forall j(j \in f(A, i) \supset \{j\}[C] \neq \emptyset)\}$$

This is just the Stalnaker-Lewis idea carried over to the dynamic framework: it rules out input possibilities whose nearest A -possibilities do not all verify C .

Let's see an example of this proposal in action. We'll try it on (13), which we'll assume is the translation of our original counterfactual donkey sentence (4) into our interpretation language.

$$(13) \quad (\exists x \tilde{\text{donkey}}(x) \tilde{\text{Balaam-owns}}(x)) \Box \rightarrow \text{Balaam-beats}(x).$$

Suppose we have an input context $s = \{\langle w_0, g \rangle, \langle w_1, g \rangle\}$ and a model \mathcal{M}_1 with the following features:

\mathcal{I}_1	donkey	Balaam-owns	Balaam-beats
w_0	a, b		
w_1	a, b		
w_2	a, b	a, b	a, b
w_3	a, b	a, b	a

$$\mathcal{S}_1$$

$$w_0 <_{w_0} w_2 <_{w_0} w_3 <_{w_0} w_1$$

$$w_1 <_{w_1} w_3 <_{w_1} w_2 <_{w_1} w_0$$

So Balaam doesn't own donkeys in either w_0 or w_1 , but w_0 is closer to w_2 , where he owns and beats two donkeys, than it is to w_3 , where he owns two but only beats one, whereas w_1 is closer to w_3 than w_2 . The semantics of (12) predicts that in \mathcal{M}_1 , $s[(13)] = \{\langle w_0, g \rangle\}$. This is what we'd expect. An utterance of (4) should eliminate a possibility with a world like w_1 , where in the nearest world where Balaam owns some donkeys, he doesn't beat all of them. And it should keep a world like w_0 , where Balaam beats all the donkeys he owns in the nearest world where he owns any. So far, so good. But this theory runs into problems. Most—among them how to deal with 'weak' readings, modal subordination, and *might*-counterfactuals—I will have leave aside for now, as we turn to the one that will occupy us for the remainder of the paper.

1.1. The universal entailment problem

The problem I'd like to address is that on the semantics in (12), there is no high reading. It seems, then, not to have a way to predict the kind of entailments in (5).

Take a model, for instance, like the following:

\mathcal{I}_2	donkey	Balaam-owns	Balaam-beats
w_0	a, b, c		
w_1	a, b, c		
w_2	a, b, c	a, b	a, b
w_3	a, b, c	a, b, c	a

$$\mathcal{S}_2$$

$$w_0 <_{w_0} w_2 <_{w_0} w_3 <_{w_0} w_1$$

$$w_1 <_{w_1} w_3 <_{w_1} w_2 <_{w_1} w_0$$

This is like the model before, except now there's another donkey which Balaam only owns in w_3 and does not beat there. As before, in this model $\langle w_0, g \rangle$ verifies (13). But it does *not* verify (14), one of the universal entailments we would expect.

$$(14) \quad \text{donkey}(c) \wedge \text{Balaam-owns}(c) \square \rightarrow \text{Balaam-beats}(c)$$

So it doesn't verify the universalized (5), either. This semantics, then, does not have high readings. How troubled should we be by this?

The first thing to note is that we don't always want these universal entailments: some counterfactual donkey sentences seem not to have them except in special contexts, and most counterfactual donkey sentences can be put in contexts where they don't seem to have these entailments. Suppose, for example, that I could pick any number between 1 and 10, but I could only pick one number. I actually picked 4. And now I say the following:

$$(15) \quad \text{If I had picked a prime number, I would have picked 2.}$$

Certainly there is no commitment here to the truth of (16).

$$(16) \quad \text{If I had picked 7, I would have picked 2.}$$

This was noted by van Rooij and is what WR call a 'low' reading of counterfactual donkey sentences.¹⁰ And we might think that \mathcal{M}_2 and the semantics of (12) is just what we need to make sense of the following kind of argument, which includes the target counterfactual donkey sentence interpreted in a way that excludes the universal entailments.

$$(17) \quad \text{Balaam is very poor and } c \text{ is a very expensive donkey. So if he owned a donkey, he wouldn't own } c, \text{ but would only own } a \text{ and } b, \text{ who are cheap. And he would beat both } a \text{ and } b \text{ if he owned them. So if Balaam owned a donkey, he would beat it. That he wouldn't beat } c \text{ if he owned it is irrelevant.}$$

¹⁰Their accounts treat low readings in the same way as weak readings, through selective binding.

It is data like these which motivate Wang's acceptance of a semantics like (12) without high readings. But what are we to say about those cases in which the universal entailments do seem to be present? As we noted at the outset, it's pretty natural accept them when (4) is uttered without a surrounding argument like the one in (17).

1.2. The special ordering fix and WR's objection

Wang herself says nothing about how to derive these entailments. WR, however, suggest a way for an account like Wang's (and that given in (12)) to predict them in certain contexts. They observe (p. 296) that if for all the individuals in the domain, the nearest world where one individual satisfies the antecedent is no nearer than the nearest world where any other individual satisfies the antecedent, then the counterfactual donkey sentence will have the relevant universal implications. A bit more generally and formally—and this is my formulation—we get the universal entailments in contexts with a *special* similarity ordering set where

- (18) A model \mathcal{M} 's ordering set \mathcal{S} is *special* relative to an input state s iff
 $\forall i(i \in s \supset \forall j(j \in /A/i \supset \exists k(k \in f(A,i) \wedge g_j = g_k)))$.

That is, for all possibilities i in s , if j is an A -possibility for i , then among the nearest (relative to i) A -possibilities is a possibility which shares an assignment with j .

For example, in a model with the interpretation \mathcal{I}_2 and input state as before, what would the ordering set have to look like in order for it to be special? The ordering for w_0 in \mathcal{S}_3 is $w_0 <_{w_0} w_2 <_{w_0} w_3 <_{w_0} w_1$. This prevents \mathcal{S}_2 from being special, since $\langle w_0, g \rangle$ is in s and there is a possibility in $/A/\langle w_0, g \rangle$, namely $\langle w_3, g^{x \rightarrow c} \rangle$, that does not share an assignment with any possibility in $f(A, \langle w_0, g \rangle)$, which only includes $\langle w_2, g^{x \rightarrow a} \rangle$ and $\langle w_2, g^{x \rightarrow b} \rangle$. To make the ordering special, we need to adjust the ordering of worlds so that $f(A, \langle w_0, g \rangle)$ also includes a possibility whose assignment is $g^{x \rightarrow c}$. Since w_3 is the only world where c is a donkey owned by Balaam, we can only do this by making $w_3 \leq_{w_0} w_2$. For illustration, let's let the new ordering for \mathcal{S}_4 be $w_0 <_{w_0} w_2 =_{w_0} w_3 <_{w_0} w_1$. We can keep $<_{w_1}$ as before.

Now that we have a special ordering, let's see how it generates the universal entailments. The trouble we ran into before is that $\langle w_0, g \rangle$ verified (13) but not (14), repeated here as (19a) and (19b), respectively.

- (19) a. $(\exists x \tilde{\wedge} \text{donkey}(x) \tilde{\wedge} \text{Balaam-owns}(x)) \square \rightarrow \text{Balaam-beats}(x)$.
 b. $\text{donkey}(c) \tilde{\wedge} \text{Balaam-owns}(c) \square \rightarrow \text{Balaam-beats}(c)$

But now with $f(A, \langle w_0, g \rangle)$ including $\langle w_3, g^{x \rightarrow c} \rangle$, it will no longer be that $\langle w_0, g \rangle$ verifies (19a), since $\{\langle w_3, g^{x \rightarrow c} \rangle\}$ doesn't verify C . And to get an interpretation on which it *does* verify (19a), Balaam would have to beat c in w_3 .

To keep the semantics as is, we need to have a special ordering to get the universal entailments. What the simple ordering semantics + dynamic binding theory predicts, then, is that the uni-

versal entailments only arise in contexts where the similarity ordering is special. WR, however, claim to empirically falsify this prediction, and reject Wang's account on these grounds. They claim that there are contexts on which the entailments arise but on which the similarity ordering is not special. I will illustrate their point with my own case, but it's in the same spirit as the one they offer.

- (20) SCENARIO: Balaam took part in a game show which had the following format: if you win the easy first round, you win Herbert, an obnoxious and disobedient donkey. The reward for the much more difficult second and third rounds are the well-mannered and obedient donkeys Eeyore and Platero, respectively. Losing a round of the game eliminates the player, keeping them from advancing to any later rounds. Balaam was eliminated in the first round, and so remains donkeyless.

John, only aware of the game's first round, asserts our original counterfactual donkey sentence (4), repeated here as (21), since he knows about Balaam's short temper.

- (21) If Balaam owned a donkey, he would beat it.

Sarah, who has more information about the game, corrects him with (22).

- (22) No, Balaam could have won Platero or Eeyore too, and he wouldn't beat either of them if he owned them.

It is implausible, WR would contend, to claim that in this context a world where Balaam advances to and wins the third round is just as similar to the actual world as the one where he wins just the first round. But this is what we would have to say to give John's utterance a false reading which (22) can be used to disagree with.

\mathcal{I}_3	donkey	Balaam-owns	Balaam-beats	
w_0	h, e, p			\mathcal{S}_3 -Intuitive
w_1	h, e, p	h	h	$w_0 <_{w_0} w_1 <_{w_0} w_2 <_{w_0} w_3$
w_2	h, e, p	h, e	h	\mathcal{S}_3 -Special
w_3	h, e, p	h, e, p	h	$w_0 <_{w_1} w_1 =_{w_1} w_2 =_{w_1} w_3$

To get the needed universal entailments, we need \mathcal{S}_3 -Special, but it's hard to see how the ordering could be like that, rather than like the non-special \mathcal{S}_3 -Intuitive.

1.3. A semantics with high readings

WR conclude that van Rooij was right: we need to give a semantics of counterfactual donkey sentences which has a reading—the high reading—on which the universal entailments arise no matter what the similarity ordering, no special order needed.

The main innovation in van Rooij's proposal is to derive similarity orderings over possibilities out of the ones over worlds, and allow possibilities to be comparable only if they share an assignment function. We define an assignment-sensitive similarity ordering \leq^* based on the old world ordering \leq as follows.¹¹

$$(23) \quad j \leq_i^* k \text{ iff } w_j \leq_{w_i} w_k \wedge g_j = g_k$$

Now the only changes we need to the semantics is to have a selection function use this assignment-sensitive ordering rather than the ordering on worlds, and a semantics for $\square \rightarrow$ which uses the new selection function.

$$(24) \quad f^*(A, i) = \{j : j \in /A/i \wedge \neg \exists k (k \in /A/i \wedge k <_{w_i}^* j)\}$$

$$(25) \quad s[A \square \rightarrow C] = \{i : i \in s \wedge \forall j (j \in f^*(A, i) \supset \{j\}[C] \neq \emptyset)\}$$

What this new assignment-sensitive semantics does is encode the need to check for each assignment the nearest A -possibility with that assignment whether it verifies C , regardless of whether there are A -possibilities with different assignments and nearer worlds. This predicts the universal entailments regardless of the similarity ordering on worlds. And in particular, it predicts the universal entailments for (21) in scenario (20) without having to posit the supposedly implausible special ordering. Using S_3 -Intuitive, the assignment-sensitive selection function f^* will return $\{\langle w_1, g^{x \rightarrow h} \rangle, \langle w_2, g^{x \rightarrow e} \rangle, \langle w_3, g^{x \rightarrow p} \rangle\}$, which has members (namely $\langle w_2, g^{x \rightarrow e} \rangle$ and $\langle w_3, g^{x \rightarrow p} \rangle$) which do not verify $\text{Balaam-beats}(x)$. So the assignment-sensitive semantics predicts the sentence to be false in this model, as desired. And more generally, a possibility will verify a counterfactual donkey sentence iff it also verifies the universal entailments. Thus WR claim that this kind of case supports assignment-sensitive semantics like (25) over the assignment-insensitive theories like the one given in (12).¹²

2. Why we don't need the high reading

I find WR's argument for the assignment-sensitive semantics unpersuasive. As mentioned in §1, we can't always assume that the similarity ordering in the semantics of counterfactuals matches an intuitive notion of similarity. So we can't just appeal to our intuitive idea of similarity, as WR do, to rule out the special ordering in scenario (20). Later in this section I will sketch what we need to say about the similarity relation to get the special ordering in the relevant scenarios, and defend this as a tenable view. But first I will argue that even if we move to the assignment-sensitive semantics with high readings, we still need to appeal to an ordering of the special kind in scenarios just like (20) in order to correctly predict the presence of *strong* entailments.

The takeaway is that within the ordering semantics + dynamic binding framework, the move to assignment-sensitivity doesn't save us from having to appeal to a special ordering in scenarios

¹¹In van Rooij's original formulation and WR's follow-up, there's an additional condition on the similarity orderings for possibilities: for \leq_i^* to hold between j and k , it must be that $g_j = g_k \supseteq g_i$. As far as I can tell, though, this doesn't play any helpful role.

¹²It is only after they make this argument that they move, for independent reasons (based on NPI data), to a dynamic strict theory. As they present the argument discussed in this section, it is an argument in favor of van Rooij's account (more or less that of (25)) over Wang's.

like (20) anyways, so, at least in debates between those who share this framework, the proponent of assignment-*insensitive* semantics may avail herself of this ordering to generate the universal entailments we've been discussing.¹³

To make this point, we need to make a distinction between two kinds of universal entailments a counterfactual donkey sentence might have. The universal entailments we've been discussing so far, the *high* entailments, are like those we'd expect from universal quantification scoping over the whole conditional—everything is such that if it were a donkey Balaam owned, he would beat it. This is as opposed to *low* entailments, which can be true so long as the conditional is true of the thing that would satisfy the antecedent, were it to hold. The other kind of universal entailments are *strong* entailments, which are like those we'd expect from universal quantification in the consequent—if Balaam owned a donkey, he would beat every donkey he owned. This is as opposed to *weak* entailments, which do not require this. We can summarize these entailments with (partial) paraphrases:

High	Low
$\forall x((A(x) \Box \rightarrow C(x)))$	$(\exists x A(x)) \Box \rightarrow C(x)$
Strong	Weak
$\dots \Box \rightarrow \forall x(A(x) \supset C(x))$	$\dots \Box \rightarrow \exists x(A(x) \wedge C(x))$

Once we've made these distinctions, we can see first, that strong and weak can each be combined with high and low, and second, that these combinations are not equivalent with the simple high and low entailments as stated above.

	High	Low
Strong	$\forall x((A(x) \Box \rightarrow \forall y(A(y) \supset C(y))))$	$(\exists x A(x)) \Box \rightarrow \forall y(A(y) \supset C(y))$
Weak	$\forall x((A(x) \Box \rightarrow \exists y(A(y) \wedge C(y))))$	$(\exists x A(x)) \Box \rightarrow \exists y(A(y) \wedge C(y))$

What is important for us are the contrasts between high/weak, high/strong, and simple high entailments. The contrast between high/weak and the others is easy enough to see; note that in the problem case from §1.2, \mathcal{M}_3 with \mathcal{S}_3 -Intuitive, the high/weak entailments for (4) in fact hold, though the high and high/strong ones don't. The high/strong vs. high contrast is less obvious, but in the next section we'll see an example that makes it clear that they can differ.

The problem for the assignment-insensitive semantics was supposed to be that it failed to predict high entailments given an intuitive similarity ordering, and the proposed solutions were special orderings on the one hand and moving to assignment-sensitivity on the other. But while assignment-sensitivity does, on its own, get us simple high entailments, it doesn't get us high/strong entailments. It turns out that to get high/strong entailments, the assignment-sensitive semantics also needs to use special orderings. But the special orderings can get us the high/strong entailments without assignment-sensitivity. So if we want high/strong entailments,

¹³Actually, this is a bit stronger conclusion than is warranted. Perhaps there are other semantic theories which still make use of this framework, but work out the details in a different way. And perhaps there could be some reasonably non-ad hoc such theory that is assignment-sensitive and gets both high and strong readings.

rather than just high entailments, it seems that we're going to need to appeal to special orderings. Let's illustrate this point with a case for which we need high/strong, and not merely high, entailments.

- (26) SCENARIO: Cory, who is donkeyless, is a bit crazy. He's disposed to take out his anger on his most prized possession. He also took part in the game show described in (20), but also lost in the first round. Had he won any rounds, the prize from the most advanced round he won would have become his prized possession, and he would have beaten it, but he wouldn't beat anything else.

Now consider the following:

- (27) If Cory owned a donkey, he would beat it.

In this scenario, the salient reading of (27) seems false. And it seems false because the relevant high/strong entailments don't hold. If Cory had owned Eeyore, for example, it wouldn't be true that he would beat every donkey he owned. But note that all of the high entailments *do* hold. If Cory owned Herbert, he would beat Herbert; if he owned Eeyore, he would beat Eeyore; and if he owned Platero, he would beat Platero. So, first point from this example: high/strong \neq high.

The structure of this scenario is very similar to that of scenario (20). Again we can consider models with the intuitive ordering and a corresponding special ordering

\mathcal{I}_4	donkey	Cory-owns	Cory-beats	
w_0	h, e, p			\mathcal{S}_4 -Intuitive
w_1	h, e, p	h	h	$w_0 <_{w_0} w_1 <_{w_0} w_2 <_{w_0} w_3$
w_2	h, e, p	h, e	e	\mathcal{S}_4 -Special
w_3	h, e, p	h, e, p	p	$w_0 <_{w_1} w_1 =_{w_1} w_2 =_{w_1} w_3$

Second point from this example: to get the desired high/strong entailments, both the assignment-insensitive semantics in (12) and the revised, assignment-sensitive semantics from (25) need to use a special ordering, such as \mathcal{S}_4 -Special. Using \mathcal{S}_4 -Intuitive, the assignment insensitive f will return $\{\langle w_1, g^{x \rightarrow h} \rangle\}$, and the assignment-sensitive f^* will return $\{\langle w_1, g^{x \rightarrow h} \rangle, \langle w_2, g^{x \rightarrow e} \rangle, \langle w_3, g^{x \rightarrow p} \rangle\}$. In either case, all of the selected possibilities verify Cory-beats(x), yielding the prediction that the counterfactual is true on either semantics. So no high/strong entailments either way.

But when we move to \mathcal{S}_4 -Special, both selection functions will return $\{\langle w, h \rangle : w \in \{w_1, w_2, w_3\} \wedge h \in \{g^{x \rightarrow h}, g^{x \rightarrow e}, g^{x \rightarrow p}\}\}$, predicting a *false* reading given \mathcal{I}_4 , and more generally a false reading unless the strong/high entailments also hold.

Just as with the case in §1.2, the special ordering is what we need to get the right prediction for the assignment-insensitive semantics, despite the special ordering not matching the intuitive one for the scenario. But now this is also what we need to make the right prediction for the assignment-sensitive semantics as well. The move to assignment-sensitivity, then, doesn't keep

us from needing to appeal to special orderings in these sorts of scenarios. This undermines WR's argument for assignment-sensitivity on the grounds that it does avoid such appeals.

2.1. Why the special ordering?

Perhaps, though, what we should conclude from this not that WR's argument doesn't refute the assignment-insensitive semantics, but that it *also* refutes the assignment-sensitive semantics, and that a more radical revision is required.¹⁴ We should require a high/strong reading, one that predicts these entailments even without a special ordering.

In this section I want to briefly defend the view that we need not make such a move—that using the special ordering even in the scenario is not particularly implausible. I do so by outlining a proposal about the similarity relation which will predict special orderings in the relevant contexts. This will not yet give us an argument against accounts which get the entailments through a high/strong reading instead of through the special ordering; that argument will come in §3.

What makes one world closer than another to an evaluation world? As discussed in §1, the answer can't simply be that considering all the facts in these worlds, it is more intuitively similar than the other is. For the same reason, it can't be that it has some greater amount (by some measure) of overlap in facts, where all facts count the same. Facts of some kinds count more heavily in determining (dis)similarity than others.

However, proposals like Lewis's (as well as others in the same spirit) to weigh differences in certain kinds of fact more heavily than others won't predict the special ordering in all the cases we would need special orderings for. We may assume that it takes more widespread miracles and less perfect match of particular facts with the evaluation world for Balaam or Cory to win two or three rounds of the game than it would for them to win just one. We should say, then, what an account of the similarity relation would have to look like to get the special orderings when we need them.

Here is my suggested amendment: we start with some standard account, such as Lewis's, for determining similarity. Then we allow the similarity orderings to be affected by the antecedent of an asserted counterfactual. In particular, we say that for each of the salient ways the antecedent might be made true, how it is made true in a given world is irrelevant to determining similarity.¹⁵ When determining similarity between two worlds, we look for violations of law, amount of mismatch in particular fact, and so on, *except in the parts of the world that are involved in making the antecedent true.*

¹⁴I suspect WR would be sympathetic to this extension of their argument, since their independently motivated move to a dynamic strict account avoids the problem with high/strong entailments. Their account predicts these, rather than the merely high entailments that they claim it does.

¹⁵Regarding 'making true', I have in mind something along the lines of Fine's notion of exact truthmaking (see Fine (2017)). 'Salient' is, as it often is, left vague and underdeveloped. Investigating what account of salience gets us the best results for this proposal would be a worthwhile undertaking, but not one I can pursue here.

This will typically result in special orderings for counterfactuals with indefinites in the antecedent. If the reason that the world where Cory owns Eeyore and Platero as well as Herbert was farther from the evaluation world than the one where he owns just Herbert is that it takes more widespread miracles for him to own all three than it does to just own Herbert, then these worlds will be brought to the same degree of similarity by my proposal, since it tells us to ignore the differences involved in the salient ways of making it true that Cory owns a donkey, and his owning the three donkeys is one salient way of owning a donkey and his owning just Herbert is another.

We need not take this proposal to be entirely ad hoc, since it extends beyond counterfactuals with indefinites in the antecedent to any counterfactual with an antecedent that has more than one salient alternative way which might make it true. This gives us nice results both for counterfactuals with disjunctive antecedents as well as other unspecific antecedents.

Since asserting counterfactuals with disjunctive antecedents presumably makes salient the possibility of either disjunct making the antecedent true, our proposal tells us that which disjunct is true (and what goes into making it true) is irrelevant to similarity, regardless of differences in amount of miracles required to make each true. Thus, we'd expect the conjunctive implications from counterfactuals with disjunctive antecedents in the cases that motivate acceptance of simplification of disjunctive antecedents. For instance, we would expect to be able to infer (28b) from (28a) in the example from Nute (1975), since according to my proposal there should be worlds where the sun grows cold that are just as similar to the actual world as any world where we have good weather.

- (28) a. If we were to have good weather this summer or if the sun were to grow cold before the end of the summer, we would have a bumper crop.
 b. If the sun were to grow cold before the end of the summer, we would have a bumper crop.

For a case without disjunction or an indefinite, but with multiple salient ways of making the antecedent true, consider this example from Bennett (2003: 219–220), who attributes the idea to John Pollock as reported by Nute (1980: 104).

- (29) SCENARIO: My coat was not stolen from the restaurant where I left it. There were two chances for theft—two times when relevant indeterminacies or small miracles could have done the trick. They would have involved different potential thieves; and the candidate for the later theft is a rogue who always sells his stuff to a pawnbroker named Fence.
 (30) If my coat had been stolen from the restaurant, it would now be in Fence's shop.

Our first reaction is that in this scenario this counterfactual is false, or at least unassertable, since it might have been stolen by the earlier thief. But a straightforward application of a proposal like Lewis's predicts that it would be true, since the later theft would involve a larger region of perfect match of particular fact. With my proposal, though, we ignore this difference in fact-matching, since they're involved in salient ways of making the antecedent true. This

means that there will be among the closet worlds worlds where the earlier thief steals my coat and worlds where the later thief steals it. We thus predict (30) to be false. We get a similar desirable result if we modify the example to let one of the salient possible thefts involve a bigger miracle, rather than just an earlier one. And having seen this pattern, examples can be easily multiplied.

These seem like attractive results. However, the proposal won't work for all cases. As is well known from work on disjunctive antecedents, and as we noted in §1, there are exceptions to these patterns. In some contexts, apparently it *does* matter how the antecedent is made true.

- (31) a. If Spain had joined the Allies or the Axis, they would have joined the Axis.
b. If Spain had joined a side, it would have been the Axis.

I assume that in these cases the alternative of joining the Allied side will be salient in whatever sense of salience we need for the special ordering. But for them to be true, as they plausibly are, we can't have worlds where Spain joins the Allies rather than the Axis as among the closest worlds where the antecedents are true.

In addition, even for sentences which have high entailments by default, we can construct contexts in which these entailments do not arise.

- (32) If Balaam had won any rounds, he would have won just the first one. So if he had owned a donkey, he would have only owned Herbert. And if he had owned Herbert, he would have beat him. So if he owned a donkey, he would beat it.

In this context, the sentence seems true, even though the high entailments still fail to hold. So not only do we need an account that is sometimes indifferent to antecedent truthmaker, we also need one that is sometimes *not* indifferent.¹⁶ How similarity is determined, then, depends on whether the utterance is in an antecedent-truthmaker-relevant or -irrelevant context. Ultimately we'll want an account of what makes a context one way or the other, and what unified account of similarity, if any, underlies them. But for now we'll just accept that there are these two types of orderings, and one type—the antecedent-truthmaker-irrelevant—typically leads to special orderings for counterfactual donkey sentences.¹⁷

¹⁶Alternatively, we might try to capture these differences as differences in 'salience' of alternatives, a suggestion made to me by Kyle Blumberg. As much of a black box as it currently is, we might be able to construe 'salience' in a way that allows for this. However, it won't be easy, since to get the identificatory disjunctive antecedent cases right, we'd have to say that these antecedents don't make both disjuncts salient.

¹⁷This bifurcated account is somewhat like the orderings that would be required to make sense of backtracking as well as non-backtracking counterfactuals.

- (i) a. If he jumped, he would have died.
b. He wouldn't have jumped unless there was a net. So if he had jumped there'd be a net there to save him and he wouldn't have died.

Indeed, it's not so far-fetched to think that non-backtracking and antecedent alternative indifference on the one hand, and backtracking and antecedent alternative sensitivity on the other are instances of the same phenomenon. Perhaps backtracking counterfactuals are those which the truthmaker of the antecedent is relevant to similarity, on a construal of truthmaker which includes causal origins.

This is only a sketch of an account, but it seems to me not an obvious dead-end. For WR's argument to succeed, we would need to show that nothing along these lines of determining similarity could work, since we would need to rule out special orderings in the relevant cases. So until that's done, we should take the assignment-insensitive semantics with special orderings to be a viable account of counterfactual donkey sentences with high entailments.

Before proceeding to the final section, I wish to point out one consequence of the current special ordering-based account. If, as I think we should, we still require the similarity relation to be strongly centered, even in the antecedent-truthmaker-irrelevant contexts, we will not always be able to produce a special ordering, and so won't be able to generate high entailments. This is because in some cases, the antecedent will be true *in the evaluation world*. Since the evaluation world will be strictly closer to itself than any other world is, worlds with different ways of making the antecedent true will not be as close, preventing a special ordering. In these cases, on the assignment-insensitive ordering semantics, we shouldn't expect high entailments.¹⁸ This prediction differs from that of accounts which would allow for high (or high/strong) readings. On such views, we should expect there to be high entailments in some of these cases, since the high entailments are not dependent in any way on the similarity ordering of worlds.

I will argue that on this point, the assignment-insensitive ordering semantics make the correct predictions and accounts with high (or high/strong) readings make incorrect ones. There are no high entailments when the antecedent is true.

3. Why we don't want the high reading

Before looking at a case where the predictions of the different accounts come apart, I'd like to make an observation about what is involved in high entailments. We've been putting them in terms of a universal quantifier, ranging over a domain given in the model, implicitly assumed to be restricted by the context.¹⁹ But we've glossed over what exactly this amounts to by only looking at cases where what exists does not vary from world to world.²⁰ Once we start to look at scenarios where this assumption is dropped, we need to ask whether the outermost \forall used to state what the high entailments are is meant to range over just those things that exist in the world of evaluation, or rather whether it includes merely possible entities as well. In other words, we need to ask whether this is an actualist or possibilist quantifier.

I think it's clear enough how this question is to be answered. Suppose Allie and Bert think Mary the potter probably didn't make anything yesterday. And now Allie says the following:

¹⁸Why don't we give up strong centering for these cases? After all, if the only difference between the evaluation world and some other one is how the antecedent is made true, we might expect them to be equally similar to the evaluation world. This is worth considering, but the data in the next section suggest we should not do so.

¹⁹Most likely it's a bad idea to put this contextual restriction in the models themselves, rather than, say, putting domain variables in the syntax. See Stanley and Szabó (2000). Incidentally, we might want our similarity orderings not to be just given in the models either, but at least partly determined through something syntactically present. One proposal for how to do this is made in Arregui (2009).

²⁰And in particular where the extension of the restrictor of the antecedent's indefinite (in the cases we've looked at: what is a donkey) doesn't vary from world to world.

(33) If Mary had made a vase, she would have made it from glass.

Now consider:

Case 1: Mary didn't make any vases, and there is no contextually relevant actual pottery.

In this case, (33) does not come out trivially true or give rise to presupposition failure. Nor does it depend on looking at various non-pottery that exists in the world (the high entailment need not imply, for example, that if Mary were a vase that she made, she would have made herself from glass). Instead, what goes into determining the truth or falsity of (33) in Case 1 are some merely possible vases and their composition in worlds where Mary made them—the quantifier in question is a possibilist one. So if there are high readings of counterfactual donkey sentences, they require that all relevant possible entities are such that, in the closest worlds where they satisfy the antecedent, they satisfy the consequent.

With this in mind, let's return to the different predictions made by the special ordering and the high reading accounts of high entailments. If there are high readings, we should expect high entailments even when the antecedent is true in the evaluation world, and we've now seen that this requirement extends to merely possible entities. If high entailments come from a special similarity ordering, we shouldn't expect them to arise when the antecedent is true in the evaluation world, since in such cases there can be no special ordering without violation of strong centering.

Let's look a case, then, where some contextually relevant actual entity satisfies the antecedent and consequent but a merely possible one doesn't satisfy the consequent in the nearest world where it satisfies the antecedent. Suppose the conversation between Allie and Bert continues:

- (34) a. *Bert:* No, she could have made it from clay!
 b. *Allie:* Oh, I didn't know she had any clay left, nevermind what I just said, then.

So here Bert raises a relevant possible way for the antecedent to be made true that wouldn't lead to the truth of the consequent, which gets Allie to retract her claim. This is just what we'd expect on a high reading. But now suppose that it turns out that Mary in fact *did* make some vases yesterday.²¹

Case 2: Mary made two vases, both of glass.

In this case it seems that Allie's utterance of (33) was true, if only by luck. And the fact that Mary could have made a different vase and she would not have made that one from glass has no

²¹One might worry that this would make the original assertion infelicitous or at least difficult to evaluate, since counterfactuals generally presuppose the falsehood of their antecedent. But there are well known exceptions to this generalization, such as the famous case from Anderson (1951): "If Jones had taken arsenic, he would have shown just exactly those symptoms which he does in fact show." That Allie and Bert are unaware at the time of utterance that the antecedent is true, but are also not certain that it's false, should make it clear enough that nothing too strange is going on here.

bearing on its truth. Once the facts about what Mary actually made are known to Allie and Bert, challenging the original assertion again by raising the possibility of the clay vase is bizarre.

- (35) a. *Allie*: Looks like I was right after all.
 b. *Bert*: ??No, even though she *didn't* make any clay vase, she still *could* have made a vase from clay, and she wouldn't have made *that* from glass.

So it seems that in this case, any available reading of (33) is true, regardless of the possibility Bert raises. The high entailments seem not to arise in this case. This is just as the special ordering (with strong centering) account predicts. And it's not predicted by accounts which allow high readings. Where there are high entailments, I conclude, we should take them to be due to a special ordering rather than being baked in semantically, through a high reading.

There are a couple objections we should address. First, the proponents of high readings—van Rooij and WR—allow that in some contexts there are low (or for them, low/weak) readings. Why not think this is what's happening here? Two reasons. First, because their method for obtaining low readings guarantees weak readings. But the salient reading of (33) is not weak. Consider:

Case 3: Mary made one vase of glass and one of clay.

Here we would take (33) to be false, even though it would be true in Case 2. But on a weak reading, it would also be true in Case 3.

Second, this utterance seems like it has high entailments in the evaluation worlds where the antecedent is not true (like in Case 1). This is why Allie retracts her assertion once the possible clay vase is brought to her attention—for all she knows, she and Bert are in a world where Mary made no vases, and in such a world her assertion, if it had high entailments, would be false. It's difficult to see how an account with high readings would treat this utterance as having a high reading in Case 1, but a low reading in Case 2.

The other objection is that the merely possible clay vase gets ignored due to quantifier domain restriction. To evaluate this properly, it would be important to spell out what the account of domain restriction would have to look like to get this right. But there is some reason ahead of time to doubt that it would work, given our judgments of the other cases. A possible clay vase needs to be in the domain to make Bert's original interjection true, and it seems that it is deemed relevant by both Bert and Allie to Allie's claim. So we would need to have an account which does not exclude this possible vase through quantifier domain restriction when it should be included—Case 1, for example—and exclude it when there happens to be actual vases that Mary made. I don't know how this could be done in a way that's not implausibly ad hoc.

It could be that either of these or some other objection could be worked out together with an account with high (or better, high/strong) readings that treats the above cases successfully. But given the difficulties that would seem to involve, and the fact that the data in this section is just what the special ordering account predicts, I tentatively conclude that counterfactual

donkey sentences do not get high readings, but instead get their occasional high entailments from special orderings.

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Focus on what's not at issue: Gestures, presuppositions, appositives under contrastive focus¹

Maria ESIPOVA — *New York University*

Abstract. This paper is an attempt to systematically investigate how contrastive focus interacts with various types of not-at-issue content (co-speech and post-speech gestures, lexical presuppositions, and appositives). I look, in particular, at when focus forces at-issue interpretations of typically not-at-issue content, when it does not, and when such at-issue interpretations are impossible even to satisfy focus-related requirements. I conclude that the main factors affecting how a given type of content aligns along these dimensions are its prosodic (in)dependence and level of attachment in the syntax. The two factors also interact in a non-trivial way, in particular for gestures, which I use as a basis for an analysis of gestures that does not assume that their temporal alignment directly determines their semantics (contra Ebert and Ebert, 2014; Ebert, 2017; Schlenker, 2018), but instead relies on syntax/semantics and syntax/prosody interaction.

Keywords: focus, not-at-issue content, gestures, presuppositions, appositives.

1. Introduction

Contrastive focus has been observed to affect presupposition projection (Abusch, 2002; Simons et al., 2017, a.o.). For example, (1) typically gives rise to a global inference, triggered by *stop*, that Umbridge used to drink firewhisky, but (2) does not give rise to any global inferences about her previous drinking habits, despite the presence of the presupposition triggers *stop* and *start*.

- (1) Umbridge might have stopped drinking firewhisky.
→ Umbridge used to drink firewhisky.
- (2) *Context: The faculty at Hogwarts have to report to Madam Pomfrey whenever they significantly change their drinking habits. Ron knows that Umbridge has filed such a report, but he doesn't know how exactly her habits have changed; he says:*
Umbridge might have **stopped** drinking firewhisky, but she also might have **started** doing so.
↯ Umbridge used {to drink, to not drink} firewhisky.

Standard theories of presupposition projection (e.g., Heim, 1983; Schlenker, 2009) can handle examples like (2) by resorting to *local accommodation*, which is a process of making a presupposition part of the at-issue content by treating it as a conjunct at the level at which it is triggered. For example, applying local accommodation in (2) makes it roughly equivalent to:

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- (3) Umbridge might have used to drink firewhisky and stopped, but she also might have used to not drink firewhisky and started.

A similar observation can be made for inferences triggered by *co-speech gestures*, i.e., content-bearing, non-conventionalized gestural adjuncts co-occurring with verbal expressions they adjoin to. Such inferences typically project from embedded environments (Ebert and Ebert, 2014; Ebert, 2017; Schlenker, 2018; see also Tieu et al., 2017a, b for some experimental evidence):

- (4) *Context: The Yule ball at Hogwarts is tomorrow.*

If Hagrid brings a dog^{LARGE} , it's gonna be a mess.
→ If Hagrid brings a dog, it will be a large one.²

The status of the inference in (4) is a matter of debate. Ebert (and Ebert) (2014; 2017) claim it is a Pottsian (2005) supplement, and Schlenker (2018) argues it is a special kind of presupposition. The two analyses make very similar predictions for (4). However, contrastive focus can sometimes force co-speech gestures to be interpreted as at-issue restrictive modifiers:³

- (5) If Hagrid brings a dog^{SMALL} , it's gonna be OK,

but if he brings a dog^{LARGE} , it's gonna be a mess.
↗ If Hagrid brings a dog, it will be a {small, large} one.
≈ If Hagrid brings a **small** dog... but if he brings a **large** dog...

At first glance, the parallel between (2) and (5) could be used as an argument in favor of the presuppositional analysis of co-speech gestures, but the empirical picture turns out to be more complicated. This paper is an attempt (to my knowledge, the first one) to systematically investigate the interaction of contrastive focus with different types of not-at-issue content and explain the observed differences in a principled way. I look at when focus-related considerations force at-issue interpretations of typically not-at-issue content and when they do not. I also show that, in some cases, at-issue interpretations are unavailable even when that would be the only way

²For those unfamiliar with 'Harry Potter' lore, Hagrid is a half-giant with a fondness for large animals, so this inference is quite natural.

³The first discussion of examples like (i) I am aware of is due to Rob Pasternak (p.c.), but such examples can be in principle analyzed via metalinguistic negation, which targets the form and not the content. In this paper I try to look at examples that are unlikely to involve metalinguistic uses of expressions containing projective content.

- (i) I don't want a beer^{SMALL} , I want a beer^{LARGE} !

to make contrast felicitous. The data suggest that two major factors affecting the focus-related behavior of a given type of not-at-issue content are whether it is prosodically independent and where it attaches in the syntax. With this in mind, I sketch an analysis of gestures that relies on both those factors, thus diverging from both Ebert's and Schlenker's accounts.

The rest of the paper is organized as follows. In Section 2 I clarify my notation, terminology, and data elicitation practice. In Section 3 I explore when contrastive focus forces at-issue interpretations of typically not-at-issue content, when it does not, and when even contrast requirements cannot force such interpretations. In Section 4 I discuss the issues those data pose for Ebert's and Schlenker's analyses of gestures and propose an alternative. Section 5 concludes.

2. Notation, terminology, and data elicitation

I adopt the following notational conventions in this paper:

- In 'verbal expression^{GESTURE}' the gesture co-occurs with the verbal expression (the underlining loosely indicates temporal alignment of the gesture, without any syntactic claims).
- In 'verbal expression — GESTURE' the gesture follows the verbal expression.
- New gestures are illustrated by pictures.
- A **word** written in bold indicates prosodic (contrastive) focus marking: primarily (L+)H* pitch accent in ToBI terms (Beckman and Ayers, 1997) on the stressed syllable of the bolded word for verbal content, and kinetic emphasis for standalone gestures.
- A *word* written in italics in examples indicates prosodic contrastive topic marking: (L+)H* or L*+H pitch accent on the stressed syllable of the italicized word. Note that it is very hard, if not impossible, to distinguish between contrastive topic and contrastive focus prosodic marking in isolation. The choice of marking is thus informed by the semantic considerations.
- [...]_F marks semantic focus whenever it is relevant.
- (IP...) marks intonational phrases (IPs) in ToBI terms whenever it is relevant.

Throughout the paper I will use the term *not-at-issue* to talk about content that projects from embedded environments all the way to the global context, such as the presupposition in (1) or the gestural inference in (4). I will use the term *at-issue* to talk about content that does not project at all, i.e., is interpreted under the lowest operator under which it is embedded, as in (2) or (5). Thus, for the purposes of this paper I do not care, in particular, whether a given piece of content can be directly negated in the discourse. For example, it has been shown in Syrett and Koev, 2014 that utterance-final appositive relative clauses (ARCs), as in (6) (adopted from Syrett and Koev, 2014; crucially, the original example does not contain negation), can be relatively easily targeted by direct negation in the discourse. For me the content of the ARC in A's utterance in (6) is still not-at-issue, since it projects from under negation.

- (6) A: The symphony didn't hire my friend Sophie, who is a classical violinist.
 → Sophie is a classical violinist.
 B: That's not true! Sophie isn't a classical violinist.

As for the term *local accommodation*, while it was originally coined for presuppositions, I will use it to talk about treating any type of typically not-at-issue content as a conjunct at the

local syntactic level. For presuppositions that is the level at which the trigger is merged; for appositives and gestures that would be the level at which they adjoin in the narrow syntax.


Finally, the data reported in this paper are based on introspective judgements of native speakers of English (all linguists); for each example judgements were elicited from at least three speakers (for most examples the number of speakers is more than five). Any variation or uncertainty in judgements is reported.

3. When contrastive forces local accommodation, when it does not, and when it cannot

3.1. Contradictory inferences

We have already seen one case of at-issue interpretations of typically not-at-issue content under contrastive focus in (2) for lexical presuppositions and in (5) for adnominal co-speech gestures; (7) illustrates the same case for adverbial co-speech gestures.

(7) If Hermione stirs her potion^{CLOCKWISE} , it will turn blue,

but if she stirs her potion^{COUNTERCLOCKWISE} , it will turn green.⁴

↗ If Hermione stirs her potion, she'll do so {clockwise, counterclockwise}.

Such examples can be accounted for without any sophisticated theory of interaction of not-at-issue content with focus. Projecting an inference p globally means imposing a requirement on the context set that it entail p . In each of the examples above, the two inferences p and q that would normally project contradict each other. Since no context set can entail a contradiction, it cannot be the case that both p and q project. Technically, locally accommodating only one of the inferences in each case should suffice to avoid the contradiction, but this should be ruled out via further pragmatic reasoning on what the speaker believes to be possible (à la Gazdar's, 1979 clausal implicatures or any alternative). For example, in (5) and (7), projecting one of the contradictory inferences and accommodating the other would render one of the antecedents false, but it is odd to utter a conditional whose antecedent the speaker believes to be false.

The reasoning above applies regardless of the type of focus involved or what the focus alternatives are. However, when the inferences contributed by the not-at-issue expressions within an utterance are not contradictory, the type of focus and the nature of the alternatives do matter for whether a given content ends up projecting. The next two subsections review such cases.

⁴I believe, when they are not contrasted with each other, the CLOCKWISE and COUNTERCLOCKWISE gestures do not necessarily give rise to any inferences about the directionality of movement, but in a context when the directionality is the only locus of contrast, it naturally has to be interpreted maximally iconically.

3.2. Contrastive topic + focus configuration

Oftentimes the content semantically in focus has to address the question under discussion (QUD; in the sense of Roberts, 2012, a.o.) and thus is inevitably at-issue, as opposed to backgrounded. This is the case, in particular, within a contrastive topic + focus (CT+F) configuration (in the sense of Büring, 2003, a.o.). Consider, for instance, the following pair of examples:

- (8) a. *Hermione* petted **Buckbeak**, and *Luna* petted **Fang**.⁵
 QUD: Who petted whom?
 sub-QUDs: Who did Hermione pet? Who did Luna pet?
- b. *Hermione* **petted** Buckbeak, and *Luna* **fed** Buckbeak.
 QUD: Who did what to Buckbeak?
 sub-QUDs: What did Hermione do to Buckbeak? What did Luna do to Buckbeak?

In (8a), the part of content that specifies that it was Buckbeak who Hermione petted is new information addressing the immediate sub-QUD and thus cannot possibly be presupposed; that Hermione petted someone might very well be (perhaps weakly) presupposed (the same is true, *mutatis mutandis*, about Fang and Luna). In (8b), what is at-issue is what the girls did to Buckbeak; that they did something to Buckbeak might, once again, be presupposed.

Now, let us turn to perhaps less obvious CT+F examples with co-speech gestures:

- (9) *Context (applies to all animal fighting examples): At Hogwarts, when a small animal and a large animal find themselves in the same room, they usually fight.*
 If *Flitwick* brings a **dog**^{[SMALL]_F}, and *Hagrid* brings a **dog**^{[LARGE]_F}, they'll fight.⁶
 ↗ If {*Flitwick*, *Hagrid*} brings a dog, it will be a {small, large} one.
 ≈ If *Flitwick* brings a **small dog**, and *Hagrid* brings a **large dog**...
- (10) If *Hermione* **stirs** her potion^{[CLOCKWISE]_F},
 and *Luna* **stirs** her potion^{[COUNTERCLOCKWISE]_F}, there will be an explosion.
 ↗ If {*Hermione*, *Luna*} stirs her potion, she'll do so {clockwise, counterclockwise}.
 ≈ If *Hermione* stirs her potion **clockwise**, and *Luna* stirs her potion **counterclockwise**...

The gestural inferences in the two examples above do not project, even though the two gestural inferences in either example do not contradict each other, so the simple reasoning described in the previous subsection is insufficient to account for their non-projection. Instead, the gestures in the examples above behave like ordinary modifiers under focus in a CT+F configuration, i.e., the prosodic prominence co-occurring with each word-gesture pair signals semantic focus on the gesture rather than on the verbal expression. Intuitively, the reason why prominence has to associate with the gestures in both examples is because the verbal content of the two items under prominence in each example is non-contrastive, and there is a general requirement for all F-items within a CT+F coordinated structure to contrast with each other:

⁵Buckbeak is a hippogriff, and Fang is a dog.

⁶Flitwick is a part-goblin and thus very short, so the inference that if he brings a dog to the Yule ball, it will be a small one would be a natural one.

- (11) #*Hermione* petted **Buckbeak**, and *Luna* petted **Buckbeak**.

At this point I will not offer a comprehensive story about what it means for two expressions to be contrastive (but see, e.g., Katzir, 2014 for a discussion). For the purposes of this paper, let us assume the—invariably simplified—view that for any two expressions α and β of the same semantic type ending in t , α and β are properly contrastive if neither entails the other (assuming generalized entailment), and α and β of type e are contrastive if $\llbracket \alpha \rrbracket \neq \llbracket \beta \rrbracket$. Similarly, I will not engage in a discussion about the nature and status of this contrast requirement on F-items in CT+F coordinated structures. I will just assume that it holds, at least in the examples above (but see van Rooij, 2010; Büring, 2016 for a potentially relevant discussion).

One could try to rebut the contrast-based intuition above by arguing that the gestures in (9) and (10) give rise to more general inferences; e.g., *a dog*^{SMALL} in *Hagrid brings a dog*^{SMALL} does not give rise to an inference about the size of a dog Hagrid would bring but rather about the size of dogs in general. If that is the case, then the inferences of *a dog*^{SMALL} and *a dog*^{LARGE} would be contradictory, and thus the reasoning from the previous subsection could derive non-projection in (9) without appealing to any focus-related considerations. To use the same argument for (10), one would have to assume that the gestures in (10) necessarily attach to the verb *stirs* rather than the whole VP *stirs her potion*, since the two VPs do not have the same semantics due to the different indices on the pronouns. This reasoning would predict that mere co-occurrence of mutually exclusive gestures with the same predicate within one utterance should force non-projection. However, this prediction is not borne out; once we remove prominence from the word-gesture pairs, either by getting rid of the CT+F configuration altogether or by making something else the F-items, the gestural inferences can project:

- (12) If **Flitwick** brings *a dog*^{SMALL}, and **Hagrid**(, too,) brings *a dog*^{LARGE}, they'll fight.
→ If ⟨Flitwick, Hagrid⟩ brings a dog, it will be a ⟨small, large⟩ one.
- (13) If *Hermione* stirs **her** *potion*^{CLOCKWISE},
and *Luna* stirs **her** *potion*^{COUNTERCLOCKWISE}, there will be an explosion.
→ If ⟨Hermione, Luna⟩ stirs her potion, she'll do so ⟨clockwise, counterclockwise⟩.⁷
(A sample context: Hermione and Luna are brewing potions next to each other; Hermione's potion requires stirring clockwise, and Luna's potion requires stirring counterclockwise; stirring two nearby potions in different directions causes an explosion.)

This observation suggests that even if gestures can give rise to generic inferences about predicates, more narrow inferences are certainly also possible.




Furthermore, one could speculate that focus-marking prosodic prominence co-occurring with a gesture always makes it at-issue, without any additional contrast considerations. This, however, is not the case either. Once we make the verbal content of the word-gesture pairs under focus-marking prominence within a CT+F coordinated structure contrastive, as in (14), the prominence can associate with the verbal content. Co-speech gestures do not like to be at-

⁷With the caveat that the contrast between the two gestures might be interpreted as an inconsistency in the default stirring gesture (see fn. 4), in which case the direction of movement would not be interpreted iconically.

issue unless under pressure, so the prominence will in fact preferably associate with the verbal content, thus, no longer forcing the gestures to be at-issue.⁸

- (14) If *Hagrid* brings a [dog]_F^{LARGE}, and *Filch* brings a [cat]_F^{SMALL}, they'll fight.
 → If ⟨Hagrid, Filch⟩ brings a ⟨dog, cat⟩, it will be ⟨large, small⟩.⁹

Here is also a naturally occurring example of this configuration produced by a Parisian guide:

- (15) If you're going for a coffee^{SMALL}  ... You know, if you're going for
a real coffee^{SMALL} , not a Starbucks coffee^{LARGE}  ...
 → ⟨Real, Starbucks⟩ coffees are ⟨small, large⟩.

So, as an intermediate summary: when a prosodically F-marked element within a CT+F coordinated structure is a word-gesture pair, the at-issue interpretation of the gesture is only forced when the verbal content in that pair does not properly contrast with the other F-items.

Now, does the same generalization apply to lexical presuppositions? One problem is that we can usually only speculate what the at-issue/not-at-issue content of a given trigger is. That said, let us look at *start* and *stop*. One option is that they contrast in both at-issue and presuppositional content: for *start P* the two components are, roughly, 'P now' and 'not P before', and for *stop P* they are 'not P now' and 'P before'. If the generalization above applies to lexical presuppositions, having *stop* and *start* as prosodically F-marked elements within a CT+F coordinated structure should not force local accommodation, which indeed seems to be the case.¹⁰

- (16) If *Umbridge* **stopped** drinking firewhisky, and *McGonagall* **started** doing so, we're in trouble.
 → ⟨Umbridge, McGonagall⟩ used to ⟨drink, not drink⟩ firewhisky.

Now let us look at another pair of lexical items, *know* and *think*, which can be construed as having the same at-issue content but differing in their not-at-issue content, with *know* but not *think* triggering a factive presupposition. If that is correct, the generalization above predicts local accommodation when the two are prosodically F-marked elements in a CT+F coordinated structure. It seems indeed that the inference typically triggered by *know* in non-contrastive contexts does not obtain when *know* is contrasted with *think* in a CT+F coordinated structure:

- (17) a. If Hermione knows that her parents are in danger, she'll talk to Dumbledore.

⁸It is as of now unclear to me what is the cause and what is the effect here. It might very well be that co-speech gestures are preferably not-at-issue precisely because it is harder for focus-marking prominence to associate with them, which, given certain assumptions about givenness, can very well result in default projection.

⁹Here it is quite natural to get a secondary generic inference that dogs are in general larger than cats.

¹⁰Local accommodation, of course, is still possible, e.g., in a context similar to the one in (2).

- Hermione's parents are in danger.
- b. If *Ron* **thinks** that his parents are in danger, and *Hermione* **knows** that **hers**¹¹ are, they'll talk to Dumbledore.
 ↗ Hermione's parents are in danger.

There is an apparent problem with a local accommodation approach to (17b), though, since (17b) does not really have the reading whereby the complement of *know* is a conjunct under *if*:

- (18) If Ron thinks that his parents are in danger, and Hermione's parents are in danger and she thinks that they are, Ron and Hermione will talk to Dumbledore.

Instead, (17b), intuitively, seems to suggest a contrast in how much evidence about their parents being in danger Ron and Hermione respectively need before they talk to Dumbledore, regardless of whether their parents actually are in danger. There have been some attempts to revisit the lexical semantics of *know* in terms of the level of certainty of the attitude holder or amount of evidence available to them (see, e.g. Wiegand, 2018 for a recent discussion). However, as things stand, those accounts are insufficient to predict the nature of inferences triggered by *know* and their projection behavior in all environments; in particular, they do not account for (17a). One (perhaps unsatisfying) possibility would be to say that *know* is lexically ambiguous between a factive, presupposition-triggering predicate, whose at-issue content is roughly equivalent to that of *think*, and a non-factive, non-presuppositional predicate meaning something like 'believe with a great amount of certainty/evidence'—as opposed to *think*, which would mean something like 'believe with a moderate amount of certainty/evidence'. As things stand, both readings would be predicted to be possible in non-contrastive environments (so, if there is a preference for the factive reading, something additional needs to be said), but the second reading would become much more salient when *know* is contrasted with *think*.

Setting the peculiarities of attitude predicates aside, it would seem that the data for some lexical presupposition triggers, in particular, *start/stop* and *know*, are compatible with the generalization made for co-speech gestures. The content that would normally project does not do so and is instead treated as part of the at-issue content (via local accommodation or lexical adjustments) when it is necessary to make the necessarily at-issue F-items within a CT+F coordinated structure contrastive. When the contrast requirement can be satisfied by some other content, the typically not-at-issue content, both gestural and presuppositional, can remain not-at-issue.

3.3. Not-at-issue focus

Let us now turn to focus that does not require at-issueness of the content it targets. Such focus marks novelty of certain content without having it address the QUD, for example:

- (19) (IP If **Flitwick** brings a dog), (IP which will be **small**), (IP and **Hagrid**(, too,) brings a dog), (IP which will be **large**), (IP they'll fight).
 → If ⟨Flitwick, Hagrid⟩ brings a dog, it will be ⟨small, large⟩.

¹¹The focus-marking prominence on *hers* is not-at-issue focus, discussed in the next subsection.

- (20) (IP If *Hermione* stirs **her** potion), (IP which she'll do **clockwise**), (IP and *Luna* stirs **her** potion), (IP which she'll do **counterclockwise**), (IP there will be an explosion).
 → If ⟨*Hermione*, *Luna*⟩ stirs her potion, she'll do so ⟨clockwise, counterclockwise⟩.

Note that the ARCs in the two examples above are not F-items in CT+F coordinated structures; (19) is an instance of additive coordination (which can be highlighted by adding an overt additive particle *too*), and in (20) the F-items are the two *her* pronouns with distinct antecedents. In fact, true appositives cannot be F-items in a CT+F configuration at all. ARCs, and appositives more generally, are packaged into their own IPs (see Selkirk, 2005 and references therein). Trying to impose CT+F prosody on the strings in (19) would change prosodic grouping, resulting in a restrictive RC interpretation (which in this case will also require tense changes in the RCs):

- (21) (IP If *Flitwick* brings a dog which is **small**), (IP and *Hagrid* brings a dog which is **large**), (IP they'll fight).¹²
 ↗ If ⟨*Flitwick*, *Hagrid*⟩ brings a dog, it will be a ⟨small, large⟩ one.

Note that something similar happens with post-posed nominal adjuncts; (22a) has two bona fide non-restrictive nominal appositives, while in (22b) the adjuncts are interpreted as restrictive modifiers and require existence of two salient Fangs:

- (22) a. (IP If *Filch* brings **Mrs Norris**), (IP a **small** beast), (IP and *Hagrid* brings **Fang**), (IP a **large** beast), (IP they'll fight).¹³
 b. (IP If *Flitwick* brings Fang the **small** beast), (IP and *Hagrid* brings Fang the **large** beast), (IP they'll fight).

While it might be tempting to say that the restrictive interpretations of the adjuncts in (21) and (22b) are instances of local accommodation of appositives, the prosodic, morphosyntactic, and lexical changes alone suggest different structures to begin with. In fact, as I will show in the next section, local accommodation of adnominal appositives would yield different readings from those of restrictive modifiers but is for the most part impossible.

Interestingly enough, similar not-at-issue focus can be argued to be possible for what Ebert and Schlenker call *post-speech gestures*, i.e., gestural adjuncts that follow the verbal expressions they adjoin to (even though the utterances below are quite awkward to pronounce, presumably due to the fact that post-speech gestures like to be utterance-final):

- (23) (IP If **Flitwick** brings a dog) — (IP **SMALL**), (IP and **Hagrid** brings a dog) — (IP **LARGE**), (IP they'll fight).
 → If ⟨*Flitwick's*, *Hagrid's*⟩ brings a dog, it will be ⟨small, large⟩.
- (24) (IP If *Hermione* stirs **her** potion) — (IP **CLOCKWISE**), (IP and *Luna* stirs **her** potion) — (IP **COUNTER-CLOCKWISE**), (IP there will be an explosion).
 → If ⟨*Hermione*, *Luna*⟩ stirs her potion, she'll do so ⟨clockwise, counterclockwise⟩.

¹²Some people disprefer *which* as a relativizer in restrictive RCs and need to also replace *which* with *that* here.

¹³Mrs Norris is a cat.

Ebert has at different points argued that post-speech gestures can have at-issue (Ebert and Ebert, 2014) or “parenthetical” (Ebert, 2017) semantics.¹⁴ Schlenker (2018) claims that post-speech gestures are “supplements”, which is compatible with them being more like either appositives or parentheticals. For the purposes of this paper, these differences do not matter. What matters is that, with regard to the possibility of bearing not-at-issue focus, not-at-issue post-speech gestures¹⁵ pattern with other prosodically independent not-at-issue content.

A natural question at this point is if there are counterparts of (21) and (22b) for post-speech gestures, i.e., if we can have an example with gestures linearly following the verbal expressions they adjoin to but still in the same IP as those verbal expressions. The answer seems to be ‘no’. For example, the following string is very hard to pronounce:

- (25) ??_{(IP} If *Flitwick* brings a dog — SMALL), _{(IP} and *Hagrid* brings a dog — LARGE), _{(IP} they’ll fight).

There seems to be an articulatory constraint on gestures that requires that once they share an IP with some verbal content they should be anchored to some vocal prosodic event, such as pitch accents in languages like English,¹⁶ i.e., they have to be linearized as what we have been so far calling *co-speech gestures*. In other words, there are two major articulatorily non-taxing possibilities for alignment of gestures: as prosodically independent items in their own IPs or as prosodically dependent items within verbal IPs.

Now, going back to not-at-issue focus, it is easy to see that the interpretations of the sentences in (19)/(23) and (20) are essentially the same as in (12) and (13) (repeated below), respectively:

- (12) If **Flitwick** brings a dog^{SMALL}, and **Hagrid**(, too,) brings a dog^{LARGE}, they’ll fight.
- (13) If *Hermione* stirs her potion^{CLOCKWISE},
and *Luna* stirs her potion^{COUNTERCLOCKWISE}, there will be an explosion.

The difference, however, is in how prominence is marked. Intuitively, it is OK to mark prominence on contrastive ARCs or post-speech gestures, since they are in their own IPs. Trying to mark co-speech gestures as prominent in (12) or (13) is awkward, possibly because it creates a confusing or even garden-path environment regarding the structure, since the prosodic differences between CT+F and additive coordination in this case are very subtle. However, some speakers accept not-at-issue focus on the second word-gesture pair only in (12) and (13).

¹⁴It is not entirely clear to me how “parenthetical” post-speech gestures are different from “supplemental” co-speech gestures, considering that Potts calls both appositives and parentheticals supplements (Potts, 2005, p. 6).

¹⁵Certainly not all gestures that follow some verbal material are not-at-issue. Some of them can be independent standalone utterances that have ordinary at-issue semantics. Some can have elaboration at-issue uses similar to those of *one* appositives (discussed, for example, in Nouwen, 2014):

- (i) Bring me a beer, a small one.
(ii) Bring me a beer — SMALL.

Yet, the gestures in (23) and (24) seem to be making a contribution similar to that of ordinary appositives.

¹⁶For example, Loehr (2004) shows that apexes of gesture strokes tend to align with pitch accents in English.

Now, what happens to presupposition triggers? One observation is that two different lexical items with the same (purported) at-issue content and different (purported) presuppositional content cannot participate in additive coordination, regardless of how prominence is marked:

- (26) *If Ron thinks that his parents are in danger, and Hermione, too, knows that hers are, they'll talk to Dumbledore.

This is presumably because the additive presupposition of *too* cannot ignore sublexical not-at-issue content,¹⁷ i.e., *too* in (26) triggers the presupposition that Ron knows that his parents are in danger, not that he thinks that they are, which is not satisfied in the context. The presupposition of *too* can ignore lexically independent not-at-issue content such as gestures (whether co- or post-speech) and appositives, which allows them to participate in additive coordination. A similar generalization applies to how different types of not-at-issue content behave under ellipsis. Note that these facts require an additional explanation under Schlenker's presuppositional analysis of co-speech gestures, but this discussion is well beyond the scope of this paper.

That said, some people can to some extent accept the following utterance, without an additive particle and with not-at-issue focus on *knows* only (although the judgements are hard):

- (27) *Context: McGonagall doesn't know if Ron's parents are in danger, but she knows that Hermione's are; she doesn't know what Ron and Hermione think; she says:*
If Ron thinks that his parents are in danger, and Hermione **knows** that **hers** are, they'll talk to Dumbledore.

The take-home message of the last two subsections is that a major factor in how focus interacts with a given type of not-at-issue content is whether that content is prosodically independent. Co-speech gestures are prosodically anchored to the verbal content they share an IP with, and lexical presuppositions are a sublexical component of a lexical item that also contains some at-issue content;¹⁸ as a result, it is hard for them to bear not-at-issue focus, but they can serve as F-items in CT+F coordinated structures (and sometimes they have to). Appositives and post-speech gestures necessarily occupy their own IPs; as a result, they can bear not-at-issue focus but cannot be F-items in CT+F coordinated structures. Additionally, there might be subtler differences between lexically dependent (presuppositions) and lexically independent (gestures) not-at-issue content regarding not-at-issue focus, but the data are somewhat messy. Next I will show that some not-at-issue content cannot be locally accommodated even as a last resort.

3.4. When local accommodation is impossible

Let us start with an observation that appositives adjoining to nominals do not have the semantics of restrictive modifiers but instead contribute a proposition about the DP they associate with:

¹⁷A notorious exception are gender features, which have often been given a presuppositional analysis but can be famously ignored under ellipsis and in additive coordination; I will not have much to say about this.

¹⁸Except triggers like *too* and *again*, which arguably only contribute presuppositional content. Interestingly enough, these triggers are typically considered "strong" in the sense that they do not easily allow for local accommodation in the first place, regardless of focus placement. Why this is so is beyond the scope of this paper.

- (28) a. (IP Hagrid brought his dog), (IP who is large).
 ≈ Hagrid brought his dog, and, by the way, his dog is large.
 b. (IP Hagrid brought his dog), (IP a large beast).
 ≈ Hagrid brought his dog, and, by the way, his dog is a large beast.

To know if this content can be at-issue, we want to see if those propositions can be treated as maximally local conjuncts. As it happens, they typically cannot, not even as a last resort:¹⁹

- (29) *Context: Hermione knows that Hagrid has a single dog, but she doesn't know how big that dog is. Hagrid is planning to bring his dog to the Yule ball. Hermione says:*
 a. #_(IP If Hagrid brings his dog), (IP who is **small**), (IP it's gonna be OK), (IP but if he brings his dog), (IP who is **large**), (IP it's gonna be a mess).
 b. #_(IP If Hagrid brings his dog), (IP a **small** beast), (IP it's gonna be OK), (IP but if he brings his dog), (IP a **large** beast), (IP it's gonna be a mess).

No antecedent in (29) can have a reading along the lines of 'If Hagrid brings his dog and his dog is (a) {small, large} (beast)...', even though that would have made the sentences meaningful. Surprisingly enough, such propositional readings cannot be accommodated for gestures either, regardless of whether they are linearized as co-speech or post-speech:

- (30) *Same context as in (29).*
 a. #_(IP If Hagrid brings his dog^{SMALL}), (IP it's gonna be OK), (IP but if he brings his dog^{LARGE}), (IP it's gonna be a mess).
 b. #_(IP If Hagrid brings his dog) — (IP **SMALL**), (IP it's gonna be OK), (IP but if he brings his dog) — (IP **LARGE**), (IP it's gonna be a mess).

Note that the co-speech gestures in (30a) could get a restrictive modifier interpretation in a different context (one in which Hagrid has at least two dogs, one small and one large), but the post-speech gestures in (30b) cannot (for reasons discussed in the previous subsection).

So, to sum up the data on when local accommodation is possible and when it is not: adnominal appositives and post-speech gestures always have propositional semantics and cannot be locally accommodated; adnominal co-speech gestures can be accommodated when they have predicative semantics but not when they have propositional semantics.

A natural question is whether similar restrictions apply to lexical presuppositions, i.e., if only predicative, but not propositional presuppositional content can be locally accommodated. Since we can typically only speculate about the exact form of the presuppositional content in any given case, it is hard to talk about its semantic type, and I will not attempt to do so here. That said, the analysis I sketch in section 4.2 suggests that it is not the propositional type of a given

¹⁹Schlenker (2013) discusses some apparent exceptions for ARCs:

- (iv) If tomorrow I call the Chair, who in turn calls the Dean, then we will be in deep trouble.
 ↗ If tomorrow I call the Chair, they will call the Dean.
 ≈ If tomorrow I call the Chair, and they call the Dean...

Such examples routinely involve a description of a sequence of events; since they would be hard to, if not impossible, to replicate with gestures, I do not discuss them in this paper.

piece of not-at-issue content that makes it unaccommodatable, but rather the mismatch between the type of that piece of content and the type of the phrase it adjoins to in the narrow syntax.

3.5. Summary of the data

Table 1 summarizes the data discussed in this section (with some simplifications).

content type	structural properties	semantic type	at-issue interpretations	not-at-issue focus
appositives	prosodically independent; lexically independent	propositional	impossible	possible
post-speech gestures	prosodically independent; lexically independent	propositional	impossible	possible
co-speech gestures	prosodically dependent; lexically independent	predicative or propositional	can be forced for predicative gestures as a last resort; impossible for propositional gestures	hard
lexical pre-suppositions	prosodically dependent; lexically dependent	??	can be forced as a last resort (for some triggers)	hard

Table 1: Different types of not-at-issue content: summary

In the next section I will discuss what issues these data raise for Ebert's and Schlenker's analyses of gestures and sketch an alternative analysis that avoids these issues.

4. Analyses of gestures

4.1. Issues for Ebert's and Schlenker's analyses

As I have said before, the differences (if any) between Ebert's and Schlenker's analyses of post-speech gestures do not matter for the data at hand. As far as both analyses predict that post-speech gestures cannot be locally accommodated, these data pose no problems for them.

Ebert's (2017) analysis of co-speech gestures is two-fold. She claims that co-speech gestures in general have supplemental semantics akin to that of appositives, but she also allows for NP-level gestures with "exemplification" semantics. In other words, under her view, for example, *a dog*^{LARGE} typically has the same semantics as *a dog*, (*IP which is/will be large*), but—if my

understanding of her claims is correct—the gesture LARGE can also sometimes be interpreted as indicating the size of a typical entity in the denotation of the predicate *dog*.

As things stand, it is unclear if this view can predict the restrictive modifier interpretations of predicative co-speech gestures under pressure (as in (5), (7), (9), or (10)). As we have seen in the previous section, appositives only have propositional semantics, so even if they were capable of being locally accommodated (which they do not seem to be), the predicted readings would not be those of restrictive modifiers. As for “exemplification” interpretations, it is unclear to me if they can be at-issue and what the predicted result would be, if they can.

Schlenker (2018) argues that co-speech gestures trigger assertion-dependent presuppositions he calls *cosuppositions*. A gestural cosupposition has the form $V \Rightarrow G$, where V is the verbal expression the gesture adjoins to, G is the gesture’s content, and \Rightarrow is generalized entailment. When this cosupposition projects, the local context c' of $[[V] G]$ has to entail it: $c' \Rightarrow (V \Rightarrow G)$. When it is locally accommodated, it is conjoined to V : $V \& (V \Rightarrow G)$, which is equivalent to $V \& G$, where $\&$ is generalized conjunction. Note that for Schlenker’s cosuppositional mechanism to apply, it is crucial that the denotations of V , G , and c' are all of the same type.

Without going into technical details, given certain assumptions about how local contexts are computed, Schlenker’s cosuppositional analysis yields correct predictions for adnominal *et*-type co-speech gestures when they adjoin to *et* expressions, i.e., NPs, both for projection and local accommodation. For example, the following results obtain for *Hagrid brings his dog*^{LARGE}, if the gesture adjoins to the NP *dog*: if the cosupposition projects, we get a conditional inference, roughly, ‘If Hagrid brings his dog, his dog is large’ (from which it is easy to generalize to ‘Hagrid’s dog is large’ tout court); if the cosupposition is accommodated, we get the at-issue content of the sentence to be ‘Hagrid brings his large dog’, which is exactly what we want.

Things become more complicated when gestures adjoin to expressions of type $\langle et, t \rangle$ or e , i.e., DPs. If all co-speech gestures trigger presuppositions, which seems to be Schlenker’s claim, we have to assume that DP-level co-speech gestures are of the same type as the DP they adjoin to. Depending on our further assumptions about the denotation of the gesture and the local context, the cosuppositional mechanism can yield similar results for DP-level attachment of the gesture as for NP-level attachment when it comes to projection. However, as things stand, we will also predict local accommodation to be possible in this case. The exact result for local accommodation will depend on what denotation we assume for the DP-level gesture. For example, if we assume that a DP-level gesture LARGE denotes an existential quantifier ‘a large object’, we get the at-issue content of the sentence to be ‘Hagrid brings his dog and a large object’. If we introduce an anaphoric link across the verbal expression *his dog* and the gesture LARGE, we can get the at-issue content of the sentence to be ‘Hagrid brings [*his dog*]_{*i*} and *it*_{*i*} is large’. Neither is attested.

More generally, since the only attested at-issue interpretation of adnominal gestures is that of restrictive *et* modifiers, we should find a way to block any other at-issue interpretations. If one wants to maintain Schlenker’s claim that all co-speech gestures trigger cosuppositions, they would have to stipulate either that adnominal co-speech gestures can only attach to *et* expres-

sions, or that only *et* adnominal co-speech gestures can be locally accommodated. Neither option seems to be well-motivated. Furthermore, under such an approach, the fact that both post-speech gestures and non-predicative co-speech gestures cannot be locally accommodated seems entirely accidental. In the next subsection I will sketch an analysis of gestures, focusing specifically on adnominal gestures, that does not assume that the linearization of a gesture directly determines its semantics. Instead, I will propose that the semantics and projection properties of a gesture are determined by its level of attachment in the syntax, which will also restrict its linearization possibilities.

4.2. Proposal: syntax/semantics and syntax/prosody of gestures

I will assume that all NP-level adjuncts, gestural or not, denote predicates of *et* type (which is not particularly controversial), and all DP-level adjuncts, gestural or not, denote propositions containing a pronoun anaphoric to the DP the adjunct merges with in the narrow syntax. This latter assumption is quite natural to make for ARCs and nominal appositives (which for our purposes can be just reduced ARCs), and I am generalizing it to DP-level gestures. For example, an NP-level gesture *LARGE* denotes $\lambda x.\text{large}(x)$, but a DP-level gesture *LARGE* denotes $\text{large}(x)$, where x is anaphoric to the DP the gesture adjoins to.

Now, Schlenker's cosuppositional mechanism can apply to NP-level gestures, because they have the same type as the verbal expression they modify. When the cosupposition projects, we get a conditional, assertion-dependent inference; when it is accommodated—in particular, to satisfy the contrast requirements under focus—the gesture behaves as a restrictive modifier.

However, the cosuppositional mechanism cannot apply to DP-level gestures, since they are not of the same type as the DP they adjoin to. More generally, DP-level adjuncts cannot be interpreted where they merge in the narrow syntax. Instead, they have to raise at LF and adjoin at some sentential level. As a first approximation, they adjoin at the highest possible level at which the discourse referent introduced by the DP they originally merged with is still available for them. Further assumptions about the status of not-at-issue DP-level adjuncts might be needed to derive their projection behavior when they do not end up having matrix scope even after raising. For example, Schlenker's (2013) semantic *translucency* of appositives will do the job (Schlenker's treatment of appositives is in general very much in line with the story I've been developing here, modulo some differences in syntactic assumptions). Regardless of those further assumptions, however, this general approach makes the mechanism of local accommodation, i.e., conjunction at the level of "triggering", inapplicable to DP-level adjuncts.

This story gives us a principled reason why different mechanisms apply to NP- vs. DP-level gestures, with potentially different results when it comes to at-issue interpretations. But how do we explain why post-speech adnominal gestures seem to be incapable of having predicative semantics and, subsequently, at-issue interpretations? I propose that that is because NP-level gestures cannot be linearized as post-speech due to articulatory and prosody/syntax constraints. There are two conflicting requirements that ensure this result. On the one hand, NP-level adjuncts want to be in the same IP as the NPs they adjoin to (we have seen this, for example,

for restrictive RCs and postposed restrictive nominal modifiers). However, as we have seen in Section 3.3 (example (25) and discussion thereof), once a gesture is in an IP with some at-issue content, it cannot be prosodically independent due to articulatory reasons, i.e., it has to be co-speech. These two requirements can be formulated as OT-style constraints:

- (31) ANCHORG: Assign * for each gesture that is inside an IP containing verbal content but is not anchored to any vocal prosodic event.
- (32) WRAPNP (a narrow version of Truckenbrodt, 1999's WRAPXP constraint): Assign * for each IP boundary inside an NP.

The constraints above are in principle violable, but since there is always a better candidate, with the NP-level gesture linearized as co-speech, post-speech NP-level gestures should not emerge:

	[D [NP GESTURE]]	ANCHORG	WRAPNP
(33)	☞ a. (IP...D NP ^{GESTURE} ...)		
	b. (IP...D NP — GESTURE...)	*!	
	c. (IP...D NP) — (IP GESTURE)		*!

Since DP-level gestures packaged into their own IPs do not violate WRAPNP, DP-level gestures can be linearized either as co-speech or post-speech:

	[[D NP] GESTURE]	ANCHORG	WRAPNP
(34)	☞ a. (IP...D NP ^{GESTURE} ...)		
	b. (IP...D NP — GESTURE...)	*!	
	☞ c. (IP...D NP) — (IP GESTURE)		

Here I am not committing to any specific constraint-based theory (the tableaux above are done in the style of the classical OT for simplicity). However, if we want to capture both variation and gradience in judgements, which is especially pertinent when dealing with gestures, theories that place constraints on a numerical scale, such as stochastic OT (Boersma, 1997 et seq.), or have weighted constraints, such as Harmonic Grammar and variations thereof (Legendre et al., 1990 et seq.), might be better suited than the classical OT (Prince and Smolensky 1993/2004).

5. Conclusion

In this paper I have looked at how different types of not-at-issue content interact with contrastive focus. In particular, I have tried to address the following questions:

1. When do focus-related considerations force at-issue interpretations of typically not-at-issue content?
2. Can a given type of content bear the so-called not-at-issue contrastive focus (i.e., focus that marks contrast without addressing the QUD)?
3. When are at-issue interpretations of a given type of content impossible, even when that would be the only way to satisfy contrast requirements?

Regarding Question 1, I have looked at cases when the semantically focused element has to be addressing the immediate QUD and thus has to be at-issue, as is the case for F-items in a CT+F configuration. I have shown that at-issue interpretations of typically not-at-issue content are forced in this case only if it is necessary to make the F-items properly contrastive across the conjuncts. These considerations apply to prosodically dependent not-at-issue content only, namely, co-speech gestures and lexical presuppositions. Prosodically independent content, such as appositives and post-speech gestures, cannot be an F-item in a CT+F configuration.

Regarding Question 2, I have observed that it is much easier for prosodically independent not-at-issue content to bear not-at-issue contrastive focus. There also seem to be further subtle differences between lexically independent (co-speech gestures) and lexically dependent (presuppositions) content with respect to not-at-issue focus, which need to be investigated further.

The answers to the first two questions group together lexical presuppositions and co-speech gestures on the one hand and appositives and post-speech gestures on the other, which goes in line with Schlenker's (2018) analysis of gestures (contra Ebert and Ebert, 2014; Ebert, 2017), even though it is unclear whether this patterning reveals anything about the semantics of the types of content at hand rather than the role of their structural properties.

The answer to Question 3, however, emphasizes the role of said structural properties for at least appositives and gestures, since only those adnominal adjuncts that match the phrase they adjoin to in semantic type (in particular, predicative co-speech gestures) can have at-issue interpretations under pressure. Adnominal appositives, post-speech gestures, and propositional co-speech gestures cannot have at-issue interpretations even under pressure. Taking this observation as a pivotal point, I have sketched an analysis of adnominal gestures whereby NP-level gestures are predicative and thus can be locally accommodated by conjoining with the NP they adjoin to, but DP-level gestures are propositional, like appositives, and thus cannot be locally accommodated. I have further proposed that DP-level gestures can be linearized as either co- or post-speech, but NP-level gestures can only be linearized as co-speech, due to articulatory and prosody/syntax constraints. A natural next step is to extend this approach to adverbial gestures.

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Partition by exhaustification: Comments on Dayal 1996¹

Danny FOX — *Massachusetts Institute of Technology*

Abstract. In this paper I argue for a new constraint on questions, namely that a question denotation (a set of propositions) must map to a partition of a Stalnakerian Context-Set by point-wise exhaustification (point-wise application of the function *Exh*). The presupposition that Dayal attributes to an *Answer* operator follows from this constraint, if we assume a fairly standard definition of *Exh* (Krifka, 1995). But the constraint is more restrictive thereby deriving the sensitivity of higher order quantification to negative islands (Spector, 2008). Moreover, when combined with recent proposals about the nature of *Exh* – designed primarily to account for the conjunctive interpretation of disjunction (e.g. Bar-Lev and Fox, 2017) – Dayal’s presupposition follows only in certain environments. This observation allows for an account of the “mention-some” interpretation of questions that makes specific distributional predictions.

Keywords: exhaustivity, Free Choice, maximality, higher-order quantification, mention-some, negative-islands, partition, scalar implicatures, uniqueness.

1. Introduction

According to Dayal (1996), a question denotation is a set of propositions (as in Hamblin, 1973) and an interrogative construction presupposes that one member of the set is true and entails all other true members (i.e. is a *most informative true member*). This maximality presupposition has been defended in two different ways. First, Dayal showed how it accounts for various inferential patterns: existence inference for plural constituent questions (*which girls are here?*) and uniqueness for their singular counterparts (*which girl is here?*). Second, later literature has pointed out that the maximality presupposition can also account for various constraints on question formation, most clearly for negative islands.²

I will begin this paper with a new perspective on Dayal’s proposal. Under this perspective, the maximality presupposition is not taken as primitive but is derived instead from the demand that a complete answer to a question be identifiable by exhaustification. More specifically, I will propose that any possible complete answer to a question (every cell in the partition the question induces) must be derivable by the exhaustification of a member of the question denotation. This perspective invites two modifications in the presupposition, which, in turn, overcome two empirical challenges, one coming from the “mention-some” interpretation of questions (MS) and the other from a new form of extraction sensitive to negative islands (Spector, 2008). MS can be explained when the demand of cell-identification is combined with recent proposals in the theory of exhaustification. The sensitivity to negative islands is explained by strengthening cell-identification, demanding that

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² See Fox and Hackl, 2006; Abrusán and Spector, 2011; Abrusán, 2007, 2014. For other islands that might have a semantic account see Abrusán, 2007, 2014; Oshima, 2007; and Schwarz and Simonenko, 2016.

exhaustification yield a mapping from question denotation onto the partition. The resulting picture can then be redrawn (as pointed out to me by Roger Schwarzschild). Specifically, we can dispense with the standard definition of the partition-induced-by-a-question and simply demand that (point-wise) exhaustification partition the context-set.

1.1. The duality of questions – an arithmetic challenge

When is a proposition *relevant* to a question (or when is it *about* the topic that the question introduces)? When is it *informative* relative to the question? When does it provide a *complete* or a *partial* answer? These issues, which are central for various areas of pragmatics, can be addressed straightforwardly when we think of a question as a partition of a space of possibilities – Logical Space, or the Stalnakerian Context-Set. Entertaining a question involves a concern with locating oneself in a space of possibilities, where certain distinctions matter and others don't. A partition is useful for describing such a concern. What matters given a partition (what is relevant) is what cell you're in. So a proposition that distinguishes between cell members (true of some, false of others) will be irrelevant. If a proposition eliminates a cell, it will be informative (i.e. will provide a partial answer to the question), and if it eliminates all but one cell, it will be maximally informative, thus providing a complete answer.³

(1) **Question Pragmatics** (Hamblin, Groenendijk and Stokhof, Lewis, etc.)

A Question characterizes a topic of conversation and as such tells us what is *relevant, informative, orthogonal, etc.*

→ **Question as Partition** (of a space of possibilities)

But since Heim (1994) there has been growing evidence that questions do not denote partitions. The arguments are by now quite involved (besides Heim, see also Guerzoni, 2003; Guerzoni and Sharvit, 2007, 2014; Klinedinst and Rothschild, 2011; Cremers and Chemla, 2016; Spector and Egré, 2015; Xiang, 2016). Heim's original case can be illustrated through a comparison of certain questions that need to be associated with the same partition but, nevertheless, differ in their semantic properties. For example, the question *who (among Mary, Sue and Jane) is here?* has a different denotation from its negative counterpart: *who (among Mary, Sue and Jane) is not here?* This difference can be seen when looking at the different results obtained when embedding the two questions under the verb *surprise*: *John is surprised by who is here* means something different from *John is surprised by who is not here*.⁴ At the same time, the two questions determine the same partition, as no proposition can be relevant or informative relative to one of these questions without bearing the same relationship to the other.⁵

³ For additional useful notions that can be elucidated with partitions, see Groenendijk and Stokhof, 1984; Lewis, 1987 and much subsequent work.

⁴ Heim concludes that the propositional argument of *surprise* must be the weakly exhaustive answer to the question. But Spector and Egré (2015) provide evidence for a more nuanced conclusion, which might be relevant later on (see note 39).

⁵ The argument can be appreciated most clearly when focusing on the de re reading of questions. On relevant complications that come from the de-dicto interpretations, see George, 2011. Throughout this paper I will be focusing on the de re interpretation.

So, as Heim pointed out, a partition does not provide enough information to explain the semantic contribution of a question to the meaning of an indicative sentence in which it is embedded. A popular response to this observation – the one advocated by Heim – is that questions denote sets of propositions (so called, Hamblin sets). These sets are not always mutually exclusive, and hence do not necessarily partition a set of possibilities.⁶

(2) **Question Semantics** (Heim, Klinedinst and Rothschild, Cremers and Chemla, etc.)

Questions show an asymmetry between positive and negative information. Therefore, questions cannot denote partitions.

→ **Question as Set of Propositions** (not necessarily mutually exclusive)

Our questions *who is here?* and *who is not here?*, in particular, denote two different sets of mutually compatible propositions ($\{p: \exists x \in A p = \lambda w. x \text{ is here in } w\}$ and $\{p: \exists x \in A p = \lambda w. x \text{ is not here in } w\}$). And the difference between these two sets suffices to explain the different consequences that arise when the two questions are embedded as arguments of *surprise*.⁷

But since partitions are necessary for understanding question pragmatics (the function of a question in thought and communication), we need to derive them from question denotations. And this can be done in a very simple way (as pointed out by many). Specifically, if we have a set of propositions, Q , we can partition Logical Space to sets of possibilities that agree with each other on the truth-value of members of Q .

(3) *The partition of Logical Space induced by Q* , $\text{Partition}_L(Q)$ – henceforth the *Logical Partition*, is the set of equivalence classes of W under the relation

$$w \sim w' \text{ iff } \forall p \in Q [p(w) = p(w')]$$

I'll illustrate with a very simple case. Suppose we want to know which of two logically independent propositions, p and q , are true. This can be restated as a desire to determine the truth-value of each of the two propositions, i.e., to locate ourselves in the partition $P = \{\neg p \& \neg q, p \& \neg q, q \& \neg p, p \& q\}$. But if we want to express this desire, we might do so using a natural language expression with denotation $Q = \{p, q\}$. Although this denotation is not a partition, the desired partition can be retrieved from it ($P = \text{Partition}_L(Q)$).

(4) $Q = \{p, q\}$ where p and q are logically independent

$$\text{Partition}_L(Q) = \{\neg p \& \neg q, p \& \neg q, q \& \neg p, p \& q\}$$

This can serve to clarify the relationship between the two natural language questions mentioned above: the two questions (*who is here?* and *who is not here?*) denote two different sets of propositions ($\{\text{that } a \text{ is here, that } b \text{ is here, ...}\}$ and $\{\text{that } a \text{ is not here, that } b \text{ is not here, ...}\}$); yet, by (3), the two sets induce the same partition.

⁶ Hamblin, 1973 as apposed to Hamblin, 1958. See Hagstrom, 2003, for a survey.

⁷ For competing proposals about what it means to be surprised by Q , see George 2011 (3.2), Heim, 1994; Lahiri, 2002, and Spector and Egré, 2015.

So there are two different and indispensable notions of a question ((1) and (2)) – question duality. But there is a very simple way to connect them. The notion in (2) is the one delivered by grammar, and the notion in (1), necessary for pragmatics, is retrieved by the function in (3). All of this is simple enough. But now I would like to discuss a rather mundane observation about the typical relationship between questions and answers and suggest a way to think about it that leads to a problem. The problem, I will argue, is useful in understanding empirical constraints on questions. Specifically, I will argue that questions are unacceptable whenever this problem cannot be resolved.

Typically, a question with denotation Q is answered by a sentence denoting a proposition in Q . Yet the answer manages to convey a cell in the partition, by its exhaustive interpretation:

- (5) Question: Who (among Jane, Mary and Sue) is here.
 Answer: Mary is here.
 (exhaustive interpretation: Mary is here and Sue and Jane aren't.)

(6) **Observation about Answers:**

A question, with denotation Q , is typically answered by a proposition p , such that $p \in Q$, hence is not, itself, a cell in $\text{Partition}_L(Q)$. Still p manages (by exhaustification) to identify a cell.

Imagine that we turn this observation into a principle:

(7) **Question Answer Matching:**⁸

A question whose denotation, Q , is a set of propositions *must* be answered by a single sentence whose basic denotation (prior to exhaustification) is a member of Q .

This principle, now, leads to an automatic arithmetic problem. Many questions will be unanswerable in many situations. For example, when Q has n logically independent proposition, $\text{Partition}_L(Q)$ will have 2^n members:

(8) **Question Answer Duality – an Arithmetic Problem:**

There will be cases in which cells in $\text{Partition}_L(Q)$ will not be identifiable by a member of Q (based on simple numerical considerations).

Illustration: In (4), $Q = \{p, q\}$ contains 2 propositions yet $\text{Partition}_L(Q)$ contains 4:

p , by exhaustification, is strengthened to $p \& \neg q$; q is strengthened to $q \& \neg p$

The cells $\neg p \& \neg q$, $p \& q$ cannot be identified.

1.2. Dayal's presupposition as a solution to an arithmetic challenge

As mentioned, Dayal argues that an interrogative construction presupposes that one member of the question denotation is true and entails all other true members (i.e. is a *most informative*

⁸ This condition is close to Rooth's (1992) demand that the focus value of answer to a question be a super-set of the question denotation. However, Rooth's principle allows a question to be answered by a sequence of sentences each of which satisfies his condition independently. For possible arguments that the condition needs to be satisfied by a single sentence, see Bade, 2016; Aravind and Hackl, 2017.

true member). This maximality presupposition is encoded in the meaning of an obligatory lexical item – Dayal’s answer operator, Ans_D . Every question must merge with Ans_D , yielding an interrogative construction that carries a maximality presupposition.

(9) **Dayal (1996):**

- a. $Ans_D(Q) = \lambda w: \exists p \in Q [p = \text{Max}_{\text{inf}}(Q, w)]. \text{Max}_{\text{inf}}(Q, w)$
- b. $\text{Max}_{\text{inf}}(Q, w) = p$ iff $w \in p$ & $\forall q \in Q [w \in q \rightarrow p \subseteq q]$.

If the presupposition of Ans_D is met, the arithmetic problem mentioned in (8) disappears. Suppose that A is a Stalnakerian Context-Set (a set of worlds that satisfy what is presupposed in a conversational context). When an interrogative construction is used, the presupposition of Ans_D will be met (by Stalnaker’s bridge principle), and every world in A will satisfy a unique proposition of the form $\lambda w. [\text{Max}_{\text{inf}}(Q, w) = p]$, for some $p \in Q$. Moreover, every cell in the partition of A (as defined in (10)) will be identifiable (through exhaustification) by specifying the unique proposition of this form that satisfies the worlds in this cell.

(10) *The partition of context-set A induced by Q , $\text{Partition}_C(Q, A)$ – henceforth the Contextual Partition, is the set of equivalence classes of A under the relation: $w \sim w'$ iff $\forall p \in Q [p(w) = p(w')]$*

(11) If Dayal’s presupposition is met, $\text{Partition}_C(Q, A)$ can be re-written as

$$\begin{aligned} & \{[Exh(Q, p)]_A : p \in Q\}, \\ & \text{where } Exh(Q, p) = \lambda w. w \in p \text{ \& } \forall q \in Q [w \in q \rightarrow p \subseteq q] \\ & \quad = \lambda w. \text{Max}_{\text{inf}}(Q, w) = p. \\ & \text{and } \phi_A \text{ is the portion of } A \text{ that satisfies } \phi, \text{ i.e., } A \cap \phi. \end{aligned}$$

(12) **Simple Solution to the problem in (8):** If A is a context set that satisfies the presupposition of $Ans_D(Q)$, then every cell in $\text{Partition}_C(Q, A)$ is identifiable by a member of Q :

$$\forall C \in \text{Partition}_C(Q, A) \exists p \in Q ([Exh(Q, p)]_A = C).$$

Illustration:

$Q = \{p, q\}$ where p and q are logically independent,

A is a context set in which the presupposition of Ans_D is met

$$\text{Partition}_C(Q, A) \subseteq \{[p \& \neg q]_A, [q \& \neg p]_A\} = \{[Exh(Q, p)]_A, [Exh(Q, q)]_A\}$$

So here is where we are. We have seen an arithmetic problem that arises when we focus on the Logical Partition of Q (given in (3)). Specifically, we have seen that there will be many cases where we won’t be able to identify cells in that partition by a proposition in the question’s denotation. But we have also seen that things change when we move to talk about the Contextual Partition (given in (10)). If Dayal’s presupposition is met, there will never be more cells in that partition than propositions in the question’s denotation. Moreover, every cell in the partition will be derived when the context-set is updated by the exhaustification of a proposition in the question denotation (as we saw in (12)).⁹

⁹ Note that although an answer to a question must identify a cell by exhaustification, the answer to a question according to Dayal is not the cell itself, but rather the proposition that would identify the cell if exhaustified,

1.3. Evidence for Dayal's Solution

As mentioned at the very beginning, two pieces of evidence have been presented in favor of Dayal's presupposition. One, brought up by Dayal, comes from the inferences we draw from admissible questions and the other, presented in later work, comes from patterns of acceptability, in particular negative islands.

1.3.1. Inferences of admissible questions

Consider the interrogative constructions in (13). Dayal's presupposition (together with certain assumptions about the meaning of the *whP*'s restrictor) derive (i) an existence presupposition for all the constructions in (13) (that at least one of a b and c came to the party) and (ii) a uniqueness presupposition for (13)a (that at most one of the three came). And these presuppositions are supported in that they account for inferences that speakers draw from these constructions.¹⁰

- (13) a. Which girl (among a, b and c) came to the party?
 b. Who (among a, b and c) came to the party?
 c. Which girls (among a, b and c) came to the party?

To see how the presuppositions follow, consider first (13)a. The Hamblin set associated with the question is provided in (14). Since this set contains three logically independent propositions (corresponding to the three girls), it can have a maximally informative true member, only if exactly one of the three propositions is true.

- (14) $Q = \{p_a, p_b, p_c\}$ (*three logically independent propositions corresponding to the three girls*)

Presupposition: exactly one proposition among the three is true

(Eliminates five cells in the Logical Partition.)

$$\text{Partition}_C(Q, A) \subseteq^{11} \left\{ \begin{array}{l} [p_a \& \neg p_b \& \neg p_c]_A, \quad [p_b \& \neg p_a \& \neg p_c]_A, \quad [p_c \& \neg p_a \& \neg p_b]_A \\ [= \{ [Exh(Q, p_a)]_A, \quad [Exh(Q, p_b)]_A, \quad [Exh(Q, p_c)]_A \} \end{array} \right.$$

Consider next (13)b,c, and their Hamblin denotation, Q , in (15). Q contains seven propositions corresponding to pluralities of the three girls. If there is no true proposition in the set, there is, of course, no maximally informative true member, hence an existence presupposition is derived. However, nothing is predicted beyond this existence presupposition. If one of the propositions is true, the set is guaranteed to have a maximally

otherwise we would not have an argument that questions do not denote partitions directly. This duality will continue to hold in the proposal I will be making, but see note 39.

¹⁰ The existence inference is weaker in (13)b than in the other sentences. To account for this, we might assume that restrictor of the *whP*, *who*, can be true of what Bylinina and Nouwen (to appear) call the zero individual.

¹¹ Equality (rather than the subset relation) does not hold for every context-set A that satisfies Dayal's presupposition. If A satisfies Dayal's presupposition, every $w \in A$ is guaranteed to satisfy one of the exhausted propositions: $Exh(Q, p_a)$ or $Exh(Q, p_b)$ or $Exh(Q, p_c)$. Subsequently, $\text{Partition}_C(Q, A)$ is guaranteed to be a subset of $\{ [Exh(Q, p_a)]_A, [Exh(Q, p_b)]_A, [Exh(Q, p_c)]_A \}$, but one of these three propositions could be a logical contradiction (If A , for example, entails the negation of p_a). The alternative to Dayal's presupposition that I will suggest in (20) will guarantee equality.

informative true member since the set is closed under conjunction ($p_{x \otimes y} \Leftrightarrow p_x \wedge p_y$). Once again, this presupposition guarantees that the cells in the Contextual Partition are each identifiable by applying *Exh* to a member of the question denotation.

(15) Who/which girls (among a, b and c) came to the party?

$$Q = \{p_a, \quad p_b, \quad p_c, \\ p_{a \otimes b}, \quad p_{a \otimes c}, \quad p_{b \otimes c}, \\ p_{a \otimes b \otimes c}\}$$

(*seven propositions corresponding to the plural individuals in the restrictor*)

Presupposition: one of the seven propositions is true.

(Eliminates one cell in the Logical Partition.)

$$\text{Partition}_C(Q, A) \subseteq \{[p_a \& \neg p_b \& \neg p_c]_A, [p_b \& \neg p_a \& \neg p_c]_A, [p_c \& \neg p_a \& \neg p_b]_A, \\ [p_{a \otimes b} \& \neg p_c]_A, [p_{a \otimes c} \& \neg p_b]_A, [p_{b \otimes c} \& \neg p_a]_A, \\ [p_{a \otimes b \otimes c}]_A\} \\ [= \{[Exh(Q, p_a)]_A, [Exh(Q, p_b)]_A, [Exh(Q, p_c)]_A, \\ [Exh(Q, p_{a \otimes b})]_A, [Exh(Q, p_{a \otimes c})]_A, [Exh(Q, p_{b \otimes c})]_A, \\ [Exh(Q, p_{a \otimes b \otimes c})]_A\}]$$

1.3.2. Inferences of admissible questions

Recent accounts of negative islands have agreed that Dayal's presupposition is a necessary component in the explanation (Abrusán, 2007, 2014; Abrusán and Spector, 2011; Fox and Hackl, 2006; Schwarz and Shimoyama, 2011). Specifically, they all share the assumption that a negative island results from Maximality Failure (MF) – a question denotation that cannot possibly have a maximally informative true member, as demanded by Dayal's presupposition. Consider the contrast in (16). (16)a is an ordinary degree question sensitive to negative Islands, as shown in (16)b. The fact that the island is ameliorated by the introduction of the modal *allowed* in (16)c has been taken to argue that MF is the source of unacceptability. (See Fox, 2007b for a discussion of why amelioration would follow under any MF account of the negative island.)

- (16) a. Tell me how fast you drove.
 b. *Tell me how fast you didn't drive.
 c. Tell me how fast you are not allowed to drive.

I will illustrate why this might be the case focusing on Fox and Hackl's (2006) account. Under this account, degree domains are densely ordered, and consequently the denotations of all of the questions in (16) consist of infinite sets of propositions, densely ordered by entailment. In (16)b, but not in (16)a or (16)c, this leads to MF. The question in (16)a denotes the set of propositions in (17)a. This set, although densely ordered by entailment, will have a maximally informative true member, the proposition $\forall w. \text{Speed}(you, w) \sqsupseteq d^*$ where d^* is the addressee's actual speed of driving.

(17) Denotations of Questions in (16)

- a. In (16)a, $Q = \{\lambda w. \text{Speed}(you, w) \geq d: d \in D_d\}$
 b. In (16)b, $Q = \{\lambda w. \text{Speed}(you, w) < d: d \in D_d\}$
 c. In (16)c, $Q = \{\lambda w. \forall w' \in MB_w \text{Speed}(you, w') < d: d \in D_d\}$

The question in (16)b, however, will never have a maximally informative true member. For any degree d higher than d^* , the proposition $\forall w. \text{Speed}(\text{you}, w) < d$ will be true, and the propositions will be more informative the smaller d is. Since there is no smallest degree greater than d^* in the densely ordered domain of degrees, Dayal's presupposition cannot be satisfied. The effect of the modal follows as well. For example, if the modal base entails the proposition $\lambda w. \text{Speed}(\text{you}, w) < d'$ but doesn't entail anything beyond that, then $\forall w. \exists w' \square MB_w \text{Speed}(\text{you}, w') < d'$ will, of course, be the most informative true proposition in the set. The logic is outlined in (18).

(18) **Let $T(Q, @)$ be the set of true members of Q in world $@$ and d^*_w be the addressee's speed in w :**

- a. In (16)a $T(Q, @) = \{\lambda w. \text{Speed}(\text{you}, w) \geq d : d \leq d^*_@ \}$
This set has a strongest member since $\{d : d \leq d^*_@ \}$ has a maximum
- b. In (16)b, $T(Q, @) = \{\lambda w. \text{Speed}(\text{you}, w) < d : d > d^*_@ \}$
This set has no strongest member because $\{d : d > d^*_@ \}$ has no minimum.
- c. In (16)c, $T(Q, @) = \{\lambda w. \forall w' \in MB_w \text{Speed}(\text{you}, w') < d : \forall w' \in MB_@ [d > d^*_{w'}] \}$
This set could have a strongest member because $\{d : \forall w' \in MB_@ [d > d^*_{w'}] \}$ could have a minimum.

And, once more, whenever it is presupposed that Q has a strongest true member, every cell in $\text{Partition}_C(Q, A)$ (where A is the context-set) will be identifiable using *Exh*.

1.4. Interim summary

In this introductory section we have seen two empirical arguments for Dayal's presupposition, one coming from negative islands and the other from the inferences speakers draw from ordinary *wh*-questions. We also provided a possible conceptual motivation for the presupposition, namely that it eliminates an arithmetic problem we identified, stemming from our putative constraint requiring that a question be answerable by a single member of the question denotation. Specifically, we have seen in (12) that if Dayal's presupposition is met, cell identification in (19) is met as well.

(19) **Cell Identification (CI):** A question Q and a context-set A meet Cell Identification if $\forall C \in \text{Partition}_C(Q, A) \exists p \in Q ([\text{Exh}(Q, p)]_A = C)$.

It is easy to see that the converse holds as well: if CI is met, so is Dayal's presupposition (if *Exh* receives the definition in (11)). In light of this equivalence, we might ask which is the basic requirement imposed by grammar. What I will suggest in this paper is that it is CI. This suggestion will be based on two different empirical considerations. The first, from negative islands, will motivate a strengthening of the requirement from questions, which will be very natural if CI is the basic condition (but will make less sense otherwise).¹² Specifically, we will see reasons to think that it is not only true that every cell in the Contextual Partition must

¹² See Fox, 2010 where I propose a different constraint on questions. Evaluating the argument for CI based on negative islands will thus require some conceptual assessment.

be identifiable by a member of Q , but that the converse must also hold – every member of Q must identify a cell (Non-Vacuity, NV). These two requirements together yield the demand of Question Partition Matching:

(20) **Question Partition Matching (QPM)**: A question Q and a context-set A meet QPM if they meet CI and Non-Vacuity (NV)

- a. CI: $\forall C \in \text{Partition}_C(Q, A) \exists p \in Q ([Exh(Q, p)]_A = C)$ and
- b. NV: $\forall p \in Q \exists C \in \text{Partition}_C(Q, A) ([Exh(Q, p)]_A = C)$

The second empirical argument will be based on MS, which is a counter-example to Ans_D . We will see that it is not a counter-example to CI (or to the stronger QPM) if we move to a different theory of Exh , one which has been supported in the domain of Scalar Implicatures.¹³

The remainder of the paper is organized as follows. In section 2, I will further explain the two challenges just mentioned for Dayal's semantics, which in sections 3 and 4 will serve to argue for QPM. In sections 5 through 7 I will discuss various predictions that are made regarding the distribution of MS.

2. Challenges for Dayal's semantics

2.1. Mention Some

According to Dayal the answer to a question, Q , is the most informative true member of Q (hence the presupposition). This answer entails all true members of Q and is thus never an MS answer.¹⁴ So, for example, Ans_D can deliver only one type of argument to the responsive predicates *know* and *forget* in (21) and this argument would derive the MA reading. The MS reading is simply not derivable. (If Mary knows just one among the many locations where we can get gas, she does not know a true member of the Hamblin denotation that entails all other true members.)

- (21) Mary knows where we can get gas in Cambridge.
mention some (MS)
 Mary knows one location where we can get gas.
mention all (MA)
 Mary knows all locations where we can get gas.

It is, thus, reasonable to conclude that Ans_D sometimes demands too much from a question.

¹³ As we will see in section 4, the second argument can also be accommodated without directly imposing CI. What is crucial, however, is that we revise Ans_D , so that it makes explicit reference to Exh (and in particular, to a definition of Exh that can account for FC inferences).

¹⁴ It is equivalent to Weak Exhaustivity whenever Dayal's presupposition is met.

2.2. Higher order quantification – a mysterious Negative Island (Spector, 2008)

Spector (2008) identified a new type of *wh*-question, which he analyzed as involving higher order quantification. He then showed that this type of question is sensitive to negative islands, a fact that does not follow from Dayal's presupposition. Since the sensitivity to negative islands is so similar to what we see in cases that do follow from Dayal's presupposition, this suggests that Ans_D sometimes demands too little from a question.

2.2.1. Higher order quantification

Consider the sentences in (22). Under standard assumptions, *wh*Ps quantify over ordinary individuals – type e . The predicted Hamblin denotation for both questions in (22) is, therefore, the set of propositions $\{p: \exists x_e \in R [p = \lambda w. \text{Required}_w(\lambda w'. \text{We read}_{w'} x \text{ for this class})]\}$, where R is a subset of D_e (the denotation of the *wh*Ps restrictor).

- (22) a. What are we required to read for this class?
 b. Which books are we required to read for this class?

A complete answer would then specify all the things in R we are required to read (as well as all of the things in R that we are not required to read). Imagine that no such things exist. By the standard assumptions, the answer would either be undefined (if Ans_D is indeed an obligatory operator) or (if not) it might simply state that there is nothing that we are required to read.

With this in mind, Spector asks us to imagine a situation where, despite there being no particular thing we are required to read (no book, paper, reading material, etc.), there are still requirements pertaining to reading, for example, a situation where it is required that we either read all of the Russian books on the reading list or all of the French books and that the choice among these two options is left for us to make.

Now consider what would happen if we embed one of the questions in (22) under a responsive (veridical) predicate yielding a sentence of the form $x \ V \text{ what we are required to read}$, as in (23). If standard assumptions hold, the resulting statement would either be a presupposition failure or the statement that Mary stands (at the relevant time) in the V relation to the proposition that there is nothing we are required to read. It is not clear whether the sentences have this interpretation (a fact that might be attributed to Dayal's presupposition). But the sentences definitely do have a different salient interpretation, one that is true just in case Mary stands in the V relation to a proposition that expresses a disjunctive requirement.¹⁵ This does not follow from standard assumptions.

- (23) a. Mary knows/forgot what we are required to read.
 b. Mary knows/forgot which books we are required to read.

¹⁵ As we will see in section 6, such an interpretation (higher-type) is not available with an English singular *wh*P (e.g. *which book*).

So what needs to change in order to derive this salient interpretation? Spector claims that the *whP* needs to quantify over objects of a higher type than simple individuals, specifically he suggests upward entailing generalized quantifiers. This suggestion can be implemented with the assumption that the restrictor of a *whP*, a set of individuals, R , can be shifted to a set of upward entailing generalized quantifiers over R (leaving a trace of the appropriate type).¹⁶

(22)' **Higher-Order Quantification:**

LF: Wh shift(restrictor) $\lambda Q_{\text{ett}} w e_1$ are required $Q \lambda x$. PRO_1 to read x for this class?

Denotation: $\{p: \exists Q \in \text{UGQ}(R) [p = \lambda w. \text{Required}_w(\lambda w'. Q(\{x: \text{We read}_w x \text{ for this class}\}))]\}$,

Where $\text{UGQ}(R)$ is the set of upward entailing generalized quantifiers that live on R .

With this in place, we can account for the attested interpretation. The answer to the question would have to specify which propositions in the denotation are true, and since the disjunction of (the Montague Lift of) two plural individuals in R is a generalized quantifier over R , the proposition that the disjunction is required will be in the question denotation. And, of course, Dayal's presupposition would be satisfied.¹⁷

2.2.2. Sensitivity to Negative Islands

Spector presents evidence from ellipsis that higher order quantification is real and sensitive to negative islands. Consider the question answer pairs in (24) and (25). The answers (all quantificational fragments) show an ambiguity that can be explained if higher order quantification is available along with standard quantification over individuals. If the *wh* trace ranges over simple individuals, the quantifier in the fragment answer will have scope over the modal *required*. If the trace ranges over generalized quantifier, the modal will have wide scope.¹⁸

- (24) What are you required to read for this class?
War and Peace or Brothers Karamazov. (*Required*>*or*; *or* >*required*)
- (25) Which books are you required to read for this class?
a. The Russian books or the French books. (*Required*>*or*; *or* >*required*)
b. Three Russian books. (*required*>3; 3 >*required*)
c. [MB or SE] and [W&P or BK] (*required*>*or*; *or* >*required*)

¹⁶ The restriction to upward entailing quantifiers is needed to account for the fact that the answer to (22) need not specify prohibitions. For a possible way of deriving this restriction, see note 48.

¹⁷ To derive a non-trivial existence presupposition for (13) and (22), we would need to restrict or modify higher-type readings. The proposal made in section 3 would rule out a higher type readings for (13) but not for (22). To derive the presupposition that some requirement was made (in place for me at least in (22)b), one would need to remove the tautological GQ from the domain of quantification. This will be achieved if the type-shift rule is stated as in note 48.

¹⁸ Of course a full account of the connection between the representation of the question and of the fragment requires specific assumptions about the analysis of fragment answers. For concreteness, we can adopt the assumption that fragments involve ellipsis which must satisfy a Parallelism condition of the sort argued for in Rooth, 1992). This would probably require the assumption that *whPs* have a landing site above the subject and below the interrogative C (see Romero, 1998).

The unavailability of narrow scope for the quantifier in the fragment answer in (26) can be seen to demonstrate that the construction is sensitive to negative islands. This is further supported by the observation of modal obviation in (27), corresponding to what we've seen in (16)c.

- (26) What did you not read for this class?
 War and Peace or Brothers Karamazov. (*not>or; or >not)¹⁹
- (27) What are you not allowed to read for this class?
 War and Peace or Brothers Karamazov. (?not>or; or >not)

In the case of degree expressions, modal obviation provided support for the claim that Dayal's presupposition is involved in the account. So one would hope that Dayal's presupposition will provide an account here as well. But this is not the case. If you read everything but War and Peace and brothers Karamzov, the proposition that you didn't read War and Peace or Brothers Karamzov (*not>or*) would be the most informative true member of the question denotation. Thus, Dayal's presupposition would be satisfied with higher order quantification and we would expect the fragment answer in (26) to be acceptable on the *not>or* representation.²⁰

So here is where we are now. In 2.1. the MS interpretation of questions was taken to reveal an area where *Ans_D* demands too much from a question. Here we see a place where it arguably demands too little. In the next two sections, I will propose a resolution for these two problems (of under- and over-generation), beginning with the latter. The resolution in both cases will be based on the idea that the relevant question presupposition stems from the problem of question duality discussed in section 1 – from the need to connect the question denotation to the partition it induces. The problem of over-generation will be resolved by strengthening CI and demanding that the mapping between questions and partitions meet NV as well, as in (20). The problem of under-generation will be resolved once we move to a more sophisticated theory of the mapping (between denotation and partition), namely a theory of exhaustivity that can account for free choice inferences.

¹⁹ A way to see that *not>or* is ruled out is to track “ignorance inferences” – to observe the obligatory inference that the speaker does not know whether W&P was read (and likewise for BK). If *not>or* were possible, the fragment (when exhausted) could provide a complete answer to the question, which would be associated with no ignorance inferences.

²⁰ One might suggest to rule out higher order quantification for (26) based on the observation that the resulting interpretation is not sufficiently distinct from the basic interpretation. Specifically, higher order quantification yields the same partition as the one induced by the more basic semantic type. This could account for the restriction along with an appropriately stated economy condition (along the lines of e.g., Reinhart, 1983 or Fox, 2000). But stating the economy condition so that it would still allow for higher order quantification in (21) is not trivial (see (33)). For an argument that higher order quantification is indeed available in (21) (independently of my account of MS) consider the availability of Free Choice in the fragment answer, which, on many accounts, requires *can>or*.

- (i) Where can we get gas?
 Either at the Shell station or the pump across the street. (Free choice available → *can > or*)

3. Over-generation and Question Partition Matching

As mentioned in section 1, Dayal's presupposition is equivalent to the demand that every cell in the Contextual Partition be identifiable (via *Exh*, as defined in (11)) by a member of *Q* (CI). We will now see that the problem of over-generation exemplified by the unacceptability of *not>or* in (26) is resolved the moment we add to CI the converse requirement of Non-Vacuity, yielding the requirement of QPM defined in (20) repeated below:

- (20) **Question Partition Matching (QPM):** A question *Q* and a context-set *A* meet QPM if they meet CI and Non-Vacuity (NV)
- a. CI: $\forall C \in \text{Partition}_C(Q, A) \exists p \in Q ([\text{Exh}(Q, p)]_A = C)$ and
 - b. NV: $\forall p \in Q \exists C \in \text{Partition}_C(Q, A) ([\text{Exh}(Q, p)]_A = C)$

For *not* to outscope *or* in the fragment answer in (26) the antecedent question would require higher order quantification (as in (22)' for (22)). In other words, the antecedent question in (26) would have to receive the LF representation and semantic denotation in (26)':

(26)' **Higher-order quantification:**

LF: Wh shift(restrictor) $\lambda Q_{\text{ett}} \text{Not } Q \lambda x. \text{ we read } x \text{ for this class?}$

Denotation: $\{p: \exists Q \in \text{UGQ}(R) [p = \lambda w. \{x: \text{We read}_w x \text{ for this class}\} \notin Q],$

Where $\text{UGQ}(R)$ is the set of upward entailing generalized quantifiers that live on *R*.

The question denotation is guaranteed to have a maximally informative true member, thus satisfying CI (equivalent, at the moment, to Dayal's presupposition).²¹ However, it will not satisfy NV, at least if there are two or more objects in *R*. To see this, assume that $b_1 \in R$ and $b_2 \in R$. The conjunction of the (Montague-Lift) of the two will be a member of $\text{UGQ}(R)$, and the proposition in (28) will be in the question denotation. Since this proposition is too weak to be the maximally informative true member of *Q*, there is no way for NV to be satisfied.²²

(28) $\lambda w. \neg ([\text{We read}_w b_1 \text{ for this class}] \wedge [\text{We read}_w b_2 \text{ for this class}])$

A weak proposition of this sort ($\neg > \sqcap$) will always be in the question denotation.²³ And since such a proposition can never be a maximally informative true member, NV will never

²¹ This equivalence will break down in section 4.

²² Applying *Exh*, as defined (11), to this proposition will yield a contradiction. Note that nothing changes if we move to a theory of *Exh* that does not yield contradictions in cases of this sort (e.g. G&S 1994; Fox, 2007a, Bar-Lev and Fox, 2017). In all of these theories, *Exh* yields a meaning that is necessarily weaker than a cell in the partition.

²³ An obvious question that could be raised at this stage is whether the question denotation can be contextually restricted (or pruned), by, e.g., a covert restrictor, *C* conjoined with the current restrictor of the *whP* ($\text{UGQ}(R) \cap C$). The worry is that such contextual restriction could prune (28) [and all other propositions that lead to a violation of NV] from the question denotation leading to an acceptable result. (See Fox and Hackl, 2006 and subsequent work on negative islands where a very similar issue arises.) To rule this pruning out, I would like to appeal to constraints on pruning introduced in the context of work on exhaustivity (Bar-Lev, 2018; Crnič et. al., 2015; Fox and Katzir, 2011; Katzir, 2014; Magri, 2009, 2011). For example, assume with Fox and Katzir, that a proposition *p* can be pruned from a set of propositions *Q* only if the resulting question $[Q - \{p}]$ makes *p* irrelevant. This constraint on pruning would rule-out pruning of (28) given that it is the disjunction of two non-pruned alternatives (and relevance, as it was defined in section 1, is closed under Boolean operators). See also notes 32 and 37.

be satisfied in this environment.^{24,25} The moment additional quantificational expressions are introduced above the *wh*-trace, as in (27), things will change (for certain Context-sets) for the reasons discussed in Fox, 2007b – generalizing observations in Fox and Hackl, 2006.²⁶ For example, the corresponding proposition to (28) in the case of (27) will be the following:

(29) $\lambda w. \neg \text{Allowed}_w ([\text{We read } b_1 \text{ for this class}] \wedge [\text{We read } b_2 \text{ for this class}])$

And this proposition can be the most informative true proposition in the Hamblin set associated with higher order quantification. So Question Partition Matching accounts for the negative island and its obviation by appropriately selected modals.

4. Under-generation and an alternative definition of *Exh*²⁷

The over-generation problem for Dayal’s proposal was resolved in the previous section by strengthening the presupposition associated with interrogative constructions. I suggested that such constructions are not just subject to Dayal’s maximality requirement. They are also subject to NV – the requirement that every proposition in the question denotation identify a cell in the Contextual Partition. Now I would like to argue that the problem of under-generation (MS) indicates that interrogative constructions are, in fact, not subject to maximality in the first place and that this requirement should be replaced with cell-identification, CI.

Ans_D takes a set of propositions, Q, and a world, w, as input and returns the maximally informative among the true propositions in the set. From this it follows, as we saw in 2.1., that the answer to a question provides *all* of the true “positive” information (i.e. is equivalent to “weak exhaustivity”, whenever defined).²⁸ And this is why *Ans_D* yields MA in (21), repeated below, and cannot account for MS.

(21) Mary knows where we can get gas in Cambridge.
mention some (MS)

²⁴ I also predict no higher order quantification for simple questions such as *what did you read?*, as apposed to *what are we required to read?* I haven’t figured out a way to test this prediction directly, though I should note that, on the one hand, it is supported by the existence presuppositions of the sentences in (**Error! Bookmark not defined.**) [but see note 17 and 25], and, on the other hand, it might be disconfirmed by the proposal in Elliott, Nicolae and Sauerland 2018.

²⁵ As it stands, the proposal can’t be right. The contradictory GQ is an UE GQ living on R, and the resulting proposition cannot be in the question denotation if QAP is a requirement. So we need to change the type shift rule. But the type shift rule needs to change on independent grounds, see section 6.1. The proposal made in footnote 48 would eliminate the problem.

²⁶ Let Op be a universal modal. The relevant logical fact is that for every set of propositions Q, and contingent proposition $p \in Q$, it is possible for $\lambda w. \text{OP}(w, p)$ to be the maximally informative true member in $\{\lambda w. \text{OP}(w, q) : q \in Q\}$.

²⁷ The proposal made in this section is one of two proposals I considered in Fox 2013 and Fox 2015. The other proposal I entertained is incompatible with Dayal’s account of the presupposition of singular *wh* questions. See Xiang (2015) for relevant discussion.

²⁸ To repeat, an answer to a question is the proposition that identifies the correct cell in the partition, but it is not the actual cell. If it were the cell, we would not have the argument from Heim that questions do not denote partitions directly – though the picture is more subtle if the proposals in Spector and Egré (2015) are adopted. See notes 39 and 40.

Mary knows one location where we can get gas.
mention all (MA)
 Mary knows all locations where we can get gas.

The problem of under-generation suggests that Dayal's maximality requirement is too demanding. But, shouldn't it suggest the same for the requirement of CI? After all, haven't we shown in 1.4. that the two requirements are equivalent? The answer is subtle. Equivalence holds but only if the proposed method of cell-identification relies on maximality (if the function from propositions to cells is $\forall p. \forall w. [Max_{inf}(Q, w) = p]]_A$). The method of cell identification that comes out of current work on scalar implicatures breaks the equivalence and, I would like to suggest, resolves the problem.

More specifically, I would like to suggest that the MS challenge stems from an incomplete theory of exhaustification.²⁹ Once we move to a more accurate theory (based on considerations that come from the domain of scalar implicatures), we will see that the requirement of CI makes the right predictions. Specifically, we will see that there are cases where p can identify a cell by exhaustification, though p is not the most informative true member of Q. These cases, if I am right, are precisely the cases where MS arises.

Assume that there are n relevant locations and let $\diamond l_i$ stand for the proposition that we can get gas in the i-th location (and l_i stand for the proposition that we do so). Assume that the correct cell in the partition induced by a question is the proposition that we can get gas in the first and second location and nowhere else ($\diamond l_1 \wedge \diamond l_2 \wedge \neg \diamond l_3 \wedge \neg \diamond l_4 \dots \wedge \neg \diamond l_n$).³⁰ If CI must hold, this cell needs to be identified by a proposition in the question denotation via exhaustification. But if *Exh* is defined as in (11) above [*Exh*(Q,p,w) \sqsubset [*Max_{inf}*(Q,w)=p]], only MA can be derived. So this, I would like to claim, is the source of the problem.

With a more sophisticated theory of exhaustification (one that accounts for the conjunctive interpretation of disjunction in certain modal contexts), we will see that the MS/MA ambiguity can be attributed to an ambiguity in the question denotation. In the case of MA, the question denotation will be such that one of its members will identify a cell only if it contains all the positive true information. (In our case $\diamond l_1 \wedge \diamond l_2$ will be the cell identifier.) In the case of MS, a cell-identifier can be a relatively weak proposition; in our case it will be the proposition $\diamond(l_1 \vee l_2)$ [= ($\diamond l_1 \vee \diamond l_2$)]. I will show that this can explain MS under a natural modification in the answer operator (in addition to the modification that automatically results from the alternative theory of *Exh*). Moreover we will see that the necessary ambiguity in the question denotation is already in place, given the observations made in section 3.

Though our overall goal is to replace Dayal's presupposition with QPM (CI+NV), we can, nevertheless flesh out the argument made in this section using Dayal's operator in (9), restated with *Exh* replacing *Max_{inf}* (as suggested in (11)).

²⁹ This I share with Schulz and van Rooij (2006), though the theory of exhaustivity that I have is very different from theirs, as are the resulting predictions.

³⁰ As we will see, the cells are identical for MS and MA only if we keep to context-sets in which you never (even in any of the allowed worlds) get gas in more than one location (something which will require pruning of propositions from the question denotation, if NV is to hold – see notes 23, 32 and 37).

- (30) $\text{Ans}_D(Q) = \lambda w: \exists p \in Q[\text{Exh}(Q, p, w) = 1]. \uparrow p \in Q[\text{Exh}(Q, p, w) = 1]$
 where $\text{Exh}(Q, p, w) \sqcap [\text{Max}_{\text{inf}}(Q, w) = p]$

Using this format, MS will suggest two modifications in Dayal's proposal. The first is what I said above: the adjustment of the presuppositional requirement that follows the moment the Max_{inf} definition of *Exh* is replaced with one that derives the free choice interpretation of disjunction in modal contexts (FC), thereby explaining how $\diamond(1_1 \vee 1_2)$ can identify a cell. The second modification pertains just to the output of the function, which will now not be a proposition but a set of propositions (later to serve as the restrictor of an existential quantifier) – see George, 2011. This set will consist not just of the cell-identifier but of all true propositions in Q that entail the cell-identifier. With this, the MS/MA distinction will be determined by the cardinality of the set. (MS will arise if and only if the set is not a singleton – whenever Q has true members that asymmetrically entail the cell-identifier.)

We will start in 4.1. with some background on FC, introducing, in particular, the view of exhaustification argued for in Bar-Lev and Fox, 2017, 2018. We will then discuss (in 4.2.) the consequences of Spector's assumptions (about higher order quantification, introduced in section 3) for the analysis of questions involving existential modals, such as that in (21). Finally (in 4.3.-4.5.), we will see how things can be put together to provide an account of the MS/MA ambiguity.

4.1. Background on Free Choice

Consider the sentence in (31) exemplifying FC. (31) involves a disjunctive sentence under the scope of an existential modal.³¹ As argued by Alonso Ovalle (2006) [building on Kratzer and Shimoyama 2002] the basic meaning of the construction is equivalent to matrix disjunction [just as in standard modal logic: $\Box C \Box IC$ is equivalent to $\Box C \Box IC$]. If this is the case, the basic meaning needs to be strengthened to entail matrix conjunction, $\Box C \& \Box IC$. I will assume that the method of strengthening involves the covert operator *Exh* that yields standard scalar implicatures, as proposed in Fox, 2007a and further defended in Crnič, 2016; Bar-Lev, 2018; and Bar-Lev and Fox, 2017, henceforth B&F.

- (31) Free Choice:
 You are allowed to have cake or ice cream.
 $\text{Exh}(Q)(\diamond(C \vee IC)) = \diamond C \& \diamond IC \& [-\diamond(C \& IC)]$
 [where $Q = \{\diamond(C \vee IC), \diamond C, \diamond IC, \diamond(C \& IC)\}$]³²

³¹ For evidence that this is indeed the syntactic scope and various approaches to counter-evidence, see Bar-Lev, 2018.

³² To account for the optionality of the inference $-\Box C \& IC$ it is natural to appeal to the pruning of alternatives – the inference disappears if the alternative $\Box C \& IC$ is considered to be irrelevant hence pruned from Q (but see Fox, 2007a for a different account). Such pruning is consistent with the constraint argued for by Fox and Katzir, 2011 – a constraint crucial for understanding the impossibility of a conjunctive inference when the set of formal alternatives is closed under conjunction. See also note 23, as well as Chierchia, 2013; Katzir, 2014; Crnič et. al., 2015; and Singh et. al., 2016.

In Fox (2007), a single occurrence of *Exh* could not yield the conjunctive result. Instead *Exh* needed to apply recursively till it reached a fixed point. Here I would like to adopt the alternative view of exhaustification proposed by B&F, which takes cell-identification to be its defining property and is thus conceptually more in line with the proposal made here. (See Fox, 2013, 2015 where a third definition of *Exh* is pursued to account for MS.) Specifically, *Exh* takes a question, *Q*, and a proposition, *p*, and identifies a cell in the partition induced by *Q* (i.e. assigns a truth value to every member of *Q*).³³ This is done as follows. First the truth-value 0 is assigned to all of the innocently-excludable propositions (as in Fox 2007a) and then the remaining propositions are assigned the truth-value 1:

- (32) **Exhaustivity as Cell Identification** (Simplification of Bar-Lev and Fox (2017))
 $Exh(Q,p,w)=1$ iff $\forall q \in Q [q \in IE(Q,p) \rightarrow q(w)=0]$ & $\forall q \in Q [q \notin IE(Q,p) \rightarrow q(w)=1]$.

Where $IE(Q,p)$ is defined as in Fox, 2007a to be the intersection of all maximal consistent exclusions (that is

$IE(Q,p) = \bigcap \{A : A \text{ is a maximal subset of } Q, \text{ such that } \{p\} \cup \{-q : q \in A\} \text{ is a consistent set of propositions}\}$

It is easy to see that this yields the result in (31). The only member of $IE(Q, \llbracket C \& IC \rrbracket)$ is the conjunctive alternative $\llbracket C \& IC \rrbracket$. This alternative is assigned the truth-value 0 and all other members of *Q* are assigned the truth-value 1.

4.2. Spector's ambiguity

Consider the interrogative complement of the responsive predicate *know* in (21). By Spector's assumptions introduced in section 3, this construction can be associated with the two LFs in (21)':³⁴

- (21)' **LFs for the complement of *know* in (21)**
- a. Low-Type Trace (distributivity applying above *can*)**
 Wh restrictor $\lambda x. C_{int} [x \text{ dist } \forall y. \text{ can we get gas in } y]$
Denotation: $\{p : \exists X \in L [p = \lambda w. \forall y \in ATOM(X) \text{ Can}_w(\lambda w'. qe \text{ get}_{w'} \text{ gas in } y)]\}$
- b. High-Type Trace**
 Wh shift(restrictor) $\lambda Q_{\langle ct.t \rangle} \text{ can } Q \lambda x. \text{ we get gas in } x$
Denotation: $\{p : \exists Q \in UGQ(L) [p = \lambda w. \text{Can}_w(\lambda w'. Q(\{x : \text{we get}_{w'} \text{ gas in } x\}))]\}$,

³³ The procedure is more sophisticated in B&F (relying on *innocent inclusion*). As B&F discuss, the definition in (32) is equivalent to B&F's whenever applying (32) yields a non-contradictory proposition. The use of (32) is innocent in the context of this paper: If (32) yields a contradiction for a member of *Q*, (32) and B&F's operator are not equivalent, but they both yield a result that violates NV (see note 22).

³⁴ *Dist* is a covert distribute operator that can combine with an individual and return a universal quantifier over the atomic parts of this individual (as in, e.g. Heim, Lasnik and May, 1991). There are other possible representations that I am not discussing, e.g. a version of (21)'a in which *dist* is introduced below the modal. See Fox (2013) for discussion.

The restrictor of the *wh*-phrase in (21)'a denotes a set of locations, L . Assume that there are three locations in L (Λ_1 , Λ_2 and Λ_3) and keep to the shorthand introduced earlier (l_i stands for the proposition that we get gas at Λ_i). The denotation of (21)'a will then contain the following propositions (parallel to the basic case in (15)).³⁵

(21)"a **Low-Type Trace denotation of (21) when there are three locations in L**

The closure under conjunction of

$\{\lambda w. \text{Can}_w(\lambda w'. \text{we get}_{w'} \text{ gas in } \Lambda_1), \lambda w. \text{Can}_w(\lambda w'. \text{we get}_{w'} \text{ gas in } \Lambda_2),$
 $\lambda w. \text{Can}_w(\lambda w'. \text{we get}_{w'} \text{ gas in } \Lambda_3)\}$

i.e.:

$\{ \begin{array}{ccc} \diamond l_1 \wedge \diamond l_2 \wedge \diamond l_3 & & \\ \diamond l_1 \wedge \diamond l_2, & \diamond l_1 \wedge \diamond l_3, & \diamond l_2 \wedge \diamond l_3 \\ \diamond l_1, & \diamond l_2, & \diamond l_3 \end{array} \}$ ³⁶

The denotation of (21)'b will contain propositions that you get by introducing quantifiers within the scope of the existential modal – UE quantifiers that live-on L . All such quantifiers can be written as disjunction of conjunctions (of the Montague-Lift) of the individuals in L . Imagine that we “prune” from this set all propositions involving non-trivial conjunctions (conjunctions of more than one conjunct).³⁷ With such pruning we would get the following question denotation:

(21)"b **High-Type Trace denotation of (21) when there are three locations in L**

$\{ \diamond l_1, \quad \diamond l_2, \quad \diamond l_3$
 $\diamond(l_1 \vee l_2), \quad \diamond(l_1 \vee l_3), \quad \diamond(l_2 \vee l_3)$
 $\diamond(l_1 \vee l_2 \vee l_3) \}$

4.3. The identified cells

The two sets of propositions [(21)"a and (21)"b] induce the same Logical Partition. Both sets contain $\diamond l_1$, $\diamond l_2$, and $\diamond l_3$, as well as a few propositions that can be derived by Boolean combinations of these three propositions. In other words, every cell in the partition is characterized by specifying truth-values for $\diamond l_1$, $\diamond l_2$, and $\diamond l_3$, which, in turn, determine the truth-values of the remaining members of either set:

³⁵ For example, $\diamond l_1 \wedge \diamond l_2$ is the proposition $\lambda w. \forall y \in \text{ATOM}(l_1 \oplus l_2) \text{Can}_w(\lambda w'. \text{We get}_{w'} \text{ gas in } y)$

³⁶ Closure under conjunction comes from Dayal's assumption that number neutral *whP* restrictors are closed under sum-formation together with the assumption that distributivity can apply above the existential modal. See Fox, 2013 for another possible account of MS (and its ultimate rejection), one which relies on low scope for the distributivity operator.

³⁷ This pruning satisfies the constraints introduced in note 23 (see also note 32). Pruning of $\diamond(l_i \wedge l_k)$ is crucial for satisfying NV whenever every world in the context-set falsifies $\diamond(l_i \wedge l_k)$. Cases where pruning does not take place will not affect our results, but they will be harder to go over. I will have to leave the exercise to the interested reader.

$$(33) \text{ Partition}_L[(21)"a] = \text{Partition}_L[(21)"b] = \{ \neg \diamond l_1 \wedge \neg \diamond l_2 \wedge \neg \diamond l_3, \diamond l_1 \wedge \neg \diamond l_2 \wedge \neg \diamond l_3, \\ \diamond l_2 \wedge \neg \diamond l_1 \wedge \neg \diamond l_3, \diamond l_3 \wedge \neg \diamond l_1 \wedge \neg \diamond l_2, \diamond l_1 \wedge \diamond l_2 \wedge \neg \diamond l_3, \diamond l_1 \wedge \diamond l_3 \wedge \neg \diamond l_2, \diamond l_2 \wedge \diamond l_3 \wedge \neg \diamond l_1, \\ \diamond l_1 \wedge \diamond l_2 \wedge \diamond l_3 \}$$

Moreover, *Exh*, as defined in (32), will identify each of the cells for both (21)"a and (21)"b, except for the one in which $\diamond l_1$, $\diamond l_2$, and $\diamond l_3$ are all false (except for $\neg \diamond l_1 \wedge \neg \diamond l_2 \wedge \neg \diamond l_3$), but see note 10:

$$(34) \begin{array}{l} \text{a.} \quad \lambda w. \text{Exh}([(21)"a], \diamond l_1, w) = \lambda w. \text{Exh}([(21)"b], \diamond l_1, w) = \diamond l_1 \wedge \neg \diamond l_2 \wedge \neg \diamond l_3 \\ \text{b.} \quad \lambda w. \text{Exh}([(21)"a], \diamond l_2, w) = \lambda w. \text{Exh}([(21)"b], \diamond l_2, w) = \diamond l_2 \wedge \neg \diamond l_1 \wedge \neg \diamond l_3 \\ \text{c.} \quad \lambda w. \text{Exh}([(21)"a], \diamond l_3, w) = \lambda w. \text{Exh}([(21)"b], \diamond l_3, w) = \diamond l_3 \wedge \neg \diamond l_1 \wedge \neg \diamond l_2 \\ \text{d.} \quad \lambda w. \text{Exh}([(21)"a], \diamond l_1 \wedge \diamond l_2, w) = \lambda w. \text{Exh}([(21)"b], \diamond(l_1 \vee l_2), w) = \diamond l_1 \wedge \diamond l_2 \wedge \neg \diamond l_3 \\ \text{e.} \quad \lambda w. \text{Exh}([(21)"a], \diamond l_1 \wedge \diamond l_3, w) = \lambda w. \text{Exh}([(21)"b], \diamond(l_1 \vee l_3), w) = \diamond l_1 \wedge \diamond l_3 \wedge \neg \diamond l_2 \\ \text{f.} \quad \lambda w. \text{Exh}([(21)"a], \diamond l_2 \wedge \diamond l_3, w) = \lambda w. \text{Exh}([(21)"b], \diamond(l_2 \vee l_3), w) = \diamond l_2 \wedge \diamond l_3 \wedge \neg \diamond l_1 \\ \text{g.} \quad \lambda w. \text{Exh}([(21)"a], \diamond l_1 \wedge \diamond l_2 \wedge \diamond l_3, w) = \lambda w. \text{Exh}([(21)"b], \diamond(l_1 \vee l_2 \vee l_3), w) = \diamond l_1 \wedge \diamond l_2 \wedge \diamond l_3 \end{array}$$

The first three cells are identified in the same way for the two questions: by application of *Exh* to one of the propositions $\diamond l_1$, $\diamond l_2$, and $\diamond l_3$ – the weakest propositions in (21)"a and the strongest propositions in (21)"b. The other cells are identified by different propositions for the two questions, and, this, I claim is the source of the MS/MA distinction. If there is more than one location where one can get gas, the proposition that will identify the cell (when *Exh* applies to it) will mention all locations where one can get gas in the case of (21)"a [leading to an MA interpretation], and will not do so in the case of (21)"b [leading to MS].

4.4. *Answer* returns a set of propositions

Dayal's answer operator was stated in (30) as one that takes a set of propositions and returns the cell identifier if one exists (undefined otherwise). But the cell identifier under (30) is the maximally informative true member of the question denotation, and this, as already mentioned many times, will always derive MA (or presupposition failure). So our first modification, as mentioned, is to move to the B&F definition of *Exh* in (32). Our second modification will be to have the Answer operator return not just the cell identifier but the set of true propositions that entail this cell identifier:

$$(35) \text{ Ans}(Q) = \lambda w: \exists p \in Q [\text{Exh}(Q, p, w) = 1]. \{q \in Q: w \in q \ \& \ q \subseteq (\uparrow p \in Q) [\text{Exh}(Q, p, w) = 1]\}$$

Suppose that in w we can get gas at the first and second locations and nowhere else. We saw in (34)d that the cell-identifiers in the case (21)"a and (21)"b are different: it is the proposition $\diamond l_1 \wedge \diamond l_2$ in the case of (21)"a and $\diamond(l_1 \vee l_2)$ in the case of (21)"b. Since every true proposition in (21)"a is entailed by $\diamond l_1 \wedge \diamond l_2$, the result of applying *Ans*(w) to (21)"a is a singleton proposition – $\{\diamond l_1 \wedge \diamond l_2\}$. The situation in (21)"b is very different. Applying *Ans*(w) to this higher-type question yields three propositions $\{\diamond(l_1), \diamond(l_2), \diamond(l_1 \vee l_2)\}$. This distinction, I claim, underlies the MS/MA ambiguity.

4.5. Existential quantification over the *Ans*-set

In (21) (repeated below) the responsive predicate *know* takes a question as complement. I assume that the responsive predicate needs a propositional argument and that this leads to type mismatch: when *Ans* applies to the question it returns a set of propositions, which is not of the appropriate type.

(21) Mary knows where we can get gas in Cambridge.

I assume that this type mismatch is resolved when a covert existential quantifier is combined with the interrogative construction and the resulting constituent QRs as in (21)''':³⁸

(21)''' $\exists[\text{Ans}[\text{where we can get gas}]] \lambda p. \text{Mary knows } p.$

Given the ambiguity of the question *where we can get gas*, there will be two possible readings for (21). Assume that the actual world belongs to the cell in (34)d. If the embedded question receives the low-type interpretation in (21)''a, the output of *Ans* would be the singleton $\{\diamond l_1 \wedge \diamond l_2\}$. The sentence would then receive the MA interpretation stating that Mary knows this conjunctive proposition. But if the embedded question receives the high-type interpretation in (21)''b, the output of *Ans* would be a set of three propositions $\{\diamond(l_1), \diamond(l_2), \diamond(l_1 \vee l_2)\}$, in which case the sentence would assert that Mary knows one of these propositions – the MS reading.³⁹ This account can extend to matrix questions if we assume that an addressee can freely choose among members of the *Ans* set (the output *Ans*). Or alternatively, we can assume that there are covert performative operators [imperative, cause and know], with the following LF (see, e.g., Hirsch 2017 and Sauerland and Yatsushiro 2017):

³⁸ It is critical to block a representation in which *Ans* is absent, e.g.: $\llbracket[\text{where we can get gas}] \forall p. \text{Mary knows } p.$ One possibility is to assume that the only way to derive a question (without type-mismatch) is by base generating the *Ans* operator in the argument position of interrogative C (an identity relation among propositions) and QR-ing *Ans* to its scope position. Thanks to Wataru Uegaki for pressing me on this issue.

³⁹ This, at the moment, seems too weak. As things stand, the MS reading will be true if Mary just knows the disjunctive cell identifier ($\diamond(l_1 \vee l_2)$) – without knowing that it is a cell-identifier. If Mary knows that in at least one of two locations gas is available, and in fact gas is available in both of the locations, we do not want (21) to come out true, not even on an MS reading. In Fox (2013) I suggested we deal with this by appeal to a stronger notion of Answerhood [leading to the requirement that Mary not just know a member of the *Ans*-set, *p*, but also know that *p* is a member of the *Ans*-set, see Heim, 1994 and George, 2011].

(i) $\llbracket[\text{Ans-strong}] = \lambda Q. \lambda w \{ \lambda w' [p \in \llbracket[\text{Ans}]](Q)(w') : p \in \llbracket[\text{Ans}]](Q)(w) \}$

This suggestion requires a longer discussion than can be had in this context. On the one hand, there might be independent reasons to assume *Ans-strong*: as pointed out by Spector and Egré 2015, it might be needed for a uniform statement of how responsive predicates take their Q arguments [both veridical and non-veridical]; and, Spector and Egré (2015) have proposed to deal with Heim's original argument against universal use of *Ans-strong* by claiming that both *Ans-strong* and *Ans-weak* are used simultaneously. On the other hand, Klindinst and Rothschild, 2011 and subsequent work have presented evidence that is problematic for Spector and Egré. I will have to leave this as an open question, but see Spector, 2018 for a defense of *Ans-strong* in light of counter-evidence. There are other possible fixes: with van Rooij (2003) and Schulz and van Rooij (2006), we could add the demand that members of the *Ans*-set have maximum utility (given a contextually given practical problem). Or we can simply prune all non maximal (i.e. strongest) members from the answer set:

(ii) $\llbracket[\text{Ans}'] = \lambda Q \lambda w : \exists p \in Q [\text{Exh}(Q, p, w) = 1]. \{p : p \in \llbracket[\text{Ans}]](Q)(w) \ \& \ \neg \exists q \in \llbracket[\text{Ans}]](Q)(w) [q \subset p]\}$

- (36) IMP addressee Cause $[\exists[\text{Ans}[\text{where we can get gas}]] \lambda p. \text{ speaker knows } p]$.
Make it the case that there is a member of the answer set, p , such that I know p .

4.6. Back to Question Duality

In this section we have seen that two modifications in Ans_D provide an account for MS when coupled with Spector's proposal of higher order quantification. In the next sections, I will try to investigate various predictions made by this account. But first I would like to explain how the modification of Ans_D fits into the conception I outlined in sections 1 and 2. The main point is that our restatement of Ans_D is based on the idea that answers to a question in a world w are defined based on the proposition that *identifies the cell* to which w belongs (in the partition induced by the question). When this proposition is weaker than other members of the Hamblin set, we get MS; when it is the maximally informative true member, we get MA. Though the method of cell identification is different from that assumed by Dayal, we share with her a presupposition that guarantees CI.

In fact it would once again be equivalent to CI. And, as before, CI can be stated directly allowing us to accommodate the proposal in section 3. Specifically, Ans as defined in (35) could be restated as an operator that takes an information state, I , (the context set with veridical predicates) and a world, w , and demands that QPM be met.⁴⁰

- (37) $\text{Ans}(Q) = \lambda I: \text{QPM}(Q, I). \lambda w. \{q \in Q: w \in q \ \& \ q \subseteq (\iota p \in Q)[\text{Exh}(Q, p, w) = 1]\}$
 where $(\text{QPM}(Q, I))$ holds iff
- a. CI: $\forall C \in \text{Partition}_C(Q, A) \exists p \in Q ([\text{Exh}(Q, p)]_A = C)$ and
 - b. NV: $\forall p \in Q \exists C \in \text{Partition}_C(Q, A) ([\text{Exh}(Q, p)]_A = C)$

Or equivalently, as pointed out to me by Roger Schwartzchild, we can dispense with Partition_C and assume that partitions are derived by point-wise exhaustification:

- (38) $\text{Ans}(Q) = \lambda I: \text{Partition}(Q, I). \lambda w. \{q \in Q: w \in q \ \& \ q \subseteq (\iota p \in Q)[\text{Exh}(Q, p, w) = 1]\}$
 where $(\text{Partition}(Q, I))$ holds iff point wise exhaustification of Q is a partition of I .
 I.e., iff $\{[\text{Exh}_Q(p)]_I: p \in Q\}$ partitions I .

5. Is an existential quantifier necessary?

Under the proposal made in section 4, MS is only possible when the cell identifier for Q is weaker than other true propositions in Q , which is, in turn, only possible when an existential operators c-command the trace of wh -movement.⁴¹ Is this particular consequence correct? At first sight, it might seem to be, as the required operator is present in canonical examples of MS, such as (21). However, the empirical picture is far from clear. While various authors have argued that existential operators are required for MS (Chierchia and Caponigro, 2013; George, 2011 chapter 6; Fox, 2013; Xiang 2016), others have claimed that the governing factor pertains to pragmatic considerations to which we return in section 7 (Groenendijk and

⁴⁰ To deal with non-veridical predicates, we can assume with Spector and Egré (2015) that there is existential quantification over I and w , which will require a stronger notion of answerhood. See note 39.

⁴¹ This is the FC environment – where Q is closed under conjunction but not under disjunction.

Stokhof, 1984; Schulz and van Rooij, 2006; van Rooij, 2003, 2017). See Dayal, 2016 for some discussion.

Consider the questions in (39) and (40), all of which can receive an MS interpretation. The two questions in (39), like (21), both have an existential operator in the required position. But this is not obviously the case for the questions in (40).

- (39) a. Where can I buy an Italian newspaper?
 b. How can I get to the Station? (van Rooij, 2017)
- (40) a. Who has a light? (van Rooij, 2017)
 b. Who, for example, supported the bill?
 (Beck and Rullmann, 2009)

Nevertheless, it might be possible to argue that an existential operator is present in an appropriate position, despite initial appearances: in (40)a the verb *has* (which shows a definiteness effect) has been famously analyzed as involving existential quantification (Freeze, 1992), and in (40)b the phrase *for example*, can be analyzed as an existential quantifier. (Consider *John is **an example** of a senator that supported the bill*). Such analyses would not be implausible, as all of the questions show the FC effect: in all of them a disjunctive answer can be understood conjunctively, the crucial ingredient for MS, under the account advocated here:⁴²

- (41) a. Where can I buy an Italian newspaper?
 Either at store A or at store B.
 b. How can I get to the Station?
 Either by following John or by following Mary.
- (42) a. Who has a light?
 Either John or Mary
 b. Who, for example, supported this bill?
 ?McCain or Kennedy (are examples of senators who supported the Bill)

However, there are cases of MS where existential quantification is clearly absent. Consider the following examples suggested to me by Floris Roelofson:

- (43) a. Who is going to the party (by car)?
 b. Mary knows who is going to the party.

When the appropriate pragmatic conditions are met, e.g. when people are trying to figure out how to get to a party, the questions in (43) can receive an MS interpretation. And here no

⁴² The judgment in the case of (42)b is less clear to me than in the other examples. Still I think that a conjunctive interpretation is possible, as is perhaps clearer the following:

- i. McCain OR Kennedy. They are the best examples I can think of.
 ii. Either McCain or Kennedy is a good example.

In any event there will be clear cases where MS is present without existential quantification, so, at the end of the day, it might not be so important to figure out what happens in this particular case.

existential operator *c*-commands the trace and I don't think a disjunctive fragment answer can be interpreted conjunctively. This looks like a problem.

What I would like to suggest is that the MS interpretation in this case has a different explanation. The question, I suggest, receives an MA interpretation with covert domain restriction. Such domain restriction can lead to an MS illusion, as in Schwarzschild's (2000) analysis of the scope illusion that arises when existentials are embedded inside an island – singleton indefinites (see discussion in von Stechow, 2000). For example, the question in (43) might be interpreted as a request to specify all of the people going to the party whose plans the addressee is aware of (*who among the people whose plans for the party you know is going?*).⁴³

While I am not in a position to develop a full argument here, I think that the contrast in (44) might be taken to support this line of approach.

- (44) a. Everyone here knows where we/one can get gas.
 b. Everyone here knows how we/one can get to the party.
 c. Everyone here knows who is going to the party.

The (a) and (b) sentences in (44) can receive an MS interpretation consistent with everyone knowing a different answer to the question: everyone here knows some place – potentially a different place – where we can get gas (or a different way of getting to the party). This is not the case, I think, for the sentence in (44)c. If this sentence receives an MS interpretation at all, it involves what we might call uniform MS, where what everyone knows is the same thing.⁴⁴ This contrast would follow if the route to MS in (44)c involves domain restriction and if it is somewhat difficult in this case to come up with a domain restrictor that includes a variable bound by the matrix subject.⁴⁵ If this is correct, we might be able to conclude that MS requires an existential operator *c*-commanding the trace of *wh*-movement.

To see if this line of reasoning is correct, it would be very useful to find ways of controlling for domain restriction. Since I don't quite know how to do this, all I can offer in support of my conjecture at this stage are minimal pairs such as those in (44) [and the corresponding contrast in note 44], hoping that their account is based on difficulties associated with the complexity of the necessary domain restriction. Here's another minimal pair.⁴⁶ Suppose that there was no gas in the greater Boston area for a couple of days (say... the aftermath of a

⁴³ If *wh*Ps are existential quantifiers (as in Karttunen, 1977), we should expect to find similar illusive domain restriction to arise here. Specor (2018) claims that weak-exhaustivity is also an illusion arising from domain restriction.

⁴⁴ Here is a similar contrast which supports the same conclusion. Suppose you find two people arguing about where to go get gas. (i) sounds like a natural way to stop the argument. But (ii) would not be a reasonable way to break the analogous argument about who to take a ride with (as apposed to (iii) which again contains a modal).

(i) Why are you arguing? You actually both know where one can get gas.
 (ii) #Why are you arguing? You actually both know who is going to the party.
 (iii) Why are you arguing? You actually both know how one can get to the party.

⁴⁵ Thanks to Irene Heim for help in thinking through this example.

⁴⁶ This is an example from Fox, 2013 inspired by the discussion in George, 2011.

storm). Suppose Josh got a huge tank truck and delivered gas to various gas stations (so that people like us can get gas).

When I asked people to imagine that all of this is part of the common ground, they reported different judgments for the questions in (45). These questions, in such a context, should be asking for exactly the same information, as it is contextually given that the places where one can get gas are precisely those places where Josh delivered gas.⁴⁷ Nevertheless, MS is harder to get in (45)b. The contrast is stronger, I think, in (46) if we focus on situations where everyone knows different MS answers (differential MS). If, for some reason, the necessary implicit domain restriction is even more difficult in these cases, the contrast would follow from the proposal made in this paper.

- (45) a. Mary knows where we can get gas. (MS, MA)
 b. Mary knows where Josh delivered gas. (?MS, MA)
- (46) a. Luckily everyone knows where one can get gas. (MS, MA)
 b. Luckily everyone knows where Josh delivered gas. (*MS, MA)

6. Constraints on higher types

To get MS, under the proposal made here, *wh*-movement must cross an existential quantifier. But this is not a sufficient condition. It is also necessary for a trace in the scope of the existential quantifier to be interpreted as a higher-type variable (ranging over GQs). If there are environments where such an interpretation is not available, we expect MS to be unavailable as well.

6.1. Singular *wh* phrases

(47) and (48) below contrast in the availability of the interpretation identified by Spector.

- (47) a. What are you required to read for this class?
 War and Peace or Brothers Karamazov. (*Required*>*or*; *or* >*required*)
 b. Which books are you required to read for this class?
 The Russian books or the French books. (*Required*>*or*; *or* >*required*)
- (48) Which book are you required to read for this class?
 War and Peace or Brothers Karamazov. (**Required*>*or*; *or* >*required*)

This contrast can be taken to argue that singular *wh*-phrases cannot quantify over higher-type traces. Why this should be the case is not critical for current purposes. What is important is that it leads to an expectation in the domain of MS. Specifically, we expect MS to be absent for singular *wh*Ps (as long as we can control for domain restriction).

⁴⁷ Floris Roelofson (p.c.) notes that although the two questions are contextually equivalent, the difference in their form might make different practical problems salient. I do not know how to deal with this confound.

Suppose that a department chair, Sue, is required to form a committee with three professors as members, one of them serving as chair. To meet the pragmatic conditions (which we will be touching on in the next section) assume that Sue thinks the committee is not particularly important and that she would be willing to appoint anyone who is available to serve. In such a context, (49)a can receive an MS reading and (49)b cannot, or at least not easily (a contrast which is perhaps sharper if we insist on differential MS in (50), as in (44) and (46) and the examples in note 44).

- (49) a. Sue knows who can serve on this committee. (MS, MA)
 b. Sue knows which professor can chair this committee. (?MS, uniqueness)
- (50) a. (Why are you arguing?) You both know who can serve on this committee.
 (Differential MS possible for some speakers)
 b. (Why are you arguing?) You both know which professor can chair this committee.
 (Differential MS impossible)

If these contrasts are real, they can serve to argue that higher order quantification is necessary for true MS, as predicted by our proposal (with illusory MS slipping in by domain restriction, e.g. *which professor that she asked...*).

The argument would of course be better understood if we could explain the constraint on higher-order quantification. While I cannot do much here, I can provide further reasons to believe that the constraint is real.⁴⁸ Consider the sentences in (51) and imagine that there is no particular book that Sue is required to read. Under such circumstances, the sentences would be unacceptable as expected given the existence presupposition of the definite article. What is important for my purposes is that this holds even if there is a disjunctive reading requirements, e.g. if Sue is required to read one of two books (of her own choice), say either W&P or BK.

- (51) a. Mary is required to read the book Sue is.
 b. The book that Sue is required to read can be read in one week.
Deviant if Sue is required to read [W&P or BK] (required>or) and nothing else.

Now consider the sentences in (52) and (53). These sentences are no longer deviant when only a disjunctive requirement holds, something that is mysterious if the trace of *wh*-movement is interpreted as a variable ranging over individuals – given the existence presupposition associated with free relatives and plural definite descriptions. However, it is explained if the variables can range over GQs with the disjunction satisfying the presupposition (see von Stechow, Fox and Iatridou, 2014 to understand how a maximality presupposition would be satisfied).

⁴⁸ One possibility is that the mechanism that allows for higher order quantification, the necessary type shift rule, S (or the morpheme that converts the restrictor of the *wh*P), takes a predicate A of individuals and forms a predicate of GQs, based on the plural individuals in A (as in *Cand_x* from Križ and Spector, 2017, ex. (30)):

(1) $\llbracket S \rrbracket(A) = \lambda Q. \exists x \in A \& \exists A'(A' \subseteq \{x': x' \leq x\} \& Q = \lambda P. \exists x [A' \cap P \neq \emptyset])$

- (52) a. Mary is required to read what Sue is.
 b. What Sue is required to read can be read in one week.
- (53) a. Mary is required to read the books Sue is.
Suppose that Sue is required to read [W&P and BK] or [MB and SE] (required>or) and nothing else. The sentence need not be a presupposition failure and will entail that the same requirements were made of Mary.
 b. The books that Sue is required to read can be read in one week.
Suppose that Sue is required to read [W&P and BK] or [MB and SE] (required>or) and nothing else. The sentence need not be a presupposition failure and will entail that each pair of books that can satisfy the requirements can be read in one week.

The contrast can be explained if higher order quantification is impossible when variables (prior to type shift) range over singular individuals. And this constraint, in turn, leads to the prediction for MS stated in (49).

6.2. Floating quantifiers

Consider the following example from Križ, 2015, p. 192.

- (54) Nina weiß, wo man überall Käse kaufen kann.
Nina knows where one everywhere cheese buy can
 ‘Nina knows all the places where we can get cheese.’

Križ points out that MS is impossible in this example and that this impossibility is to be attributed to the expression *überall*. (If the expression is removed, MS is possible.) His explanation is based on a property that he attributes to expressions such as *überall* and *all* which he calls *homogeneity removal*. I would like to point out that the approach developed here provides an alternative that relies only on the semantic type of *überall*: on the assumption that it has a semantic type analogous to that of *all*. *All* is analyzed as an expression that combines with a plural individual and returns a generalized quantifier (or alternatively combines with a predicate of individuals and returns another predicate of individuals). By analogy, *überall* will combine with a plural location (the trace of the *wh*-phrase *wo* in (54)) and return a generalized quantifier over locations.⁴⁹ From this, it follows that the trace of *wo* must range over locations and not generalized quantifiers, and this, in turn, predicts absence of MS (under the approach developed here).

But an additional prediction is made, namely that *überall* can be introduced in a lower position in successive cyclic *wh*-movement while still allowing for MS. The crucial observation is that the trace in the base position in Spector’s representation of the higher-type meaning can be interpreted as a low-type variable (one that can appear in an argument position). In (22)’, for example, it is only an intermediate trace (Q) that is interpreted as a higher type variable, whereas the lower trace *x* is interpreted as variable of a lowest type.

⁴⁹ See Heim, Lasnik and May 1991. Of course things will not change if *überall* combined with a predicate of locations and returned a new predicate of locations.

(22)' **Higher-Order Quantification:**

LF: Wh shift(restrictor) λQ_{ett} we₁ are required Q λx . PRO₁ to read x for this class?

We thus predict MS to be distributed in the following examples as indicated, a prediction that corresponds to the judgments of a few speakers of “Austrian German” with whom I’ve consulted.⁵⁰

- (55) Was kann ich alles zusammenmischen sodass es eine Explosion gibt?
 What can I all together-mix so-that there an explosion is
 MS possible
- (56) a. Was kann ich alles tun sodass ich eine gute Note kriege? MS possible
 What can I all do so-that I a good grade get
 b. Was alles kann ich tun sodass ich eine gute Note kriege? only MA
 What all can I do so-that I a good grade get
- (57) a. Was kann ich alles mit 3 Euros kaufen? MS possible
 What can I all with 3 Euros buy
 b. Was alles kann ich mit 3 Euros kaufen? only MA
 What alles can I with 3 Euros buy

7. Pragmatic constraints on MS

Under the proposal made in this paper, two formal conditions must be met for MS to be possible: (a) an existential operator must intervene between a *wh* operator and one of its traces and (b) a trace in the scope of the existential operator must receive a higher-type interpretation (range over GQs). In sections 5 and 6, I tried to investigate these constraints focusing on environments where they are not met. While the availability of implicit domain restrictions makes it difficult to reach firm conclusions, I think that we have seen a few contrasts that can be taken to support the general outlook.

However, it is well known that MS is constrained by pragmatic factors (Groenendijk and Stokhof, 1994; van Rooij, 2004; van Rooij and Schultz, 2006). My hope, following George, 2011 (section 6.1.2), is that the relevant pragmatic factors can be thought of as considerations that enter into disambiguation. For example, following van Rooij, we might claim that a question must have a useful function in guiding action and that the MS interpretation cannot serve this function unless the relevant pragmatic conditions are met. While this line of thought needs to be worked out, I think there are good reasons to think that the pragmatic considerations entertained in the literature are not sufficient to constrain MS, and that formal conditions are needed as well. In addition to the considerations discussed in sections 5 and 6 (and to George, 2011, section 6.1.2), I would like to mention an important argument made in Xiang, 2016.

Xiang points out that if the pragmatic conditions discussed in the literature were taken to be sufficient we would incorrectly predict the existence of what she calls “mention n readings”.

⁵⁰ Thanks to Martin Hackl, Patrick Grosz and Manuel Križ for consultation.

The conditions allow MS whenever there is a salient practical problem that would be resolved with (what would otherwise be) a partial answer to a question. So if we need to fill the car with gas, knowing one convenient place where one can get gas would be sufficient. Hence *Mary knows where one can get gas?* can be paraphrased as the statement that she knows one location where gas is available. But if the pragmatic conditions were sufficient, we would expect other practical problems to lead to very different demands from a partial answer leading to novel interpretations that have not been reported in the literature.

Suppose there was a practical problem that could only be resolved if we knew two places where we could get gas. If the pragmatic accounts were right, an answer to a question such as *where can one get gas? what gas stations are open?* etc. would need to specify two and no more than two locations. Assume, for example, that I am told I would be executed unless I can mention two locations where one can get gas. The practical problem (avoiding execution) cannot be resolved by a standard MS answer to the question, and if the pragmatic conditions have to be met, this should disfavor a standard MS reading. But if the pragmatic approaches were correct, we should expect to find a mention-two reading, which we don't.

(58), for example, is a sensible thing to utter if the speaker thought Mary knew an MA answer to the question. MS would be insufficient because the practical problem is not resolved and this can be taken to argue that the pragmatic constraints are indeed active. But what is important for Xiang's argument is the prediction made by the pragmatic accounts, namely, that in this context the sentence would receive an interpretation that can be paraphrased with the statement that Mary knows two locations where one can get gas, (58)a, or two gas stations that are open, (58)b, and this does not seem to be the case.

- (58) What you just told me – this threat of an execution – is of course disturbing. But I'm not worried, I can ask Mary:
- a. She knows where one can gas.
 - b. She know what gas stations are open.⁵¹

In fact, the pragmatic accounts predict many other types of mention-x readings that I do not think are available. Suppose Mary is missing one professor for a committee (and that anyone would do). If she knew of one available professor, it would be true to say that she knows who can serve on the committee (on the MS reading). Suppose, however, that her practical problem does not require that much knowledge. Suppose that all she needs to know is a department that has a professor available in it, so that she can call and have the professor sent over. Suppose further that she has this information available – the math dept. has a few available Profs. I think that the first two sentences in (59) will be true but (59)c will be false.

- (59) a. Mary knows who can send her a professor.
 b. Mary knows what kind of professor can serve on the committee. (A math professor.)
 c. Mary knows which professor can serve on this committee. (A math professor.)

⁵¹ Although the judgment seems rather clear to me, we expect the facts (here and in (59)) to be contaminated by implicit domain restriction (and to become sharper when we introduce quantifiers and consider differential mention x).

As far as I can tell, the pragmatic accounts predict that (59)c should get a *mention-department* reading. Specifically, the partial answer to the question specifying that a professor from the math department is available resolves the salient practical problem of knowing who to call.

What Xiang's example teaches us is that there is no *mention-n* interpretation. What (59) teaches us is that there is no *mention-department* interpretation. There is a very specific MS interpretation, which can be accessed only if certain pragmatic conditions are met. But these conditions are not sufficient. There are formal conditions as well which I hope to have helped elucidate.

8. Conclusions

MS is not compatible with Dayal's notion of an answer. To deal with this problem, I offered a new *Answer* operator in section 4, which differs from *Ans_D* in two different ways. First instead of demanding that the question denotation, *Q*, have a maximally informative true member, *Ans* demands that *Q* have a member that can identify the cell in the partition to which the actual world belongs (that *Q* have a cell-identifier). And second, since the cell-identifier need not be the strongest true proposition in *Q*, we let the output of *Ans* be the set of true propositions that entail the cell identifier. MS arises whenever the output of *Ans* has more than one member. There are various empirical consequences to this account of MS that I investigated in sections 5-7.

The demand for cell identification makes it natural to ask whether the converse demand holds as well, namely the demand for NV: not only should every cell be identifiable by a member of *Q*, but also every member of *Q* must identify a cell. NV was supported in section 3, leading to the final proposal in (37), which could be restated (as pointed out by Schwarzschild) as the demand that point wise exhaustification provide us with the necessary partition – (38). Either way, we resolve the problem of question duality that was introduced in the sections 1-2.

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The processing cost of Downward Entailingness: the representation and verification of comparative constructions¹

Yosef GRODZINSKY – *Edmond and Lily Safra Center for Brain Sciences (ELSC) HUJI, INM-1, Forschungszentrum Jülich*

Galit AGMON – *Edmond and Lily Safra Center for Brain Sciences (ELSC) HUJI*

Kedem SNIR – *Edmond and Lily Safra Center for Brain Sciences (ELSC) HUJI*

Isabelle DESCHAMPS – *Faculté de Médecine, Université Laval*

Yonatan LOEWENSTEIN – *Edmond and Lily Safra Center for Brain Sciences (ELSC) HUJI, Department of Neurobiology, The Federmann Center for the Study of Rationality, HUJI*

Abstract

We bring experimental considerations to bear on the structure of comparatives and on our understanding of how quantifiers are processed. At issue are mismatches between the standard view of quantifier processing cost and results from speeded verification experiments with comparative quantifiers. We build our case in several steps: 1. We show that the standard view, which attributes processing cost to the verification process, accounts for some aspects of the data, but fails to cover the main effect of monotonicity on measured behavior. We derive a prediction of this view for comparatives, and show that it is not borne out. 2. We consider potential reasons – experimental and theoretical – for this theory-data mismatch. 3. We describe a new processing experiment with comparative quantifiers, designed to address the experimental concerns. Its results still point to the inadequacy of the standard view. 4. We review the semantics of comparative constructions and their potential processing implications. 5. We revise the definition of quantifier processing cost and tie it to the number of Downward Entailing (DE) operators at Logical Form (LF). We show how this definition successfully reconciles the theory-data mismatch. 6. The emerging picture calls for a distinction between the complexity of verified representations and the complexity of the verification process itself.

Keywords: quantification, monotonicity, negation, comparative constructions, Logical Form, adjectival antonyms, decomposition, quantifier processing, speeded verification, reaction time.

1. The landscape

1.1. Monotonicity

That monotonicity is a property of many natural language quantifiers has been recognized since Barwise and Cooper (1981). Monotonicity is defined by entailment patterns:

- (1) a. A quantifier Q is Upward Entailing (UE), if $A \subseteq A' \Rightarrow Q(A) \subseteq Q(A')$
- b. A quantifier Q is Downward Entailing (DE), if $A \subseteq A' \Rightarrow Q(A') \subseteq Q(A)$

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c. A quantifier Q that is neither UE nor DE is non-monotone

Quantifiers in richer structures such as Q(A)(B) may be UE or DE on their restrictor (A) and nuclear scope (B) arguments. We illustrate this with *more than two* and *fewer than three*. As $\{\text{tall men}\} \subseteq \{\text{men}\}$ and $\{\text{have a red beard}\} \subseteq \{\text{have a beard}\}$, the following entailments hold:

- (2)
- a. left UE: $[_Q \text{More than two}] [_A \text{tall men}] [_B \text{have a beard}]$
 $\Rightarrow [_Q \text{More than two}] [_A \text{men}] [_B \text{have a beard}]$
 - b. right UE: $[_Q \text{More than two}] [_A \text{tall men}] [_B \text{have a red beard}]$
 $\Rightarrow [_Q \text{More than two}] [_A \text{tall men}] [_B \text{have a beard}]$
 - c. left DE: $[_Q \text{Fewer than three}] [_A \text{tall men}] [_B \text{have a beard}]$
 $\Leftarrow [_Q \text{Fewer than three}] [_A \text{men}] [_B \text{have a beard}]$
 - d. right DE: $[_Q \text{Fewer than three}] [_A \text{tall men}] [_B \text{have a red beard}]$
 $\Leftarrow [_Q \text{Fewer than three}] [_A \text{men}] [_B \text{have a beard}]$

1.2. Monotonicity and processing: verification and the DE Cost Effect

How are sentences with monotone quantifiers processed and verified? Barwise and Cooper famously proposed a witness set (WS) verification algorithm that is based on iterated sampling. It distinguishes UE from DE quantifiers in terms of verification complexity (cf. Szymanik, 2016 for a comprehensive recent review). The clearest case may come from proportional quantifiers: with UE ones, (e.g., *more-than-half*), a single positive Example found in a scenario suffices for verification by the WS algorithm. Yet with their DE counterparts (*less-than-half*), exhaustive scrutiny of the whole scenario is required. Thus here, the WS algorithm requires more steps to verify a DE sentence than its UE counterpart. This verification method is predicted to bring about behavioral UE/DE differences. As Barwise and Cooper comment: “we predict that response latencies for verification tasks involving decreasing quantifiers would be somewhat greater than for increasing quantifiers... These predictions are based on the complexity of the checking procedure we have suggested” (p. 192). Though not explicitly discussed by Barwise and Cooper, falsification with this checking method reverses the complexity of the WS algorithm and, correspondingly, the prediction (at least with proportional and degree quantifiers): the WS strategy above predicts that falsifying DE sentences should be faster than falsifying their UE counterparts (and similar, or even equal, to verifying their UE counterparts). We can use verification time, quantified using reaction time (RT) measurements in a verification experiment, to test this theory. Imagine a verification experiment with a 2×2 design, in which the Polarity contrast ($RT_{DE} - RT_{UE}$) is pitted against Truth-value ($RT_F - RT_T$). Under the WS algorithm, no main effects (of a Polarity factor across Truth-value, or a Truth-value factor across Polarity) are expected. Yet we expect a Polarity \times Truth-value interaction, due to the DE/UE ordering reversal in the case of falsification: longer RT in True DE and False UE verifications (Figure 1a).

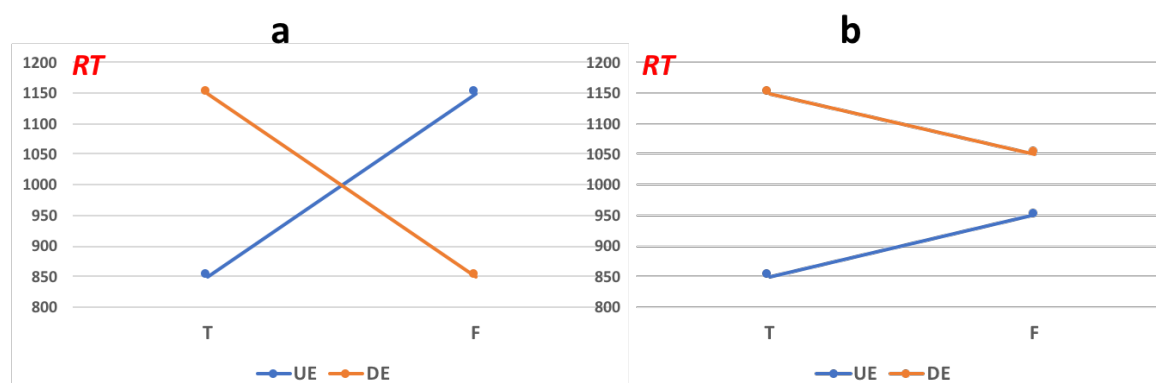


Figure 1: Response patterns with polar degree quantifiers. **a.** Predictions of the WS strategy: no main effect of Polarity or Truth-value; disordinal (non-order preserving) Polarity \times Truth-value interaction. **b.** Schematic illustration of Just and Carpenter's (1971) results: main effect of Polarity; all other effects – same as in **a.**

Actual results of such an experiment were in fact already available at the time of Barwise and Cooper's writing: Just and Carpenter (1971) presented data from speeded verification, in which quantifiers Polarity was pitted against Truth-value. Sentences with UE and DE degree quantifiers were verified against scenarios that contained 2 black and 14 red dots (or 14 black and 2 red dots).² Half of the scenarios made each sentence true, and the other half made each sentence false:

- (3) a. UE: Many of the dots are black
b. DE: Few of the dots are red

Just and Carpenter found a Polarity \times Truth-value interaction effect, as the WS algorithm would later predict. Yet they also obtained a main effect for Polarity, $RT_{DE} >^{sig} RT_{UE}$ (illustrated in Figure 1b), not predicted by the WS algorithm. We call this main effect the DE Cost (DEC) Effect. It is found across Truth-values, hence it is independent of verification.³

The shape of the interaction effect (disordinal: the slopes of the imaginary lines connecting the RTs for each quantifier are opposite to one another) is consistent with the WS, yet the unexpected main effect of Polarity suggests that the processing complexity of quantified sentences has two independent components. Indeed, Just and Carpenter proposed an account that reflects this independence. It attributes the main (DEC) Effect to costly lexical decomposition [*few*=NOT(*many*)], and the Polarity \times Truth-value interaction to attentional shifts during verification.⁴

² *Many* and *few* are arguably ambiguous between adjectival and quantificational denotations. As we show below, the same results are obtained from unambiguously proportional determiners (*more/less-than-half*).

³ A comment by Dan Goodhue played an important role in clarifying this point.

⁴ They proposed an attentional strategy, imposed by the scenario, which forces a participant to attend to the larger set of dots first; an attentional shift to the smaller set (driven by sentence content) is costly. In the experimental context, the UE stimulus sentence in (3a) is true iff followed by an image in which the larger set of 14 dots is in the predicate color. Focusing on this set for Truth-value determination is appropriate, making for a speedy response. However, this UE sentence is false when the *smaller* set of 2 dots is in the predicate color; attention must therefore be shifted to the larger set for the determination of Truth-value, and as the shift is supposedly costly, a longer response time is expected. The same logic applies to the DE case (3b), but in reverse.

1.3. Prospectus

This note focuses on one of the two components, the DEC Effect – the processing signature of the monotonicity of degree quantifiers *across Truth-value*. DEC can be expressed thus:

- (4) DEC Effect (preliminary)
 $\Delta RT = RT_{DE} - RT_{UE} > 0$

RT_{DE} and RT_{UE} are speeded verification times of the sentences containing UE and DE quantifiers, respectively. The DEC Effect is robust and has been repeatedly reported (Geurts and van der Slik, 2005; Deschamps, Agmon, Loewenstein and Grodzinsky, 2015). It is at the heart of our exploration of the representational and verification complexity of comparative quantifiers via empirical tests of their perceptual complexity. We try to identify the source of the DEC Effect and see how such an understanding bears on the semantics of comparatives.

For the remainder of Section 1, we review some recently published experimental tests, which seem to support a decompositional analysis of DE quantifiers along the lines of Just and Carpenter (cast in current lingo). We proceed to a puzzle that arises with respect to a DEC Effect found for comparative constructions and consider possible solutions (Section 2). We rule out one of these through an experiment we report (Section 3) and then delve into the details of the Downward Entailingness in the context of comparative quantifiers (Section 4): we motivate a decompositional analysis of *more-* and *less-*comparatives (Büring, 2007a,b; Heim, 2006; Rullman, 1995) and show that each of these posits a different number of DE operators in these comparatives. This difference may help in revising the DEC Effect to fit our experimental data. In Section 5, we redefine the DEC Effect accordingly and show how this definition not only helps to account for the problematic data from comparatives, thereby lending support to the decompositional analysis, but also serves as a tool for the identification of hidden DE-operators.

In Section 6, we reflect on the view that the processing complexity of quantifiers is determined by two components. First, the Polarity main effect is captured by DEC. We call it the representational component, as it is determined by the structural complexity of the quantifiers at issue. Second, the Polarity \times Truth-value interaction is in keeping with the WS algorithm. We therefore call it the verificational component. All in all, we show how results that come from the continuous time domain can be explicitly mapped onto linguistic representations and brought to bear on linguistic theory, even though this theory only features categorical variables.

1.4. Recent experimentation on quantifier monotonicity

Deschamps et al. (2015) report the results of three speeded verification experiments with polar quantifiers, in which matched auditory sentences were coupled with images that contain blue and yellow circles in varying proportions:

- (5) a. More than half of the circles are blue

- b. Less than half of the circles are blue
- (6) a. Many of the circles are blue
b. Few of the circles are blue
- (7) a. There are more blue circles than yellow circles
b. There are fewer blue circles than yellow circles

Each trial began with a visual fixation point followed by an auditory sentence, which was then followed by an image which participants were asked to verify (Figure 2). In addition to measuring a DEC Effect, these experiments tried to see whether DE Cost is affected by properties of the truth-making scenario (in this case, by Weber's Law). Therefore, the blue/yellow proportion in the scenarios was varied along a seven-valued parameter. This proportion determined both Truth-value (T/F) and task difficulty. As the proportion approached 1, the task was more difficult. In Figure 2, for Example, we see a more difficult true case and an easier false one:

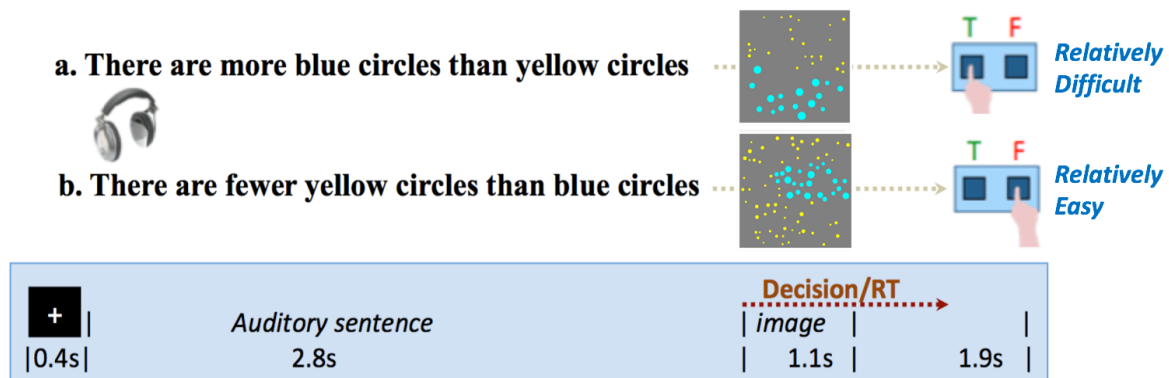


Figure 2: form, content and time-course of stimuli.

Three tests using the sentences shown in (5)-(7) and a host of control conditions were carried out in the same verification paradigm. RT functions, time-locked to image onset as seen in Figure 2, behaved in keeping with the inequality in (4) modulo Weber's Law, across all seven values of the proportion parameter and across True and False instances. Figure 3 collapses participants' scores across Truth-value and proportion and presents the DEC Effect for the polar pairs in (5)-(7) by showing the difference between means (***)⁵. The effect was robust, manifesting in almost all individual participants.

⁵ We collapse across proportions because no DEC × proportion interaction was found, see Deschamps et al. (2015) for details.

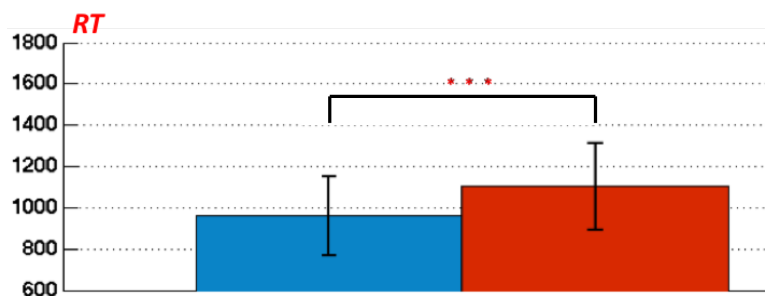


Figure 3: RTs in msec for UE (blue) vs. DE (red) stimuli. Error bars mark 1 population SD, Deschamps et al. (2015).

Deschamps et al. drew several conclusions from this result. Of these, one is of interest here: a DEC Effect is found in a variety of instances but not in control conditions⁶.

2. Problems and possible solutions

2.1. The RT puzzle in comparatives

Among the cases tested, was the pair of comparative sentences (7).⁷ It contains polar quantifiers (*more*, *less*), and as such, it seems at first blush that a DEC Effect is also expected. But processing complexity is determined by properties of generalized quantifiers,⁸ which is reflected by entailment patterns. These are mixed in comparatives – each sentence seems to have a UE and a DE component, except in reversed order:⁹

- (8) a. More cats than snakes died \Rightarrow
 More mammals than snakes died $(\{\text{cats}\} \subset \{\text{mammals}\})$
 b. More cats than reptiles died \Rightarrow
 More cats than snakes died $(\{\text{snakes}\} \subset \{\text{reptiles}\})$

- (9) a. Fewer mammals than snakes live in deserts \Rightarrow Fewer cats than snakes live in deserts
 b. Fewer cats than snakes live in big cities \Rightarrow Fewer cats than reptiles live in big cities

A natural construal of the DEC Effect here is to fix it to the cumulative monotonicity of a sentence. Decomposing each comparative left-to-right, we obtain that (7a-b) do not differ in total DE-ness, as that they both contain a DE environment and a UE environment. We can therefore compute the predicted relation between their verification times under DEC:

⁶ Deschamps et al. Compared quantifier polarity to the direction of algebraic inequalities. When the expression to be verified was not a sentence, but rather, a quasi-algebraic expression with “<” or “>”, not polarity effect analogue was found.

⁷ Note that the WS verification algorithm cannot work for comparatives, as the quantifier has no restrictor which can be sampled to determine Truth-value. See Section 6.2 for further elaboration.

⁸ Deschamps et al. also consider a frequency-based account of the DEC Effect, by which it is due to differences in the lexical frequency between DE and UE quantifiers. They reject this account on several grounds, one of which coming from frequency differences between UE quantifiers (i.e., $f_{\text{more}} > f_{\text{many}}$) that do not manifest in the RT domain (i.e., in sentence verification, $RT_{\text{more}} < RT_{\text{many}}$).

⁹ These entailment patterns are among the reasons for the characterization of these as “A-not-A” (Schwarzschild, 2008).

- (10) a. $RT_{(7a)} = RT_{UE} + RT_{DE}$
 b. $RT_{(7b)} = RT_{DE} + RT_{UE}$
 hence
 c. $RT_{(7a)} = RT_{(7b)}$, or $\Delta RT = RT_{DE} - RT_{UE} = 0$ (at the very least: $\neg(RT_{(7b)} > RT_{(7a)})$)

Deschamps et al., however, found that in comparatives, $RT_{(7b)} >^{sig} RT_{(7a)}$, or $\Delta RT > 0$. By (10), this effect is not expected. We now address possible reasons for this puzzle.

2.2. Possible solutions

We are aware of three logically possible explanations for this theory/data mismatch:

- I. The experimental results are compatible with alternative interpretations.
- II. Assumptions regarding comparative structure are incorrect.
- III. The definition of DEC is incorrect.

What follows is a consideration of these possibilities, and an amended account of the data.

3. A possible experimental wrinkle and its fix

3.1. The issue

Consider the experimental paradigm illustrated in Figure 2, where all image stimuli are composed of objects in two colors (blue and yellow). Prior to testing, participants are informed that these two colors would be the only ones to feature in the images. Sentences (5)-(6) contain a single color term, realized in the right argument of the quantifier – the last word in the sentence. Correct Truth-value judgment in the binary-choice task requires a complete parse of the sentence.

Comparatives are different. Consider the phrasal comparatives used in Deschamps et al.'s study, repeated here in (11): they contain two color terms, that is, both *blue* and *yellow*.

- (11) a. There are more blue circles than yellow circles
 b. There are fewer blue circles than yellow circles

In the context of the task, a participant has enough information to perform correctly with only part of the sentence, as parsing the first part of the comparative is sufficient for verification. If the first argument is *blue*, she can safely conclude that the second must be *yellow* and vice versa. Attending to the rest of the sentence would convey no further critical information.

But what would make her stop listening amid sentence? Recall that the task involves *speeded* verification, i.e., participants are motivated to decide and respond as fast as they can after the image appears. In a repetitive experimental session such as ours (>200 trials per run), compliant participants act efficiently: they try to perform as instructed, but at the same time seek to reduce effort. After a few trials, they can quickly learn that a partial parse is

sufficient. This may result in the deployment of a time-saving strategy with no accompanying loss of accuracy.

If this strategic response method is possible, we should compute the DEC Effect only on the first part of the comparative. This would make the comparative quantifier mono-argumental, akin to (5a-b). This would make (7a), *more-comparative*, a UE sentence; and (7b), a *less-comparative*, a DE one. With this strategy, the observed result, $\Delta RT > 0$, is expected.

Deschamps *et al.*'s experiment cannot rule out this interpretation. We must therefore modify the experimental paradigm so as to rule out this strategic performance option and ensure that the experiment tests what it aims to test. This is what we did in a new experiment, run with a group of Hebrew University undergraduate students ($n=22$), all native Hebrew speakers, who participated for either payment or credit giving their informed consent. The experiment was approved by the Hebrew University Research Ethics Committee.

3.2. Materials and methods

The experiment used Hebrew versions of the sentences in (11), but did so in a context that forced participants to produce a complete parse of the comparative¹⁰. The experimental design used the above stimuli but added an image type. That is, like before, each image contains a proportion of circles in two colors, but these were picked out of three colors (red, blue, and yellow), producing combinations as in (12), Figure 4:

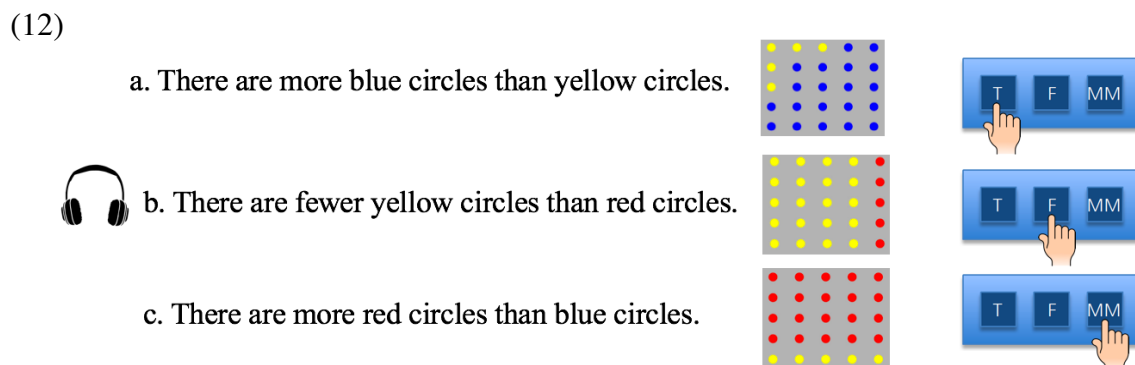


Figure 4: design and conditions of the present comparatives experiment.

Some images contained a color that was not mentioned in the sentence, which made the sentence infelicitous. Participants were instructed about these possibilities and were asked to mark these as MisMatches (MM). They were given a third button in addition to the true and false ones (MM, 12c).¹¹ In this context, the correct response was now discoverable only at the end of the sentence. Participants were forced to pay attention throughout the sentence and parse the complete comparative with both its UE and DE parts. No DEC Effect was therefore predicted.

¹⁰ The Hebrew sentences: *Yeš yoter/paxot 'igulim kxulim me-'adumim*, etc.

¹¹ Although it would also be possible to create a MisMatch using the first color term, we only tested instances in which the mismatch was realized at the end of the sentence, namely those in which the offending color was in the comparative.

This 2×3 design, with Polarity and Image Type as factors and 20 stimuli per type, led to a test that had 120 trials, preceded by a short training session. Sentence-image stimuli were presented in a random order using a Presentation[©] code.

3.3. Results

The results draw a clear picture (Table 1, Figure 5): **a.** mean error rates were low across all conditions (in parentheses, Standard Deviations). **b.** RTs present a main Polarity effect (the difference between the means for *more* and *less*, annotated blue and red in Table 1, across Truth-value); that is, even in the present test paradigm, where participants are forced to parse the sentence in its entirety, there is a significant difference between the processing of *more*- and *less*-comparatives across Truth-value ($F(1,21)=97.236$, $p<.0000001$). We return to other aspects of these data later.

(13)		Mean proportion correct (SD)			Mean RT in msec (SD)		
Sentence	Truth-value	T	F	MM	T	F	MM
a. There are <i>more</i> blue circles than yellow circles		0.954 (0.04)	0.885 (.08)	0.940 (0.05)	897 (181)	1047 (175)	798 (100)
b. There are <i>fewer</i> blue circles than yellow circles		0.898 (0.09)	0.856 (0.07)	0.950 (0.04)	1022 (208)	1115 (195)	831 (112)

Table 1: colored RTs are in keeping with the bar-graph below.

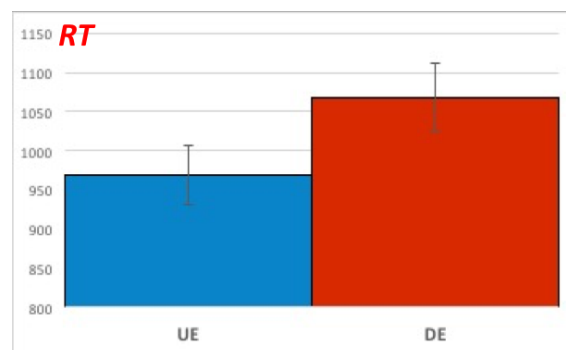


Figure 5: the Polarity main effect with UE (blue) vs. DE (red) sentences (RT in msec). Error bars mark SEM.

3.4. Interim conclusion

We can assert with confidence that the RT puzzle is not due to an experimental artifact, as it persists even when we can guarantee complete processing of the comparative. Next, we reexamine the assumptions that led to the puzzle in the first place. For the RT mismatch to be solved, one needs to look deeper into the structure of comparatives in an attempt to uncover what hidden complexity elements they may contain.

4 Comparatives and monotonicity

4.1 The need for a revised analysis

In this Section, we consider how comparatives should be analyzed. We present two well-known puzzles that the monotonicity-based analysis of comparatives faces. a. NPIs, licensed only in DE environments, are nonetheless licensed in the UE part of *less*-comparatives. b. an ambiguity in *less*-comparatives is mysteriously resolved by the insertion of an NPI. Neither puzzle arises in *more*-comparatives. We review a decompositional solution that derives the UE-ness of the comparative clause in *less*-comparatives from two DE operators. We then proceed to point out problems in this analysis, which have led some investigators to endorse an alternative, non-decompositional, lexical account, which we then sketch. Finally, as we later argue that our experimental results help to fortify the decompositional account, we demonstrate that phrasal comparatives – the cases we tested – are indeed relevant.

4.1.1 An apparent mismatch

There is a well-known mismatch between entailment patterns and the licensing patterns of Negative Polarity Items (NPI) in comparatives (exemplified here with phrasal ones): above, in (8)-(9), *more/fewer*-comparatives were shown to have “mixed”, *A-not-A*, monotonicity. One would expect this pattern to correlate with that of NPI-licensing. That is, all DE environments, and only those, should license NPIs. Yet the observed correlation is only partial: as expected, *more* licenses an NPI just in the DE *than*-phrase (14), but *fewer* licenses a NPI not only in its left, DE argument (15a), but also in its right, UE argument (15b) (Seuren, 1973):

- (14) a. #This city has more cats that ever meow than snakes (NPI in a UE environment)
 b. This city has more cats than snakes that ever bite (NPI in a DE environment)
- (15) a. This city has fewer cats that ever meow than snakes (NPI in a DE environment)
 b. This city has fewer cats than snakes that ever bite (NPI in a UE environment)

Where does this mere partial correlation between NPI-licensing and entailment patterns come from? The comparative part of (15b) is UE by its entailment pattern, but the NPI within it cannot be licensed unless in the scope of a DE operator. This mismatch not only creates a linguistic puzzle, but also a cognitive one. An explanation proposed to the merely partial entailment/NPI licensing correlation might come to the rescue of the DEC Effect puzzle. Let's dig deeper.

4.1.2. Ambiguities in comparatives and their resolution with NPIs

To get to the bottom of the issue, we look into the comparative part of the *less*-comparative by returning to Rullman's (1995) discussion of a curious ambiguity (again following Seuren). Assuming that a jet plane can fly at heights between 1000-20000ft, we get this ambiguity:

- (16) The helicopter is flying less high than *a jet plane can*

Context: jets can fly at 1000-20000ft

Reading 1: The helicopter is flying below 1000ft

Reading 2: The helicopter is flying below 20000ft

The parallel *more*-comparative evinces no such ambiguity:

(17) The helicopter is flying higher than *a jet plane can*

Reading: The helicopter is flying above 20000ft

Returning to *less*-comparatives, Rullman shows that only reading 1 must be analyzed as containing a DE environment. Assume that $\{x/x \text{ is a cargo plane}\} \subseteq \{x/x \text{ is a plane}\}$. Then (18a) entails (18b) only on the “less-than-minimum” reading:

- (18) a. The helicopter is flying less high than a plane can \Rightarrow
 b. The helicopter is flying less high than a cargo plane can

That is, if the helicopter is flying at a (maximal) height that is below the minimum height a plane can fly (=1000ft), then in particular, it is flying below the minimum height at which cargo plane can fly. By contrast, this entailment does not go through on a “less-than-maximum” reading: if the maximum height that a plane can achieve is 20,000ft (below which the helicopter is flying), then it does not follow that the helicopter is flying below the maximal height a cargo plane can reach (as this plane’s maximum height may be less than 20,000ft). It is entirely possible, then, that the helicopter in (18a) is flying higher than the cargo plane but lower than the maximum height a plane can reach (20,000ft), thereby falsifying (18b). The representation of the “less-than-maximum” reading thus does not contain a DE environment.¹² Thus generally, as Rullman (p. 87) puts it, on the “less-than-minimum” interpretation, *less than*-comparatives are DE.

Moreover, NPIs are only licensed on the “less-than-minimum” reading, because it is the only reading whose representation contains a DE environment. Indeed, (19) is not ambiguous:

(19) The helicopter is flying less high than *any* plane can

How can these complex facts be explained? Below, we show how lexical decomposition (Rullman, 1995; Heim, 2006; Büring, 2007a,b) accounts for these by breaking DE quantifiers into pieces. We will later argue that this analysis, coupled with straightforward assumptions about processing, accounts for the RT puzzle with which we began.

4.2. A sketch of the decompositional account

Below, we conflate the three accounts just mentioned into one, as they all share the relevant property which we recruit in order to account for the processing results. This account is built out of three ideas. I. quantifiers undergo lexical decomposition; II. the comparative’s missing

¹² No such ambiguity is observed with the UE *-er* – (i) only has the “more-than-maximum” reading:
 (i) The plane is flying high-*er* than a helicopter can

part, taken to be a relative-clause-like constituent, is copied from the main clause; III. some word parts cannot compose due to type mismatch, and are forced to QR. More explicitly:

I. Lexical Decomposition: *higher* decomposes into *high*+*-er*, and *less* into *little*+*-er*. Lexical entries and types: adjectives contain a degree argument (20a). *-er* is a comparative DE operator over sets of degrees, which checks for an inclusion relation between two degree segments. It is designed to deliver the right meaning when composing with both UE and DE adjectives (20b). *Little* (20c) is a DE operator (essentially, a negation), whose meaning is “not as much as d” (type $\langle d \langle \langle dt \rangle \rangle \rangle$), where d is a generalized quantifier over degrees (type $\langle dt, t \rangle$). Both *-er* and *little* are parts of a DegP, but they are blocked from composing due to type mismatch, which forces *-er* to QR at LF. *Can* is the usual existential modal (20d).

- (20) a. $[[high]]^w = \lambda d. \lambda x. Height_w(x) > d$
 b. $[-er] = \lambda P_{\langle d, t \rangle}. \lambda Q_{\langle d, t \rangle}. P \subset Q$
 c. $[[little]] = \lambda d. \lambda P_{\langle d, t \rangle}. P(d) = 0$
 d. $[[can]] = \lambda p. \exists w \in W_{Acc}: p(w)$

II. Copy: at LF, the comparative has a silent complement for *can* – a copy of the complement of the main predicate (excluding tense and *-er*). Very schematically:

- (21) The helicopter is flying high-*er* [than a plane can [fly high]]

III. QR: The main clause and the comparative clause, then, are sets of degrees, which *-er* takes as its arguments. As *-er* cannot compose with *little*, it must raise, which makes it outscope *little* at LF. Nothing blocks either *-er* or *little* from outscoping the modal. As a result, the minimum/maximum ambiguity can be derived, because these scopal orderings are possible:

- (22) a. *er* > *little* > modal
 b. *-er* > modal > *little*

The less-than-minimum/maximum ambiguity is thus derived via two different LFs – *little* works as a negation, and its scope relative to the existential modal determines the meaning:

- (23) a. LF1, the “less-than-minimum” reading of the *less*-comparative:
 $[-er \text{ than}]_1 wh_3 [t_3 \text{ little}]_4 [can [a \text{ plane fly } t_4 \text{ high}]] [t_1 \text{ little}]_2 [The \text{ helicopter is flying } t_2 \text{ high}]$
 b. LF2, the “less-than-maximum” reading of the *less*-comparative:
 $[-er \text{ than}]_1 wh_3 [can [t_3 \text{ little}]_4 [a \text{ plane fly } t_4 \text{ high}]] [t_1 \text{ little}]_2 [The \text{ helicopter is flying } t_2 \text{ high}]$

This scopal account also works to license the NPI in (19), as it posits a DE operator that scopes over the comparative. And while this analysis overgenerates,¹³ as Heim herself points out, it nonetheless marks an advance in that it is fully compositional.^{14,15}

¹³ Example (19) is unambiguous, as only the “less-than-minimum” reading is available. And yet, Heim’s account stops short of blocking the other, “less-than-maximum”, reading because it provides no way to block the modal from outscoping *little* when the disambiguating NPI is present.

¹⁴ Another issue pointed out by Heim is the lack of full synonymy between *little* α and its antonym. To get

4.3. Counting DE operators

The setup in (23) opens the door to a new perspective on the processing complexity of comparatives. Assume lexical entries as in (20), by which both *-er* and *little* are DE operators. For each of the polar comparatives (24) we obtain a count of the number of these (25):

- (24) a. X is higher than Y
 b. Y is less high than X
- (25) DE count
 a. *higher* (1): [*-er* than]₁ wh₂[Y t₂ high][X is t₁ high]
 b. *less high* (3): [*-er* than]₁ wh₃[[t₃ *little*]₄[Y t₄ high]][[t₁ *little*]₂[X is t₂ high]]

Next, we use the measure of processing complexity in order to translate this count into predictions about RT in verification tasks.

5. DEC redefined: adjudicating between the accounts

5.1. A revised DEC Effect

A reminder: the DEC Effect, whose definition is based on the monotonicity properties of environments within sentences, has not been a complete success. It correctly predicted the results of some DE/UE experimental contrasts but failed to account for the results for comparatives: contrary to fact, it predicted that $\Delta RT_{less-more}=0$, as both *more* and *less* comparatives have a DE and a UE part.

The decompositional analysis we have seen supplies a 3:1 proportion of DE to UE operators in *less/more* comparatives. If DEC can be tied to this count, the RT contrast that is repeatedly found would be accounted for. But for that, a change in perspective on the processing complexity of quantifiers is required. DEC will no longer be based on the DE-ness as measured by inferential properties. Rather, it will be expressed in terms of the number of DE operators, n_{DE} , in a given LF.¹⁶ Our proposal builds on n_{DE} , the number of DE operators in an LF:¹⁷

around this problem, Heim proposes to stick to the “non-evaluative, open-scaled, adjectives in the comparative (like *less fast – slower*, *less old – younger*), which do seem to form truth-conditionally equivalent pairs in simple sentences” (Heim, 2006, p. 21).

¹⁵ Rullman doubts the validity of the restricted decomposition account. He observes that the less-than-minimum/maximum ambiguity is more widespread than expected: in addition to the previous cases (i), it is also attested in sentences where *more* combines with its negative antonym (ii):

- (i) The helicopter is flying *less high* than a jet plane can
 (ii) The helicopter is flying *lower* than a jet plane can

This forces a decomposition of adjectival antonyms, which Rullman stops short of. But Heim and Büring do decompose adjectives, in the spirit of Kennedy (2001), e.g., *low=little*(high).

¹⁶ The DEC may also at some other semantic representation, if one sticks to an account that does not assume LF in its technical sense.

¹⁷ See also Hackl (2009); Szymanik and Zajenkowski (2010).

- (26) The DEC Effect (revised)
 $n_{DE}(\mathbf{LF}_2) > n_{DE}(\mathbf{LF}_1) \Rightarrow \mathbf{RT}(\mathbf{LF}_2) > \mathbf{RT}(\mathbf{LF}_1).$

The decompositional analysis takes *more*-comparatives to contain one DE operator (*-er*) and *less*-comparatives to contain three (*-er*, *little*). Hence, $\Delta n_{DE}=2$, and the predicted DEC Effect is correct: $\Delta \mathbf{RT} = \mathbf{RT}_{fewer} - \mathbf{RT}_{more} > \mathbf{0}.$

5.2. Fitting our results from polar phrasal comparatives to the new DEC

The above analysis pertains to clausal comparatives, which leaves us one step short of deriving the results of our own experiment, in which we showed that *phrasal* comparatives are fully processed:

- (27) a. There are more blue circles than yellow circles
 b. There are fewer yellow circles than blue circles

Our discussion thus far featured clausal comparatives, and we therefore need to consider whether phrasal ones, whose semantics is slightly different from their clausal counterparts (e.g., Beck, Hohaus and Tiemann, 2012), fit the bill. The experimental sentences in (27) have the same truth conditions. We focus on their logical forms, as these bear on DEC.

The decompositional analysis turns *more* into *many+er*, and *fewer* into *little+many+er*; the rest follows as in (20)-(23), resulting in LF representations with an unequal number of DE operators, namely one DE operator for *more* (28a), but three for *fewer* (28b):¹⁸

- (28) a. [*-er* than]₁ wh₂[t₂ many yellow circles][there are t₁ many blue circles]
 b. [*-er* than]₁ wh₂[t₂ *little*]₃[t₃ many blue circles][t₁ *little*]₂[there are t₂ many yel. circles]

This analysis, then, once coupled with the new DEC, predicts our results.

The theoretical informativeness of the revised DEC goes beyond the data we discussed: by DEC, differential response times in verification experiments with quantifiers ($\Delta \mathbf{RT}$) should correlate with the differential count of DE operators (Δn_{DE}). Experiments that measure the DEC Effect may therefore serve as a tool for the discovery of hidden DE operators through RT patterns. That is, in every case where there is a UE environment due to two DE operators (or more generally, where $2n_{DE} = n_{UE}$), we expect response times to be elevated relative to “true” UE environments. The processing signature of such operators, even if covert, should be revealed experimentally. We are currently engaged in further experimentation along these lines.

We note, moreover, that other work in our lab may provide preliminary hints regarding differences between adjectives and quantifiers with respect to hidden negation – differences that RH might welcome, but Büring’s approach would not predict, as it gives all negations

¹⁸ Additional assumptions regarding the copying process in the context of phrasal ellipsis are suppressed, as they are orthogonal to the issue under consideration, namely, they do not affect the number of DE operators at LF.

the same status. At this point, there is little evidence regarding adjectival antonyms and negations that they may conceal, yet Agmon, Deschamps, Loewenstein and Grodzinsky (2016) have begun to explore this issue both behaviorally and through functional MRI. The preliminary evidence they produced suggests a marked difference between the two types: when a two-way ANOVA is performed over data from positive and negative adjectival antonyms and polar quantifiers, an interaction effect emerges. That is, the difference between antonyms is significantly smaller than the difference between polar quantifiers (see also Tucker, Tomaszewicz and Wellwood, 2017 for a recent experimental exploration).

6. Representational and verificational complexity

The new definition of DEC views the representational complexity of a sentence as a central determinant of its processing cost. This complexity is not acknowledged by the standard WS-based view, inspired by Barwise and Cooper, which focuses on the interaction between monotonicity and Truth-value. This view ascribes the longer RTs for DE sentences to the verification procedure and not to the structure of the quantifiers themselves (cf. also Koster-Moeller, Varvoutis and Hackl, 2008). As noted earlier, this algorithm has two predictions for verification experiments with polar quantifiers: a. a Polarity \times Truth-value interaction – higher RTs are expected for true DE sentences, compared to their UE counterparts, as is a reversal of this relation for false sentences; b. no main effect – no difference is expected between the mean RTs for DE and UE sentences (Figure 1a). Prediction a is borne out, but prediction b is false (Figure 1b). The present view links complexity to the number of DE operators at LF to explain the main effect. The interaction, we argue, is explicable by the WS algorithm. It follows that *a complete account of the RT data requires two components: representational and verificational*.

This analysis of the processing data receives further support when data from several studies are broken down by Truth-value and compared. Consider Figure 6a, with Deschamps et al.'s results from a UE/DE pair of simple quantified sentences are analyzed by the factor Truth-value, and compare it to a similar breakdown of the present experiment with comparatives (Figure 6b):

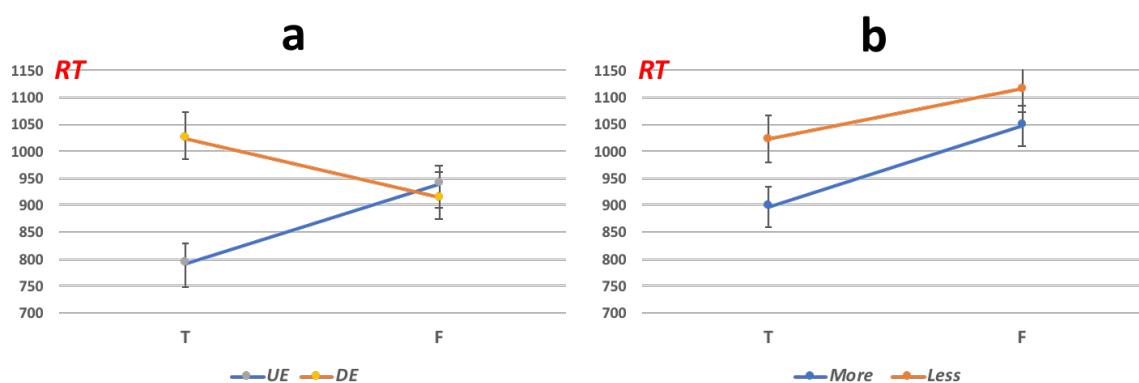


Figure 6: Polarity \times Truth-value interaction in two experiments with sentences containing *more* (blue) vs. *less* (orange). **a.** Deschamps et al.'s results from quantifiers in simple sentences – disordinal interaction effect. **b.** the comparatives experiment – ordinal interaction effect. Error bars mark SEM.

We see a nuanced picture: both studies evince a DEC Effect, attributed to representational complexity. A Polarity \times Truth-value interaction is also observed in both, but it takes different

shapes. The interaction for the simple sentences [$F(1,16)=14.755$, $p<0.001$] is disordinal, with lines whose slopes go in different directions (Figure 6a). The (smaller) effect for the comparatives [$F(1,21)=7.84$, $p<0.02$], by contrast, is ordinal – the lines in Figure 6b, though not parallel, nonetheless have slopes in the same direction.

Assuming verification by the WS strategy, this contrast is expected: when applied to simple quantificational sentences, this strategy expects performance inversion when Truth-value switches (see Bott, Klein and Schlotterbeck, 2013, Szymanik, 2016). For comparatives, no such strategy can be employed, and the lines are indeed near parallel. The slopes in Figure 6b (the difference between RTs for true and false sentences) remain unaccounted for.

Thus, despite various objections to the WS approach to verification, the experimental results, once properly handled, appear in keeping with this approach in places where it applies. We make no claim, though, regarding the algorithm that is used to verify comparatives.

7 Final thoughts

The robust DEC Effect found for phrasal comparatives (i) sharpens our view of the way the processing cost of DE-ness is manifested and shows that the complexity of quantifier processing is bi-componential; (ii) supports a decompositional view of *less*-comparatives, and (iii) underscores the value of experimental work as a powerful tool for the discovery of hidden linguistic structure.

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Linguistic barriers to logical reasoning: a new perspective on Aristotelian syllogisms¹

Andreas HAIDA — *ELSC, The Hebrew University of Jerusalem*

Luka CRNIČ — *LLCC, The Hebrew University of Jerusalem*

Yosef GRODZINSKY — *ELSC, The Hebrew University of Jerusalem*

Abstract. Experimental studies investigating logical reasoning performance show very high error rates of up to 80% and more. Previous research identified scalar inferences of the sentences of logical arguments as a major error source. We present new analytical tools to quantify the impact of scalar inferences on syllogistic reasoning. Our proposal builds on a new classification of Aristotelian syllogisms and a closely linked classification of reasoning behaviors/strategies. We argue that the variation in error rates across syllogistic reasoning tasks is in part due to individual variation: reasoners follow different reasoning strategies and these strategies play out differently for syllogisms of different classes.

Keywords: syllogisms, reasoning errors, individual variation, scalar inferences.

1. Introduction

Our paper investigates the impact of so-called *scalar inferences* on logical reasoning performance. From almost its outset, the study of the psychology of logical reasoning aimed at identifying common inferences that lead to divergence from logically valid reasoning (Sells, 1936; Wilkins, 1928; Woodworth and Sells, 1935). A long-recognized example of such an inference is the scalar inference (SI) from the truth of an existential sentence to the falsity of its universal counterpart, represented by the scheme in (1) (Begg and Harris, 1982; Newstead and Griggs, 1983; Rips, 1994).²

(1) some Ms are Ks $\overset{SI}{\rightsquigarrow}$ not all Ms are Ks

To see how commonly the SI in (1) seems to be drawn in logical reasoning tasks, consider the argument in (2), from the premise (I) to the putative conclusion (O).³ We will be looking at the

¹We would like to thank the participants of the “Semantics and Natural Logic” special session of *Sinn und Bedeutung* 22 for their comments and suggestions. Versions of this work have been presented at the LINGUAE Seminar at Institut Jean Nicod, Paris and the linguistics seminar at the University of Wisconsin at Milwaukee. We wish to thank the audiences of these events for their constructive remarks. This work was supported by grant 1926/14 from the Israel Science Foundation (Crnič), grant 2093/16 of the Israel Science Foundation (Grodzinsky), and a post-doctoral grant from the Edmond and Lily Safra Center for Brain Sciences (Haida).

²An argument that the inference in (1) is not a logical entailment comes from the fact that the negation of an existential sentence is false if its universal counterpart is true. This means that either the indefinite determiner *some* is not a logical constant of English or the SI of an existential sentence is not a logical entailment. In either case, the inference in (1) is not logically valid. We follow the standard assumption due to Grice (1975) that *some* is a logical constant, and hence that the inference in (1) is not a logical entailment. See footnote 8 for further discussion.

³Here and below, we use the letters I and O to designate existential sentences by their traditional names from Aristotelian-scholastic logic (see §2 for a compilation of relevant terminology). The difference between I- and O-sentences is that the predicate in the nuclear scope of the indefinite determiner is negated in O-sentences and

impact of the SI of the I-sentence, i.e., at the impact of (1). Take note that the I-sentence functions as the *premise* of the argument, since this will play an important role for our discussion.

- (2) $\frac{(1) \quad \text{Some Ms are Ks}}{(O) \quad \text{Some Ms are not Ks}}$ accepted by 94% of all subjects

Newstead and Griggs (1983), henceforth N&G, report that, when asked to decide whether the O-sentence “logically follows” from the I-sentence, 94% of all subjects gave a positive response.⁴ However, inferences from I-sentences to O-sentences are not logically valid: in Aristotelian logic (AL) as well as in predicate logic (PL) (and all other logics that we are aware of) existential sentences are logically compatible with their universal counterparts.^{5,6} Thus, since the reasoning task targeted logical inferences,⁷ 94% of all subjects erred in their judgment. A possible explanation for this high error rate is that the vast majority of subjects not only considered the logical entailments of the I-premise but also its SI.⁸ Importantly, the conjunction of the I-premise and its SI logically entails the O-conclusion.⁹ This observation suggests that the errors observed in the I-to-O inference task are due to the SI of the I-premise (as already concluded by N&G). Furthermore, the magnitude of the error rate suggests that almost all reasoners computed (and took it into account) the SI of the I-premise.

Next, we are looking at the same reasoners and the same I-sentence, but this time when it functions as the *conclusion* of an argument. N&G observe that the argument in (3), from the premise (A) to the putative I-conclusion, was judged logically valid by 73% of all subjects.¹⁰ That is, as indicated only 27% of all subjects rejected the validity of the A-to-I inference.

not negated in I-sentences.

⁴In the experiment instructions, subjects were informed that alphabetic letters, in our example *M* and *K*, stand for classes of things. In a follow-up experiment, N&G found that replacing the letters with concrete nouns such as *artist* or *bee-keeper* does not lead to significantly different results.

⁵The language of AL is a proper fragment of the language of PL. Semantically, AL differs from PL in that universal sentences entail their existential counterparts. Thus, in the former *all Ms are Ks* entails *some Ms are Ks* and *no Ms are Ks* entails *some Ms are not Ks*. Natural language quantifiers are Aristotelian in the sense that they entail (or presuppose) that the extension of their restriction is non-empty. Still, there might be reasoners who employ PL in logical reasoning tasks.

⁶In AL, the logical compatibility of existential sentences with their universal counterparts implies that the inference in (1) is not an entailment (cf. footnote 2).

⁷Maybe problematically, N&G’s experiment instructions do not spell out what it means for a sentence (form) to logically follow from another one. Still, if the determiner *some* is a logical constant of English (see footnote 2) N&G’s result can be taken to show that only few subjects assigned the I-sentence its logical meaning, $\exists x(Mx \wedge Kx)$.

⁸According to the grammatical view of SIs, the I-premise can entail the O-conclusion, namely if and only if the string *some Ms are Ks* is parsed with a covert exhaustification operator *exh* (Chierchia et al., 2012). This means that the grammatical view also holds that the indefinite determiner *some* is a logical constant of English and that its truth-conditional content does not bring about the inference in (1) all by itself. Hence, since I-sentences can be parsed without *exh*, the inference from I- to O-sentences is not a *logical* entailment on the grammatical view either.

⁹The SI of the O-conclusion, viz. that its stronger universal counterpart *all Ms are not Ks* (\equiv *no Ms are Ks*) is false, is entailed by the I-premise. Thus, the judgment whether the O-sentence logically follows from the I-sentence is not affected by the SI of the O-sentence.

¹⁰The letter A is the traditional name of universal affirmatives, i.e., sentences of the form *all Ms are Ks*. Universal negatives, i.e., sentences of the form *no Ms are Ks* will be designated by the letter E (see also §2).

- (3) $\frac{\text{(A) All Ms are Ks}}{\text{(I) Some Ms are Ks}}$ rejected by 27% of all subjects

In AL, A-to-I inferences are logically valid. However, the I-conclusion can only be drawn if its SI is *not* computed. Thus, the rejection rate of the A-to-I inference suggests that only a minority of reasoners computed the SI of the I-conclusion.¹¹

These observations raise the question of why the SI of an I-premise is computed more frequently than the SI of an I-conclusion, i.e., > 90% vs < 30% of all times.¹² Our answer will be based on the consideration that the locus or loci of SI computation characterize different types of reasoners, viz. the four types in Table 1, where the rows \pm strong mark whether or not the SI of a premise is computed and conjunctively added to its literal meaning, and likewise for the columns and the conclusion. (Henceforth, instead of saying that the SI of a sentence is computed and conjunctively added to its literal meaning we simply say that the sentence is *strengthened*.)

		Conclusion	
		–strong	+strong
Premise(s)	–strong	Logician	Invalidator
	+strong	Validator	Strengtheners

Table 1: Possible reasoner types by the loci of SI computation

Table 1 shows that we can hypothetically distinguish between four types of reasoners. These are reasoners that strengthen (i) neither premises nor conclusions (we call reasoners of this type *Logicians*), (ii) premises and conclusions (*Strengtheners*), (iii) premises but not conclusions (*Validators*), and (iv) conclusions but not premises (*Invalidators*). Reasoners of the first type are called *Logicians* because they only consider the logical relationships between the sentences of an argument. Strengtheners are so called because they strengthen all sentences of an argument. The name *Validator* alludes to the fact that reasoners of this type only strengthen premises, which can only lead to validation of the conclusion.¹³ Similarly, the name *Invalidator* relates to the fact that reasoners of this type strengthen the conclusion and only the conclusion, which can only lead to its invalidation.¹⁴

¹¹In PL, A-to-I inferences are not valid. Therefore, some of the rejections of the A-to-I inference might come from subjects that employ PL instead of AL. Importantly, even if there are PL reasoners, the fact that 73% of all subjects *accepted* the A-to-I inference shows that the large majority of subjects did not reject the A-to-I inference on logical grounds (i.e. they are not PL reasoners). Hence, if these subjects accepted the A-to-I inference on logical grounds (i.e. if they are AL reasoners) they did not compute the SI of the I-conclusion.

¹²There are other, perhaps more interesting questions that can be asked at this point. N&G raise the question of why reasoners interpret I-sentences in I-to-O inferences differently than in A-to-I inferences: “The paradox is that the *same* subjects who believe *all* implies *some* also believe that *some* implies the existence of negative instances!” (p. 539 in *op. cit.*) See §6, where we put this issue on the research agenda.

¹³That is, strengthened premises can entail a conclusion which is not entailed by the premises without their SIs.

¹⁴That is, the conclusion without its SI can be entailed by the premise but the strengthened conclusion may not be entailed.

We put forth the hypothesis that the observed variation in how frequently SIs are computed for premises vs conclusions is due to *individual variation*: there are different reasoning behaviors, i.e., different groups of reasoners.¹⁵ More specifically, we hypothesize that we encounter three groups of reasoners in logical reasoning studies:

- (4) The overall population consists of Logicians, Validators, and Strengtheners.

Our hypothesis predicts that I-to-O inferences are accepted by two groups of reasoners, namely by Validators and Strengtheners. Furthermore, it predicts that A-to-I inferences are rejected by just one group, namely by Strengtheners. Thus, it is supported by the observed variation.¹⁶

To test the hypothesis in (4), we conducted an experiment in which subjects were asked to form a judgment about the logical validity of so-called *sylogisms*, i.e., arguments like those in (5) and (6), where the former is logically valid and the latter logically invalid.

<p>(A) All Ms are Ks</p> <p>(5) (I) Some Ps are Ms</p> <hr style="width: 50%; margin-left: 0;"/> <p>(I) Some Ps are Ks</p>	<p>(A) All Ms are Ks</p> <p>(6) (E) No Ms are Ps</p> <hr style="width: 50%; margin-left: 0;"/> <p>(O) Some Ps are not Ks</p>
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The (in)validity of a syllogism can be affected by SI computation, and their greater complexity allows us to have more variety amongst our experimental items. More importantly, syllogisms can induce more response patterns than arguments with just one premise. Hence, they may yield evidence for all three groups hypothesized in (4) (see §4). The goal of our paper is threefold: (i) to present analytical tools that help quantify the impact of SIs on syllogistic reasoning performance, (ii) to show how these tools can be used to experimentally establish the existence of specific groups of reasoners, and (iii) to discuss to what extent an experiment that we conducted succeeded in doing so.

The paper is structured as follows. We begin with a brief review of (Aristotelian) syllogisms (§2). We then identify six syllogism classes that differ from each other in how SI computation affects (or doesn't affect) their (in)validity (§3). We proceed by spelling out the predictions of the hypothesis that there are three different groups of reasoners, viz. Logicians, Strengtheners, and Validators. That is, we show what response profiles we predict to observe given our

¹⁵Note that this is not the only possible answer. Other researchers correlate error rates in logical reasoning tasks with processing complexity (e.g. Geurts 2003). Importantly, the processing complexity of a reasoning task is assumed to be the same for all reasoners. For instance, Geurts (2003) proposes a complexity measure assuming an “abstract reasoner.”

¹⁶By being existentials, O-sentences also come with a SI, viz. the SI in (i).

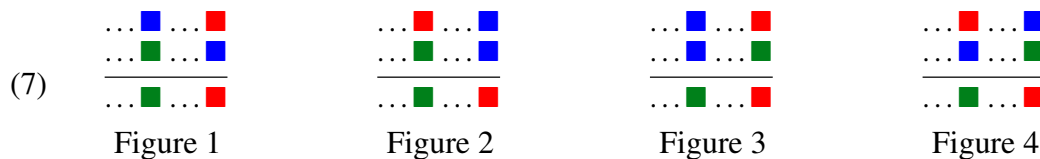
(i) some Ms are not Ks $\overset{SI}{\rightsquigarrow}$ not all Ms are not Ks

As expected, this SI also affects logical reasoning performance: N&G report that 83% of all subjects accepted logically invalid O-to-I inferences. Again, this can be put down to the fact that the I-conclusion is entailed by the conjunction of the O-premise and its SI. Moreover, it can again be hypothesized that SI computation can lead to rejection of a logically valid inference: in N&G's experiment, E-to-O inferences (i.e., inferences from *no Ms are Ks* to *some Ms are not Ks*), which are valid in AL, were rejected by 31% of all subjects, presumably because of the SI in (i). Note that more reasoners accepted O-to-I inferences than reasoners rejected E-to-O inferences, as predicted by the hypothesis in (4): the former are accepted by Strengtheners and Validators, while the latter are only rejected by Strengtheners.

sylogism classes and these reasoner groups (§4). We then describe the experiment that we conducted and discuss its results (§5). We end with a conclusion and an outlook (§6).

2. Syllogisms

As exemplified in (5) and (6) above, syllogisms are arguments that are made up of three sentences, i.e., two premises and a conclusion. The linguistic form of the sentences of a syllogism as well as their arrangement is subject to restrictions.¹⁷ Every sentence must have one of the following four form types, traditionally called A, I, E, O: (A) all α are β ; (I) some α are β ; (E) no α are β ; (O) some α are not β (where α and β are predicate expressions, henceforth *terms*). The distribution of terms in a syllogism is restricted by two constraints: (i) there is one and only one term – the so-called *middle term* – that occurs in both premises (in (5) and (6), the term *M*); (ii) the unique term of the 2nd/1st premise is the (linearly) 1st/2nd term of the conclusion. Constraint (i) allows four distributions of terms, traditionally called figures: 1. the middle term is the 1st/2nd term of the 1st/2nd premise; 2. the middle term is the 2nd term of both premises; 3. the middle term is the 1st term of both premises; 4. the middle term is the 2nd/1st term of the 1st/2nd premise; for all four cases, constraint (ii) uniquely determines the term distribution in the conclusion. The four figures are graphically represented in (7). The colored boxes represent the terms, which means that blue boxes represent the middle term.



Consequently, there are 256 syllogisms: 4 sentence types (A, I, E, O) to the exponent of 3 (2 premises + 1 conclusion) \times 4 figures. Syllogisms are identified by giving, in this order, the form type of the 1st premise, the form type of the 2nd premise, the figure, and the form type of the conclusion. Thus, (5) is an instance of AI1I and (6) an instance of AE3O.

Of the 256 syllogisms, 24 are valid in AL, and 15 of those are also valid in PL. Valid syllogisms have at least one universal (A or E) premise. The nine syllogisms that are valid in AL but not PL have two universal premises and an existential (I or O) conclusion.¹⁸ There are five valid syllogisms with a universal conclusion, which can only be validated by universal premises.¹⁹ Finally, there are ten valid syllogisms with an existential premise and an existential conclusion.²⁰ As we will show in §3, the distribution of existential sentences in a syllogism determines its membership in the syllogism classes that we use to test the hypothesis in (4).

¹⁷We adopt the traditional restrictions from Aristotelian-scholastic logic to make our experimental results more easily comparable with the results of previous studies (e.g. Rips 1994). We agree with Geurts (2003) that these restrictions are mostly arbitrary and hence not particularly interesting from a logical or linguistic point of view.

¹⁸These are AA1I, AA3I, AA4I, AE2O, AE4O, EA1O, EA2O, EA3O, and EA4O.

¹⁹These are AA1A, AE2E, AE4E, EA1E, and EA2E.

²⁰These are AI1I, AI3I, IA3I, IA4I, AO2O, OA3O, EI1O, EI2O, EI3O, and EI4O.

3. Syllogism classes

We now detail how the ways that SIs can affect the (in)validity of syllogisms define syllogism classes, which form the conditions of our syllogism experiment.²¹ We can identify six syllogism classes by how their members are affected by SI computation. The classes are designated by $+v$ if their members are valid in AL, and by $-v$ otherwise. This designation is followed by $\overset{SI}{\rightsquigarrow} +v$, $\overset{SI}{\rightsquigarrow} -v$, or $\overset{SI}{\rightsquigarrow} \pm v$, depending on the effect of SI computation (see below for details). An important outcome of this classification is shown in Table 2. The table foreshadows which reasoner groups of hypothesis (4) are predicted to accept the syllogisms of which of the six classes as valid.

		Effect of SI computation		
		$\overset{SI}{\rightsquigarrow} -v$	$\overset{SI}{\rightsquigarrow} +v$	$\overset{SI}{\rightsquigarrow} \pm v$
Validity status in AL	$-v$	\emptyset	Validators Strengtheners	Validators
	$+v$	Validators Logicians	Validators Logicians Strengtheners	Validators Logicians

Table 2: Which groups are predicted to accept which classes

That is, the designations of the syllogism classes also inform about the mappings from validity in AL to the predicted validity judgments of the reasoner groups of hypothesis (4) (see §4).

There are two *invariant* classes, i.e., classes whose members are unaffected by SI computation:

- $[-v \overset{SI}{\rightsquigarrow} -v]$ Invariantly invalid syllogisms

The syllogisms in this class are not validated by applying SI computation to their premises. There are three possible reasons for this: (i) SI computation is vacuous (syllogisms without existential premises, e.g. EE3I), (ii) SI computation isn't vacuous but the conclusion can only be validated by two universal premises (syllogisms with a universal conclusion, e.g. IE4E), or (iii) SI computation isn't vacuous but the premises are too weak for the SIs to be able to add enough strength to validate the conclusion (syllogisms with two existential premises, e.g. II4I, OO4I).

²¹There is another kind of non-logical inference that is known to drastically impede logical reasoning performance, viz. *illicit conversion* (IC). By IC, the two terms of an A- or O-sentence are interchanged, see (i).

- (i) a. all Ms are Ks $\overset{IC}{\rightsquigarrow}$ all Ks are Ms
 b. some Ms are not Ks $\overset{IC}{\rightsquigarrow}$ some Ks are not Ms

Note that neither the conversion of the terms of an A-sentence, (ia), nor the conversion of the terms of an O-sentence, (ib), is logically valid (hence the qualification *illicit*). We controlled for this influence on reasoning performance by excluding all syllogisms whose (in)validity is affected by IC. For example, we excluded the logically invalid syllogism AE3O in (6) because it is validated by the IC inference of the A-premise. To give an example of the opposite case, we excluded EI1O because the IC inference of the O-conclusions invalidates this logically valid syllogism.

- $[+v \overset{SI}{\rightsquigarrow} +v]$ Invariantly valid syllogisms

The syllogisms in this class are not invalidated by applying SI computation to the conclusion. There is only one possible reason for this: SI computation is vacuous because the conclusion is a universal sentence (AA1A, AE2E, AE4E, EA1E, EA2E).

Furthermore, there are four *variant* classes, i.e., classes whose members are affected by SI computation:

- $[-v \overset{SI}{\rightsquigarrow} +v]$ Invalid syllogisms that are validated by SI computation

Since universal conclusions can be only be validated by universal premises, class $[-v \overset{SI}{\rightsquigarrow} +v]$ can only contain syllogisms with an existential (I or O) conclusion. However, the SI of the existential conclusion must also be validated by the (strengthened) premises, or else SI computation does not necessarily lead to validation. This means that the members of $[-v \overset{SI}{\rightsquigarrow} +v]$ must be counterparts of a pair of valid syllogisms that differ only in that one contains I-sentences in places where the other contains O-sentences. There is one (and only one) such pair: IA3I and OA3O. This means that $[-v \overset{SI}{\rightsquigarrow} +v]$ has the following two members (and only these two members): IA3O and OA3I.

- $[+v \overset{SI}{\rightsquigarrow} -v]$ Valid syllogisms that are invalidated by SI computation

This class contains all valid syllogisms with an existential conclusion (e.g. EI1O), except for the two members of class $[+v \overset{SI}{\rightsquigarrow} \pm v]$ (see below).

- $[-v \overset{SI}{\rightsquigarrow} \pm v]$ Invalid syllogisms that are validated by selective SI computation

Here, “validated by selective SI computation” means that the members of $[-v \overset{SI}{\rightsquigarrow} \pm v]$ are validated by the strengthened premises but only if the SI of the conclusion is not computed. The class contains invalid syllogisms with an existential premise and an existential conclusion (AO1I, AO3I, OA4I, EO1O, EO2O, EO3O, EO4O). To be a member of $[-v \overset{SI}{\rightsquigarrow} \pm v]$, an invalid syllogism must have a valid counterpart in which the existential premise is replaced by its subcontrary (e.g. AI1I for AO1I).

- $[+v \overset{SI}{\rightsquigarrow} \pm v]$ Valid syllogisms that are invalidated by selective SI computation

This class contains valid syllogisms with an existential conclusion and an existential premise such that (i) the strengthened conclusion is not entailed by the premises and (ii) the strengthened conclusion is entailed by the SI of the existential premise in conjunction with the other premise. Class $[+v \overset{SI}{\rightsquigarrow} \pm v]$ has two members, namely IA3I and OA3O.²²

²²It can be easily seen that the SI of the I-conclusion of IA3I is entailed by the SI of the I-premise in conjunction with the A-premise: the SIs of the I-conclusion and I-premise are the corresponding O-sentences, and OA3O is a valid syllogism (and the other way around for OA3O).

It can be easily verified that these six classes exhaust the set of syllogisms. However, in section 5.3 we will present refinements of this classification.

4. Predictions

In §1, we formulated the hypothesis that there are three groups of reasoners, which we named Logicians, Validators, and Strengtheners. Table 3 recapitulates how we characterize these groups. In addition to this, the table shows how the members of each group interpret existential premises and conclusions, and what effect this can have for the validity of an argument. Thereby, “weak” stands for the literal ‘some or all’ meaning of the existential quantifier *some* and “strong” for its ‘some and not all’ meaning, which is derived by conjunctively adding its SI to the literal meaning. The colors encode the relation between the locus of SI computation and the potential effect of the SI.

	Logicians	Validators	Strengtheners	
	don’t compute SIS	compute SIS for premises but not for conclusions	compute SIS for premises and conclusions	
Existential premise	weak	strong	strong	can validate an invalid argument
Existential conclusion	weak	weak	strong	can invalidate a valid argument

Table 3: The three groups and their interpretation of existential sentences of an argument

With the assumption of these three groups of reasoners, we predict to observe three different response patterns in syllogistic reasoning experiments, which are given in Table 4. For obvious reasons, we predict that the validity judgments of Logicians directly reflect the logical validity of a syllogism. That is, they are predicted to accept (✓) the syllogisms of all classes that are designated as valid ($[+v\dots]$) and to reject (✗) the syllogisms of all classes that are designated as invalid ($[-v\dots]$). Validators are predicted to accept the syllogisms of all classes that are designated as $[+v\dots]$, $[\dots \overset{SI}{\rightsquigarrow} +v]$, or $[\dots \overset{SI}{\rightsquigarrow} \pm v]$ (valid or valid if SI computation applies (only) to the premises), and to reject all others. Finally, Strengtheners are predicted to reject the syllogisms of all classes that are designated as $[\dots \overset{SI}{\rightsquigarrow} -v]$ or $[\dots \overset{SI}{\rightsquigarrow} \pm v]$ (invariantly invalid or invalid if SI computation applies to the conclusion), and to accept all others.

5. Experiment and results

5.1. The experiment

To test the predictions of our approach, we conducted an experiment with 120 participants over Amazon Mechanical Turk. Since class $[+v \overset{SI}{\rightsquigarrow} \pm -v]$ evokes the same responses as class $[+v \overset{SI}{\rightsquigarrow} -v]$ for all three groups (see Table 4), we chose not to use tokens of class $[+v \overset{SI}{\rightsquigarrow} \pm v]$ in the experiment. Each participant was asked to give 100 binary acceptability judgments for

Syllogism class	Logicians	Validators	Strengtheners	
$[-v \overset{SI}{\rightsquigarrow} -v]$	✗	✗	✗	invariant
$[-v \overset{SI}{\rightsquigarrow} \pm v]$	✗	✓	✗	} affected by SI computation
$[-v \overset{SI}{\rightsquigarrow} +v]$	✗	✓	✓	
$[+v \overset{SI}{\rightsquigarrow} -v]$	✓	✓	✗	
$[+v \overset{SI}{\rightsquigarrow} \pm v]$	✓	✓	✗	
$[+v \overset{SI}{\rightsquigarrow} +v]$	✓	✓	✓	invariant

Table 4: The predicted reasoning patterns for the members of each group

20 tokens of each of the five selected syllogism classes. Participants were told that they will be presented arguments with two premises and a conclusion, and were instructed “to say whether the premises being true means that the conclusion must be true as well.” That is, we used a necessity statement and the intuitive notion of the truth of a sentence to evoke judgments about logical validity. The syllogism in (8) exemplifies the tokens that we used in our experiment.

- (8)
$$\begin{array}{l} \text{No Italians are miners} \\ \text{All bikers are Italians} \\ \hline \text{No bikers are miners} \end{array}$$

For the three terms of the syllogism tokens, we used different nationalities, professions, and hobbies (above *Italian*, *miner*, and *biker*, respectively), without repetitions. Which of the three terms functioned as the middle term was always randomly determined. The experimental task was preceded by a practice session consisting of two arguments that were different in form from (Aristotelian) syllogisms. Participants received feedback to their responses in the practice session.

5.2. Results: acceptance rates

Table 5 shows the mean acceptance rates of the syllogisms of each class. The ordering of the table rows reflects how many groups are predicted to accept the syllogisms of the corresponding class.²³ The table furthermore shows which differences between the mean rates we predict with the hypothesis that there are Logicians (L), Validators (V), and Strengtheners (S): brackets of the right side of Table 5 connect certain pairs of rows; for each bracket (and transitively each connected sequence of brackets), we predict a higher mean acceptance rate for the class at the lower tip of the bracket than for the class at the upper tip.

²³Since we don't make any predictions about the relative size of the groups, the order of the rows of class $[-v \rightsquigarrow +v]$ and $[+v \rightsquigarrow -v]$ with respect to each other is arbitrary.

Class	L	V	S	% acc.
$[-v \rightsquigarrow -v]$	✗	✗	✗	19
$[-v \rightsquigarrow \pm v]$	✗	✓	✗	56.4
$[-v \rightsquigarrow +v]$	✗	✓	✓	64.6
$[+v \rightsquigarrow -v]$	✓	✓	✗	60.7
$[+v \rightsquigarrow +v]$	✓	✓	✓	76.3

Table 5: Mean acceptance rates and predicted differences

Since the judgments with respect to class $[-v \rightsquigarrow -v]$ and $[+v \rightsquigarrow +v]$ are not impeded by SI computation,²⁴ the error rates of 19% false positives and 23.7% false negatives are the most immediate reflexes of true performance errors. The error rates show that there is no general positive response bias. Five of the six predictions marked in Table 5 are borne out. However, ANOVA and post-hoc tests show that the difference between the mean acceptance rate of class $[-v \rightsquigarrow \pm v]$ and $[+v \rightsquigarrow -v]$ does not reach significance. That is, our prediction that syllogisms of class $[+v \rightsquigarrow -v]$ are accepted more often than syllogisms of class $[-v \rightsquigarrow \pm v]$ because the former are accepted by Logicians and Validators, while the latter are only accepted by Validators, is *not* borne out.

5.3. Discussion

As was just pointed out, the difference between the mean acceptance rate of class $[-v \rightsquigarrow \pm v]$ and $[+v \rightsquigarrow -v]$ does not reach significance. On closer inspection, the reason for this is that there is too much variation in acceptance rates across the syllogisms in $[+v \rightsquigarrow -v]$. For instance, the tokens of the type in (9) are accepted $\sim 80\%$ of all times, while the tokens of the type in (10) are only accepted $\sim 50\%$ of all times.

(A)	All Ms are Ks	(A)	All Ks are Ms
(9)	(I) Some Ms are Ps	(10)	(E) No Ms are Ps
	(I) Some Ps are Ks		(O) Some Ps are not Ks

As can be easily seen,²⁵ the latter syllogisms are only valid in AL, while the former are valid in both AL and PL. That is, we observe that in $[+v \rightsquigarrow -v]$ syllogisms that are valid in both AL and PL are accepted more often than syllogisms that are only valid in AL.^{26,27}

²⁴Note also that we excluded syllogisms whose (in)validity is affected by IC inferences (see footnote 21).

²⁵Recall that all syllogisms with two universal premises and an existential conclusion, such as AE4O and EA3O, are invalid in PL and that all syllogisms that are valid in PL are also valid in AL.

²⁶We did not collect the information whether a participant had training in formal logic. However, Rips (1994) notes that the subjects of his and Jeffrey Schank's experiment were "20 University of Chicago students, none of whom had taken a course in logic." Importantly, the data set of Rips (1994) also suggests that a syllogism's validity in PL is a relevant factor for the acceptance rates within class $[+v \rightsquigarrow -v]$: syllogisms in $[+v \rightsquigarrow -v]$ that are valid in both AL and PL were accepted 68% of all times and syllogisms in $[+v \rightsquigarrow -v]$ that are only valid in AL 51% of all times.

²⁷One might think that this result is expected since Rips (1994) already notes that "subjects gave 85.8% "follows"

Another distinction that we overlooked in the design of our experiment is whether or not the sentences of a syllogism are inconsistent (before or after strengthening). Taking inconsistency into account leads to the following subclassifications of the classes identified in §3, where the designation $-c$ stands for ‘inconsistent:’

- Subclass $[-v \overset{SI}{\rightsquigarrow} -c]$ of $[-v \overset{SI}{\rightsquigarrow} -v]$

Class $[-v \overset{SI}{\rightsquigarrow} -c]$ contains syllogisms with the following properties: the SI of one of its premises in conjunction with the other premise entails the contradictory of the conclusion. The syllogisms in this class (e.g. AI2A) have a valid syllogism as a counterpart which expresses the problematic entailment.²⁸

- Subclass $[-c]$ of $[-v \overset{SI}{\rightsquigarrow} -v]$

This class contains syllogisms that are formed from sets of inconsistent sentences, i.e., counterparts of valid syllogisms in which the valid conclusion is replaced by its contradictory (e.g. AA1O, which is the inconsistent counterpart of the valid syllogism AA1A).

- Subclass $[+v \overset{SI}{\rightsquigarrow} -c]$ of $[+v \overset{SI}{\rightsquigarrow} -v]$

Class $[+v \overset{SI}{\rightsquigarrow} -c]$ contains all valid syllogisms with an existential (I or O) conclusion that have a valid counterpart in which the superaltern (A or E) is the conclusion (e.g. AA1I, which has AA1A as a counterpart; the SI of the I-conclusion of AA1I is the contradictory of the A-conclusion of AA1A).

The relevance of this subclassification for syllogistic reasoning studies can be seen from the fact that the rate of false positives is lower for class $[-v \overset{SI}{\rightsquigarrow} -c]$ and class $[-c]$ than for class $[-v \overset{SI}{\rightsquigarrow} -v]$, where $[-v \overset{SI}{\rightsquigarrow} -v]$ is now taken to exclude the syllogisms in the former two classes (i.e. the designation $-v$ now stands for ‘invalid but consistent’). This is shown in Table 6.²⁹

Class	% acc. in Rips (1994)
$[-v \overset{SI}{\rightsquigarrow} -v]$	10.3
$[-v \overset{SI}{\rightsquigarrow} -c]$	1.5
$[-c]$	1

Table 6: The effect of inconsistency on the rate of false positives

responses to [syllogisms that are valid in both AL and PL], but only 63.3% “follows” responses to the nine [syllogisms that are only valid in AL]. In Dickstein’s study [Dickstein 1978], the corresponding percentages are 89.4 and 70.8.” Importantly, however, the class of syllogisms that are valid in both AL and PL has class $[+v \rightsquigarrow +v]$ as a subclass. The syllogisms in $[+v \rightsquigarrow +v]$ are expected to be accepted more often than any other syllogism (and hence to lift the mean acceptance rate of its superclass) because they are logically valid and not invalidated by SI computation. From our point of view, it is highly unexpected to find an effect of PL validity *within* class $[+v \rightsquigarrow -v]$.

²⁸In the case of AI2A, the valid counterpart is AO2O: its O-premise is the SI of the I-premise of AI2A and its O-conclusion is the contradictory of the A-conclusion of AI2A.

²⁹Our item set does not contain tokens of class $[-v \overset{SI}{\rightsquigarrow} -c]$ or $[-c]$. Therefore, we use the data of Rips (1994) in Table 6.

There are two possible explanations of the effect of inconsistency on the rate of false positives: (i) inconsistency leads to better recognition of invalidity; (ii) there are reasoners that do not form a judgment about logical consequence but about logical consistency (i.e. they check whether the conclusion is logically consistent with the premises).

We do not observe the same effect of inconsistency on false negatives. That is, as shown in Table 7 the rate of false negatives is not lower in class $[+v \overset{SI}{\rightsquigarrow} -c]$ than in class $[+v \overset{SI}{\rightsquigarrow} -v]$.³⁰

Class	% acc. in our data	% acc. in Rips (1994)
$[+v \overset{SI}{\rightsquigarrow} -v]$	53.4	51.3
$[+v \overset{SI}{\rightsquigarrow} -c]$	51.9	57

Table 7: The effect of inconsistency on the rate of false negatives

In the context of our hypothesis that there are Strengtheners, this result neither supports hypothesis (i) nor hypothesis (ii). For both syllogisms in $[+v \overset{SI}{\rightsquigarrow} -v]$ and syllogisms in $[+v \overset{SI}{\rightsquigarrow} -c]$, Strengtheners compute the SI of the conclusion. By hypothesis (i), they recognize the resulting invalidity of the logical consequence relation better for syllogisms in $[+v \overset{SI}{\rightsquigarrow} -c]$ than for syllogisms in $[+v \overset{SI}{\rightsquigarrow} -v]$. That is, by hypothesis (i) they are predicted to reject syllogisms in $[+v \overset{SI}{\rightsquigarrow} -c]$ more often than syllogisms in $[+v \overset{SI}{\rightsquigarrow} -v]$. By hypothesis (ii), some of the Strengtheners may form a consistency judgment instead of a judgment about logical consequence. Therefore, by hypothesis (ii) they are predicted to accept syllogisms in $[+v \overset{SI}{\rightsquigarrow} -v]$ more often than syllogisms in $[+v \overset{SI}{\rightsquigarrow} -c]$. Neither prediction is supported by the observed data. A possible explanation for the data in Table 7 is that the SI of an existential conclusion is (sometimes) not computed if the premises settle the stronger universal alternative (i.e. if they entail the universal alternative or entail its negation).³¹ In the case of the syllogisms in $[+v \overset{SI}{\rightsquigarrow} -c]$, the universal alternative is settled by the premises since they entail the contradictory of the SI of the conclusion, which is the negation of the universal alternative.

5.4. Results: identifying groups of reasoners

In this section, we illustrate how to determine whether the observed mean acceptance rates reflect homogeneous behavior within different groups and not heterogeneous behaviour of a single group (i.e. all subjects). Recall that every participant of our experiment gave a judgment about 20 tokens of each of the five selected syllogism classes. This means that for every participant we have a rich response profile by means of which we can detect consistent behavior

³⁰All of the syllogisms in class $[+v \rightsquigarrow -c]$ are invalid in PL, since they have two universal premises and an existential conclusion. Therefore, the numbers for class $[+v \rightsquigarrow -v]$ in Table 7 reflect only the acceptance rates of PL-invalid syllogisms. Our data set contains tokens of only one such syllogism. The apparent difference between the acceptance rate of the syllogism in $[+v \rightsquigarrow -v]$ and the mean acceptance rate of class $[+v \rightsquigarrow -c]$ is not significant.

³¹According to Fox (2007), SI computation is motivated by the goal to reduce speaker ignorance inferences. If the premises of a syllogism settle the universal alternative of the conclusion, no speaker ignorance inference arises for this alternative and hence there is no motivation to derive the SI of the conclusion.

In Figure 2 and Figure 3, we show the inhabited coordinate space, i.e., the space onto which all subjects with an error rate of $\leq 12.5\%$ relative to the invariant classes are mapped (\approx half of all subjects).

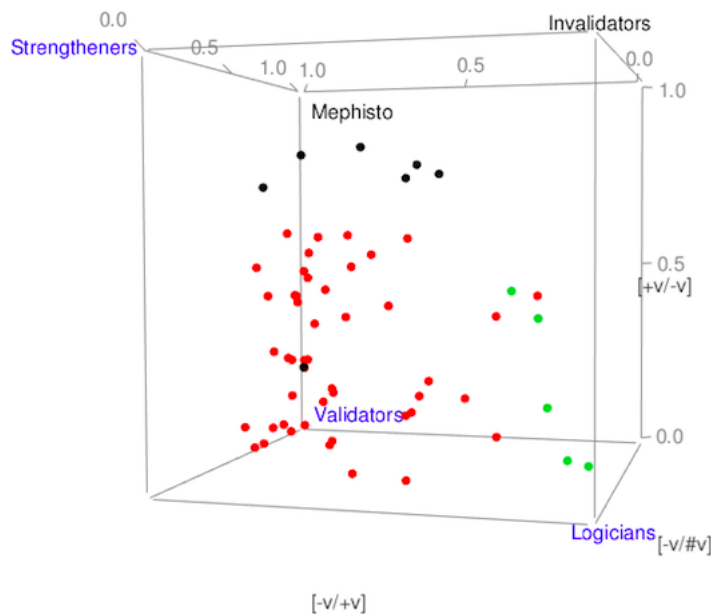


Figure 2: The inhabited coordinate space

The figures show that there are two density clusters (determined by DBSCAN), which are marked in red and green (outliers are black). The Logicians' corner is a border point of the green cluster (i.e., it is in the neighborhood of a core point of the green cluster but not itself a core point). This means that the subjects that belong to the green cluster can count as Logicians. Similarly, the Validators' corner is a core point of the red cluster. Hence, the subjects that belong to the red cluster can count as Validators.³² The two perspectives provided by Figure 2 and Figure 3 show that the Strengtheners' corner is not populated and neither is any other corner. This means that there is no evidence for populations other than Logicians and Validators. Note that Figure 3 shows that almost all subjects are above the zero point of the z-axis and Figure 3 shows that almost all subjects are left of the diagonal of the base square of the cube. This means that almost all subjects strengthen conclusions sometimes. However, we don't observe systematic strengthening of conclusions, i.e., there are no Strengtheners.

In a certain sense, our data do not contain a lot of noise: as the result of DBSCAN shows our data set contains only few outliers. However, we still need to be concerned about the quality of the data since the clusters that we can identify and associate with specific reasoning behaviors are very spacious. That is, the large majority of points are very distant from the corners that represent the reasoning behaviors that we hypothesized to exist. This means that only a small

³²Since the number of density clusters and their size depend, by design, on the parameter settings that determine what counts as a populated neighborhood, different parameters would have produced different results. The point of our demonstration is to show that there are parameters that determine two clusters that we can identify with two reasoner groups of hypothesis (4). Importantly, there is no parameter setting that would give us the group of Strengtheners of the group of Invalidators.

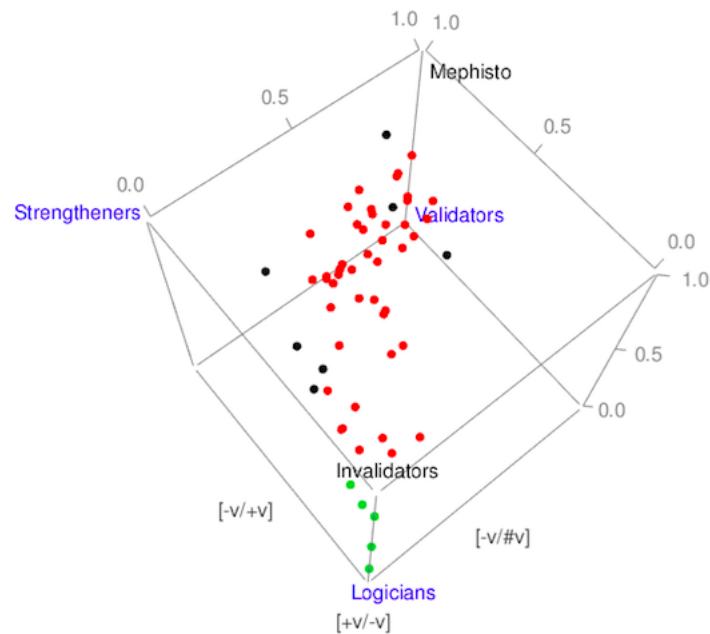


Figure 3: Another perspective on the inhabited coordinate space

proportion of subjects showed the hypothesized behaviors consistently. We think that this is a consequence of the experimental design (primarily the length of the experiment).

6. Conclusion and outlook

We have presented a classification of syllogisms that allows to quantify how frequently the premises and/or the conclusion of a syllogism is strengthened by SI computation. Furthermore, we have put forward the hypothesis that there are three groups of reasoners, viz. Logicians, Validators, and Strengtheners, whose reasoning behavior is characterized in terms of the loci of SI computation in logical arguments. In this way, we could argue that the variation in error rates observed across syllogisms is an effect of individual variation: members of different reasoner groups form the same judgment for the syllogisms of some classes and different judgments for the syllogisms of other classes. The experimental results that we presented support this hypothesis to a certain extent. For instance, the assumption that there is a group of Strengtheners makes correct predictions for the mean error rates of certain classes. Problematically, though, there is no further evidence for the hypothesized group of Strengtheners. That is, our data set contains no cluster of response patterns that can be identified with the response pattern of an idealized Strengtheners. Importantly, however, we *did* find this kind of evidence for the two other groups, viz. for the groups of Logicians and Validators.

In future research, we want to address two issues: (i) There is evidence that suggests that some reasoners employ PL in syllogistic reasoning tasks. This behavior raises the question under what circumstances these reasoners associate natural language quantifiers with non-Aristotelian meanings. Answering this question will inform us about the nature of the requirement that ensures the Aristotelian property of (strong) natural language quantifiers, i.e., the requirement that the restriction of a quantifier be non-empty. (ii) The reasoning behavior of Validators shows

the preferred locus for SI computation in logical arguments, viz. the premises of an argument. We want to answer the question whether such a preference can also be found in other supra-sentential contexts, and if so, how these contexts can be characterized. This will inform us about the reason why Validators employ SI computation selectively and hence inform about the motivation for SI computation being employed in natural language discourse.

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A Comparison of *fei* and *aber*¹

Stefan HINTERWIMMER — *University of Cologne*

Cornelia EBERT — *Leibniz-Zentrum Allgemeine Sprachwissenschaft, Berlin*

Abstract. This paper compares the modal particle *fei* (Schlieben-Lange, 1979; Thoma, 2009) with the modal particle/sentence adverb *aber* (not to be confused with the conjunction *aber*, ‘but’). Intuitively, both items express some form of contrast and correction. We will show that both are special among discourse particles in the following sense: They make a contribution that is interpreted at a level distinct from the level where at-issue content (Potts, 2005) is interpreted, as is standard for modal particles (see Gutzmann, 2015 and the references therein). But more interestingly, they exclusively relate to propositions that have not entered the Common Ground via being the at-issue content of an assertion made by the addressee.

Keywords: discourse particles, assertions, at-issue content, presuppositions, conventional implicatures, conversational implicatures.

1. Introduction

In this paper we compare the Bavarian modal particle *fei* (Schlieben-Lange, 1979; Thoma, 2009), which does not have a direct counterpart in standard German, with the modal particle/sentence adverb *aber* (not to be confused with the conjunction *aber*, ‘but’), which exists in Bavarian as well as in standard German. Intuitively, both items express some form of contrast and correction. We will show that both are special among discourse particles in the following sense, however: They make a contribution that is interpreted at a level distinct from the level where at-issue content (Potts, 2005) is interpreted, as is standard for modal particles (see Gutzmann, 2015 and the references therein). But more interestingly, they exclusively relate to propositions that have not entered the Common Ground via being the at-issue content of an assertion made by the addressee.

Following Hinterwimmer (to appear), we assume that *fei* is used by the speaker to direct the addressee’s attention to a conflict between her own and the addressee’s beliefs that is not maximally prominent at the point where the sentence containing *fei* is uttered. Such a conflict would be maximally prominent if a proposition p entailing the negation of the proposition q denoted by the sentence with *fei* had been previously asserted by the addressee. After all, by asserting p , the addressee has presented herself as believing p to be true and proposed to add p to the Common Ground (Stalnaker, 1978). It is thus evident to a speaker who believes a proposition q entailing the negation of p that the addressee believes *not* q , and by asserting q it likewise becomes evident to the addressee that the speaker believes *not* p . Consequently, the conflict between the addressee’s and her own beliefs can be assumed by the speaker to be

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obvious not only to her, but to her addressee as well as soon as she has asserted q , and there is hardly any need to draw the addressee's attention to it.

The situation is different whenever the speaker only infers on the basis of contextual information and/or general background knowledge that the addressee believes a proposition p entailing the negation of the proposition q he is about to assert, or when *not* q is entailed by a conventional or conversational implicature or a presupposition of a previous utterance by the speaker. In such a case, the addressee has not explicitly proposed to add p to the Common Ground, and the question of whether p is true is therefore not automatically maximally prominent at the point where the speaker is about to assert the proposition q . Consequently, the conflict in beliefs does not automatically become maximally prominent as soon as the speaker has asserted q . The addition of *fei* to a sentence denoting q in order to direct the addressee's attention to that conflict is thus not superfluous.

This explains the distribution of *fei*, which is as follows: First, *fei* cannot be added felicitously to a sentence denoting a proposition q in a situation where the addressee has previously asserted a proposition p which contradicts q . Second, the addition of *fei* is perfectly felicitous when the speaker's assumption that the addressee believes p is based on contextual information and/or general background knowledge, or when p is a conventional or conversational implicature or a presupposition of a previous utterance by the speaker.

The discourse particle/sentence adverb *aber*, in contrast, requires there to be a proposition p entailing the negation of the proposition q denoted by the sentence with *aber* that is, on the one hand, prominent at the point where that sentence is uttered. On the other hand, p may likewise not be the at-issue content of a sentence previously uttered by the addressee. Consequently, *aber* behaves like *fei* in certain respects and can felicitously be added to a sentence denoting the proposition q whenever the speaker can infer on the basis of contextually salient information that the addressee believes a proposition p entailing *not* q . In contrast to *fei*, however, *aber* cannot be added to a sentence denoting the proposition q in the three following situations: (a) The information on the basis of which the speaker infers that the addressee believes p is not contextually salient, but only general background knowledge. (b) p is entailed by a conventional implicature of a previous utterance of the addressee. (c) p is entailed by a presupposition of a previous utterance of the addressee.

The paper is structured as follows. Section 2 introduces the data to be accounted for. Section 3 summarizes the analysis of *fei* proposed in Hinterwimmer (to appear). Our analysis of *aber* is presented in Section 4. Section 5 gives the conclusion.

2. Data

Consider the contrast between the felicity of *fei* and *aber* in Tom's reaction in (1), on the one hand, and their infelicity in Tom's reaction in (2), on the other. Since *aber*, as already said in the introduction, exists in standard German as well as in Bavarian, where it is spelled out as *oba*, all examples are given in Bavarian for ease of comparison. The modal particle *doch*, which likewise exists in standard as well as in Bavarian German, has been included for comparison.

(1) Paula (wearing only a shirt): I geh spaziern.

I'll go for a walk.

Tom: S'is (*fei/oba/doch*) saukoit draussn.
It's terribly cold outside.

(2) Paula: S'is goa ned koit drauss'n.
It's not cold at all outside.

Tom: (So a Schmarr'n!) S'is (#*fei/#oba/doch*) saukoit drauss'n.
(What nonsense!) It's terribly cold outside.

In (1), the proposition denoted by the sentence Tom utters contradicts a proposition which Tom can plausibly assume Paula to believe on the basis of her non-verbal behavior in combination with the sentence she utters – namely that it is not cold outside. If she believed otherwise, she would presumably not leave the house with the intention to go for a walk wearing only a shirt. In such a situation, not only *doch* but also *fei* and *oba* can be added felicitously. In (2), in contrast, Paula has explicitly asserted that it is not cold outside. In that situation, only *doch* and neither *fei* nor *oba* can be added felicitously. It thus seems to make a difference whether the addressee has previously asserted a proposition that contradicts the proposition denoted by the sentence with *fei* or *oba*, or whether it can only be inferred by the speaker that the addressee believes that proposition on the basis of a combination of verbal and non-verbal behavior. The modal particle *doch*, in contrast, seems to be insensitive to that difference.

Consider next the contrast between (3) and (4). In (3), the addition of *fei* or *oba* is presumably infelicitous for the same reason for which it was infelicitous in (2) – the addressee has previously asserted a proposition which contradicts the proposition denoted by the sentence containing the respective discourse particle/sentence adverb (these sentences will henceforth be called the *prejacent*s). In (4), in contrast, where the same proposition – namely that Otto has eaten the whole cake – has not been asserted, but rather conversationally implicated by the addressee's immediately preceding utterance, both *fei* and *oba* can be added felicitously.

(3) Paula: Da Otto hod den ganzn Kuacha gessn.
Otto has eaten the whole cake.

Tom: Da Otto hod den Kuacha (#*fei/#oba*) ned gessn. Des woa d'Maria.
Otto hasn't eaten the cake. It was Maria!

(4) Paula: Da Otto is in da Kich gwen und da Kuacha is weg.
Otto was in the kitchen and the cake is gone.

Tom: Da Otto hod den Kuacha *fei/oba* ned gessn. Das woa d'Maria.
Otto hasn't eaten the cake. It was Maria!

Taken together, the contrasts discussed so far could be taken to show that both *fei* and *oba* can only be added to a sentence denoting the proposition *p* if the speaker believes but does not know for sure that the addressee believes a proposition contradicting *p*. After all, it is one of the defining features of conversational implicatures that they can be cancelled, and inferences based on verbal combined with non-verbal behavior are usually defeasible as well. As soon as an interlocutor *x* has asserted a proposition *q*, in contrast, the other interlocutors know for sure that *x* at least presents herself as believing *q*, and in the absence of mind-reading abilities, that

is the strongest evidence that one can hope to get that x believes q . But now consider the following contrasts.

- (5) Paula: In Fronkreich gibts imma no an Kini.
In France there is still a king.
 Tom: (So a Schmarr'n.) In Fronkreich gibts (#fei/#oba/doch) koan Kini nemma.
What nonsense! In France there is no king anymore.
- (6) Paula: Da Kini von Fronkreich is a Depp.
The king of France is an idiot.
 Tom: In Fronkreich gibts (fei/?oba/doch) koan Kini nemma.
In France, there exists no king anymore.

The infelicity of both *fei* and *oba* in Tom's reaction to Paula's statement in (5) is exactly what we would expect, given what we have said so far, since the proposition asserted by Tom contradicts the proposition asserted by Paula. What is unexpected, though, is the felicity of *fei* in Tom's reaction to Paula's statement in (6): It is standardly assumed, following Strawson (1950) (see Elbourne, 2013 for an overview of the discussion), that by using the definite article the speaker presupposes the existence of a unique entity satisfying the predicate denoted by the respective NP. Consequently, Paula (wrongly) assumes the Common Ground to entail the existence of a unique king of France at the point at which she utters the sentence. Tom has therefore just as strong evidence that Paula believes there to be a king of France in the case of (6) as he has in the case of (5). Concerning *fei*, it is thus not tenable that its addition is infelicitous whenever the speaker knows that the addressee believes a proposition contradicting the proposition denoted by the prejacent. The addition of *oba*, in contrast, while not being quite as infelicitous as in (5), is at least awkward in (6) as well.

Let us turn to the contrast between (7) and (8) next.

- (7) Paula: Da Chomsky is a berühmta Soziologe.
Chomsky is a famous sociologist.
 Tom: (So a Schmarr'n.) Da Chomsky is (#fei/#oba/doch) koa Soziologe.
What nonsense! Chomsky is no sociologist.
- (8) Paula: Da Chomsky, a berühmta Soziologe, is a Anarchist.
Chomsky, a famous sociologist, is an anarchist.
 Tom: Da Chomsky is (fei/?oba/doch) koa Soziologe.
Chomsky is no sociologist.

Again, the infelicity of *fei* and *oba* in Tom's reaction to Paula's utterance in (7) is unsurprising in light of the discussion so far. What is remarkable, however, is that *fei* is fully felicitous in Tom's reaction to Paula's utterance in (8). After all, as far as the relation between the proposition denoted by Tom's reaction and the proposition that Chomsky is a famous sociologist is concerned, the only difference between (7) and (8) is the following: In (7) that proposition is the at-issue content of Paula's previous assertion, while in (8) it is a conventional implicature in the sense of Potts (2005). As shown by Potts (2005), nominal appositives such as *a berühmta Soziologe* ('a famous sociologist') in (8), appositive relative clauses, and

expressives belong to a special kind of linguistic content dubbed *conventional implicatures*. One of the defining features of conventional implicatures is that they, in contrast to ‘ordinary’ semantic content, and similar to presupposed content, are not affected by semantic operations such as negating and questioning: The sentences in (9a-b), for example, are not understood as negating or questioning that Jennifer is a great drummer, but only that she will join the band.

- (9) a. Jennifer, who is a great drummer, will not join the band.
b. Will Jennifer, who is a great drummer, join the band?

At the same time, and in contrast to presupposed content, conventionally implicated content is assumed by the speaker to be new to the addressee. Intuitively, the contrast between conventionally implicated and ‘ordinary’ asserted content, which Potts (2005) dubs *at-issue content*, is the following: Getting across the at-issue content is the main point of the respective utterance. It is thus explicitly put on the table by the speaker (see Farkas & Bruce, 2010), and the addressee is invited to at least implicitly accept the respective proposition, or otherwise reject it explicitly. Conventional implicatures, in contrast, constitute side remarks that do not really promote the conversation and are assumed to be uncontroversial by the speaker, i.e. the speaker expects the addressee to simply accept them. This intuition is formalized by Potts (2005) in the following way: At-issue and conventionally implicated content are assumed to be interpreted at separate levels that do not interact with each other. By uttering the opening sentence in (8), Paula thus makes two claims at the same time: that Noam Chomsky is an anarchist, and that Noam Chomsky is a famous sociologist. The two claims do not have the same status, though. While the first one is the main point of her utterance, and she invites Tom to at least implicitly accept or else reject it, the second one is just a side remark she assumes to be uncontroversial. Nevertheless, Tom does not have any more reason to doubt that Paula believes Chomsky to be a famous sociologist in (8) than in (7), where that proposition is the at-issue content of her assertion. The felicity of *fei* in Tom’s reaction in (8) thus provides further evidence that it is not the question of whether the speaker knows or only believes that the addressee believes a proposition contradicting the prejacent of *fei* that is at stake. The behavior of *oba*, in contrast, is less clear in this regard: While its addition to Tom’s reaction in (8) is certainly not as infelicitous as in (7), it is still awkward and clearly considerably less felicitous than the reaction with *fei*.

Interestingly, the reaction in (8) with *oba* becomes entirely acceptable once Paula’s utterance is addressed and acknowledged first.

- (10) Paula: Da Chomsky, a berühmta Soziologe, is a Anarchist.
Chomsky, a famous sociologist, is an anarchist.
Tom: Aha / Wenn’st moanst... / Ja scho...
Ok / If you think so... / Yes, okay, ...
Da Chomsky is oba koa Soziologe.
But Chomsky is no sociologist.

We assume that by his reaction Tom acknowledges Paula’s utterance and thus agrees to the respective content being added to the Common Ground. After Tom’s acknowledgement, all parts of Paula’s utterance have entered the Common Ground and are now equally prominent. And this seems to be the crucial difference that sets (10) apart from (8). We observe the same

pragmatic effect in (6), where Tom's reaction can also be rescued by acknowledging the content of Paula's utterance first.

- (11) Paula: Da Kini von Fronkreich is a Depp.
The king of France is an idiot.
 Tom: Aha / Wenn'st moanst... / Ja scho...
Ok / If you think so... / Yes, ok, ...
 In Fronkreich gibts oba koan Kini nemma.
In France, there exists no king anymore.

Note also that, unsurprisingly, the facts in (8) and (10) can be re-established with speech-accompanying gestures, which have been claimed to pattern exactly like appositives by Ebert & Ebert (2014).

- (12) Paula: Des TRIANGLE_[Stoppschild] in der Müllerstroß is nei.²
The stop sign in Müllerstraße is new.
 Tom: Des is/Stoppschilder san (fei/?oba/doch) ned dreieckad.
It is/Stop signs are not triangular.

Again, adding an acknowledging phrase in Tom's response to Paula's remark makes *oba* felicitous.

- (13) Paula: Des TRIANGLE_[Stoppschild] in der Müllerstroß ist nei.
The stop sign in Müllerstraße is new.
 Tom: Aha / Wennst moanst... / Ja scho...
Ok / If you think so... / Yes, okay, ...
 Des is/Stoppschilder san oba ned dreieckad.
It is/Stop signs are not triangular.

Consider now the following example, where *fei* and *oba* clearly part ways. Consider first the contrast between the felicity of *fei* in an out-of-the-blue utterance of (14) as compared to the infelicity of *oba*.

- (14) Tom: Des neie Buach vom Kehlmann is (fei/#oba/#doch) spitze!
The new book by Kehlmann is great!

Intuitively, for *fei* to be felicitous it is sufficient for Tom to have good reasons to believe on the basis of general background knowledge that his addressee would have expected the new book by Daniel Kehlmann to be not great (because she does not like the books by Daniel Kehlmann, for example, or believes that no great books are written anymore these days). Consequently, the addition of *fei* would be awkward if Tom knew his addressee to be a fan of Daniel Kehlmann, for example, or to have no opinion whatsoever regarding the books of Daniel Kehlmann. Concerning *oba*, in contrast, general background knowledge is not sufficient to license its use (and similarly for *doch*): Even in a context where the addressee is well known to hate the books by Daniel Kehlmann, the addition of *oba* to (14) leads to infelicity if the

² We indicate that a gesture GEST occurs at the same time as a certain expression EXP by GEST_[EXP]. TRIANGLE denotes a gesture where the speaker iconically indicates a triangular object.

sentence is uttered out of the blue. Rather, for *oba* to be felicitous, the question of whether the new book by Daniel Kehlmann is great needs to have been raised at least implicitly in the preceding conversation. Additionally, just as with *fei*, the speaker needs to have good reasons to believe that the addressee would have expected the new book by Daniel Kehlmann to be not great. Consequently, both *fei* and *oba* are perfectly fine in Tom's reaction to Paula's utterance in (15).

- (15) Paula: S'gibt oifach koane gscheidn Biacha nemma.
There simply are no good books anymore.
 Tom: Des neie Buach vom Kehlmann is (fei/oba/doch) spitze!
The new book by Kehlmann is great!

With this in mind, consider next the contrast between (16) and (17).

- (16) Paula: Des neie Buach vom Kehlmann is spitze!
The new book by Kehlmann is great.
 Tom: Des is (#fei/#oba/doch) da letzte Schmarr'n.
It's complete nonsense.

- (17) Paula: I find des neie Buach vom Kehlmann spitze!
I find the new book by Kehlmann great.
 Tom: Des is (#fei/oba/doch) da letzte Schmarr'n.
It's complete nonsense.

Again, the infelicity of both *fei* and *oba* in Tom's reaction to Paula's utterance in (16) is expected in light of our discussion so far, since the at-issue content of Paula's utterance contradicts the at-issue content of Tom's utterance. The infelicity of *fei* in Tom's reaction to Paula's utterance in (17) is likewise expected, since the at-issue content of that utterance entails that she believes a proposition that contradicts the prejacent of *fei* – namely that the new book by Daniel Kehlmann is no nonsense. What is surprising, however, is the felicity of *oba* in (17), which, given what we have said so far, should be infelicitous for the same reason as *fei*. In contrast to *fei*, *oba* only seems to be infelicitous when the addressee has previously asserted a proposition *p* that contradicts the prejacent, but not when she has asserted that she 'finds' *p*. When a speaker says that she finds *p*, this is a subjective judgment presented as an opinion and not a fact (for an analysis of German *finden* 'find', see among others Reis, 2013; Umbach, in press), which seems to matter for the felicity of Tom's reaction with *oba* in (17).

Consider furthermore the following exchange between Paula and Tom.

- (18) Paula: I woaß ned ob I ma des neie Buach üba d'Münchna Räterepublik kafa sui.
I don't know if I should buy the new book about the Soviet republic of Munich.
 Tom: Des is (fei²/oba/doch) interessant.
It's interesting.

In the case of (18), Paula's utterance indicates that she believes neither the proposition denoted by Tom's reaction nor its negation, i.e. she considers it both possible that the book is interesting and that it is not interesting – otherwise there would be no point in making the utterance in the

first place. In such a situation, the addition of *fei* is perfectly felicitous, while *oba* is degraded (although far from being infelicitous).

Our observations regarding the distribution of *fei* and *oba* can be summarized as follows.

(a) The distribution of *fei*:

fei can be added felicitously to a sentence denoting the proposition *p* in a context where the interlocutor either believes *not p* or at least considers *not p* to be a likely option and *not p*

- (i) can be inferred from the context or general background assumptions, or
- (ii) is entailed by the conversational or conventional implicatures or presuppositions of a previous utterance by the interlocutor.

The addition of *fei* is infelicitous, in contrast, if there is a previous utterance by the interlocutor whose at-issue content in combination with the fact that the interlocutor has asserted it entails that she believes *not p*.

(b) The distribution of *oba*:

oba can be added felicitously to a sentence denoting *p* in a context where

- (i) a proposition entailing *not p* is activated in the discourse,
- (ii) it can be inferred that the addressee believes *not p*,
- (iii) there is no recent assertion *A* by the addressee such that the at-issue content of *A* entails *not p* and
- (iv) neither the presuppositions nor the conventional implicatures of a recent utterance by the interlocutor entail *not p*.

Having presented data that illustrates the differing felicity conditions of *fei* and *aber*, we will show in the following that the two particles sometimes also differ in their perlocutionary force.

- (19) (Tom just sat down on a chair next to Melanie.)
 Melanie to Tom: Do sitzt (*fei/oba/doch*) imma d'Miriam.
This is where Miriam usually sits.

All particles are licensed in (19). There is, however, a difference in what (19) pragmatically conveys depending on the particle used. While the utterance with *doch* is an allegation and indicates that Melanie is of the opinion that Tom should know about the fact that Miriam usually sits in this chair, with *fei* it has informational character and conveys that Melanie assumes that Tom does not know about this fact, fully in line with what we have argued so far about the semantics of *fei*. With *oba*, however, (19) turns into a demand for Tom to stand up and look for a different place to sit. In other words, while (19) with *fei* is an informational statement, with *oba* it is a demand.

Similarly, in the following example, adding *oba* turns the utterance into an implicit demand, while *fei* and *doch* do not.

- (20) Child: *Was gibt's zum Mittagessen?*
 What have you cooked for lunch?
 Mother: *Lachs mit Spinat.*
 Salmon with spinach.
 Child: *I mog (fei/oba/doch) koan Spinat ned!*
 I don't like spinach!

With *oba*, the child implicitly asks his mother to prepare some alternative food for him, the utterances with *fei* or *doch* lack this connotation.

In Section 3, we will summarize and partially refine the analysis of *fei* argued for in Hinterwimmer (to appear), and in Section 4 we will present our analysis of *oba* and discuss how this analysis can account for the observed semantic behaviour of *oba* and its pragmatic effects.

3. The analysis of *fei*

fei is a modal particle that is derived from Latin *finis* and French *fin* (*end, border*) and entered Bavarian German in the 12th century (Schlieben-Lange, 1979; Glaser, 1999). As already said in the introduction, *fei* does not have a direct counterpart in standard German. Distributionally, it shares all the characteristics of modal particles (Weydt, 1969; Thurmair, 1989; Jacobs, 1991; Omelius-Sandblom, 1996; Zeevat, 2003; Karagjosova, 2004; Corniglio, 2011; Zimmermann, 2008; 2011, Gutzmann, 2015; see the papers in Bayer and Struckmeier, 2017 for a recent overview): It is always optional, it can only occur in the so-called middle field, it cannot receive the main accent of the respective clause, it cannot be questioned, it cannot be negated and it does not contribute to the truth conditions of a sentences containing it, i.e. a sentence with *fei* always has the same truth conditions as the corresponding sentence without *fei* (see Thoma, 2009 and Hinterwimmer, to appear for details). In descriptive linguistic work, *fei* is taken to add emphasis to the meaning of the sentence containing it. The first analysis of *fei* in modern linguistic terms has been proposed by Thoma (2009), and that analysis is also the starting point for the analysis proposed by Hinterwimmer (to appear).

Thoma (2009) assumes that *fei* is not only a modal particle, but also encodes polarity focus. The second part of this assumption is refuted in Hinterwimmer (to appear). For reasons of space, we cannot go into the details of that refutation here and have to refer the interested reader to Hinterwimmer (to appear). According to Thoma (2009), the felicity conditions of *fei* can be stated as follows: Adding *fei* to a sentence α with propositional content p is felicitous in a context C iff the speaker believes in C that the addressee believes $\neg p$. Based on the data discussed in Section 2, Hinterwimmer (to appear) shows that Thoma's analysis, while capturing an essential component of *fei*'s felicity conditions, misses an important aspect – namely that *fei* is only felicitous if the speaker's assumption that the addressee believes $\neg p$ is inferred on the basis of contextually available information or general background knowledge, or if the conversational or conventional implicatures of a previous utterance by the addressee in combination with the fact that she has made that utterance entail that she believes $\neg p$. Whenever the at-issue content of a previous utterance by the addressee in combination with the fact that she has made that utterance entail that she believes $\neg p$, in contrast, the addition of *fei*

is infelicitous. Additionally, as shown by the felicity of *fei* in Tom's reaction to Paula's utterance in (18), repeated here as (21), the felicity conditions assumed by Thoma (2009) are too strong: The speaker need not believe that the addressee believes $\neg p$. Rather, it is sufficient that she believes the addressee to consider $\neg p$ a likely option.

- (21) Paula: I woäß ned ob I ma des neie Buach üba d'Münchna Räterepublik kafa sui.
I don't know if I should buy the new book about the Soviet republic of Munich.
 Tom: Des is (fei[?]oba/doch) interessant.
It's interesting.

In order to state the just-sketched felicity conditions precisely, it is crucial to have a clear definition of at-issue content as opposed to secondary, i.e. presupposed or conventionally implicated, content. Hinterwimmer (to appear) follows AnderBois et al. (2015) and Murray (2017) in assuming that at-issue content differs from conventionally implicated content in the way in which it enters the Common Ground: It is only the at-issue content that is asserted, where for a proposition to be asserted means that the speaker explicitly proposes to add it to the Common Ground. Crucially, the respective proposition is only added to the Common Ground after the addressee has explicitly or implicitly accepted it. From this it follows that it is entirely unproblematic for the addressee to directly deny or question an asserted proposition. For conventional implicatures, in contrast, there is no intermediate step, i.e. they enter the Common Ground directly. Consequently, the addressee cannot directly deny or question a conventional implicature, but rather has to employ special means that interrupt the flow of the conversation such as saying 'Hey, wait a minute!' first (Shannon, 1976; von Stechow, 2004). The same applies to presupposed content, which, even if it is not already part of the Common Ground, is at least treated by the speaker as if it was. Finally, since it is one of the defining features of conversational implicatures that they can be cancelled, it is clear that they are likewise not asserted.

With these assumption in place, the felicity conditions of *fei* can now be stated informally as given in (23). Note that the version in (23) differs from the one in Hinterwimmer (to appear) in the following respect: It is stated in such a way that it accounts for the infelicity of *fei* in cases where the addressee has asserted a proposition entailing $\neg p$ as well as for the infelicity of *fei* in cases such as (17), repeated here as (22), which were not discussed in Hinterwimmer (to appear). In (22), the speaker has not asserted a proposition entailing $\neg p$, but rather a proposition entailing that she 'finds' $\neg p$. Condition (ii) is general enough to account for both cases: If the addressee has asserted a proposition entailing $\neg p$, then the fact that she has uttered that proposition entails that she believes $\neg p$, and if she has asserted a proposition entailing that she 'finds' $\neg p$, then the fact that she has uttered that proposition entails that she believes that proposition as well.

- (22) Paula: I find des neie Buach vom Kehlmann spitze!
I find the new book by Kehlmann great.
 Tom: Des is (#fei/oba/doch) da letzte Schmarr'n.
It's complete nonsense.
- (23) *fei* can be added felicitously to a sentence α denoting the proposition p in context C iff
 (i) the speaker believes that the addressee considers $\neg p$ a likely option.

- (ii) there is no recent assertion A by the addressee such that the content of A in combination with the fact that the addressee has asserted it entails that the addressee believes $\neg p$.

This informal analysis (or rather, a close variant of it) is formally implemented in Hinterwimmer (to appear) in a possible worlds framework along the lines of Hintikka (1969). In such an analysis, a person x believes a proposition p in a world w iff p is true in all worlds w' that are compatible with what x believes in w . In order to formalize the notion of considering a proposition a likely option, existential rather than universal quantification is required. Unrestricted existential quantification over the addressee's belief worlds would be too weak, however, to formalize the first felicity condition in (23): This would predict *fei* to be felicitous whenever the speaker assumes that the addressee does not completely exclude the possibility that $\neg p$ is true. Rather, what we need is existential quantification not over the entire set of the addressee's belief worlds, but rather over the following subset: the set of worlds containing only those worlds that correspond to the addressee's assumptions about what is stereotypically the case (cf. Kratzer's, 1981 analysis of modal verbs).

Putting everything together, the informally stated felicity conditions can be formalized as in (24), which is paraphrased in (25).

- (24) *fei* can be added felicitously to a sentence α denoting the proposition p in context C iff

(i) $\forall w' \in \text{DOX}_{SP, w^*} [\exists w'' \in \text{MAX}_{\text{Stereo-ADR}}(\text{DOX}_{\text{ADR}, w'}) [\neg p(w'')]]$,
 where SP is the speaker in C , ADR is the addressee in C , w^* is the world of C , DOX_{SP, w^*} is the set of worlds compatible with what SP believes in w^* , and $\text{MAX}_{\text{Stereo-ADR}}$ is the function mapping a set of worlds to the subset that makes as many of ADR 's assumptions about what is stereotypically the case true as possible.

(ii) $\neg \exists e [\text{Assertion}(e)(w^*) \wedge \text{Agent}(e, \text{ADR}) \wedge \text{recent}(\tau(e)) \wedge \text{Content}(e) = q \wedge \forall w \forall e \forall x [\text{Assertion}(e)(w) \wedge \text{Agent}(e, x) \wedge \text{sincere}(e, x) \wedge \text{Content}(e) = q \rightarrow \forall w' \in \text{DOX}_{x, w} [\neg p(w')]]]$.

- (25) *fei* can be added felicitously to a sentence α denoting the proposition p in context C iff

(i) all of the speaker's belief worlds contain at least one world that is compatible with as many of the addressee's assumptions about what is stereotypically the case as possible where the negation of p is true, and

(ii) there is no recent assertion of a proposition q by the addressee such that in all worlds where an individual x sincerely asserts q , $\neg p$ is true in all worlds that are compatible with what x believes in w (i.e. there is no recent assertion of a proposition by the addressee such that whenever someone asserts that proposition sincerely, she believes $\neg p$).

These felicity conditions account for all the facts discussed in Section 2. Concerning the question of why there should be a modal particle with such complex and subtle felicity conditions, the reasoning already sketched in the introduction applies: *fei* can be used by the

speaker to direct the addressee's attention to a conflict between her own beliefs and the addressee's beliefs that is not maximally prominent at the point where the sentence with *fei* is uttered. That is the case when the speaker's assumption that the addressee at least considers a proposition contradicting the propositional content of the prejacent of *fei* to be a likely option is inferred on the basis of contextual information or general background knowledge. It is also the case if the presuppositions or conversational or conventional implicatures of a recent utterance by the addressee entail such a proposition. But consider the case when the addressee has asserted a proposition where it directly follows from her having asserted it sincerely that she believes a proposition contradicting the propositional content p of the prejacent of *fei*. In this case, simply asserting p would have been sufficient to make the conflict between the speaker's and the addressee's beliefs maximally prominent.

4. The analysis of *oba*

After having presented our analysis of *fei*, let us now return to *oba*, the Bavarian version of *aber* ('but') (recall that the only reason why we discuss the Bavarian instead of the standard German version is to facilitate comparison with *fei* – as far as we know, there are no relevant semantic or pragmatic differences between the two uses). As already said in the introduction, we are only interested in its uses as a speech act particle or sentence adverb in this paper, i.e. in those uses where it does not conjoin two clauses, but rather occurs after the finite verb in a sentence that is uttered as a reaction to a previous utterance of an interlocutor. Recall from Section 2 that *oba*, just as *fei*, (a) can be used if the speaker assumes the addressee to believe a proposition p that contradicts the proposition denoted by the prejacent and (b) cannot be used if the addressee has asserted a proposition that entails $\neg p$, but differs from *fei* in the following respects: First, it is at least awkward when a proposition entailing $\neg p$ is presupposed or conventionally implicated by a previous utterance of the addressee (see (6) and (8), repeated here as (26) and (27), respectively, cf. also (12)). Second, it is not sufficient that the speaker believes on the basis of general background knowledge that the addressee believes $\neg p$. Rather, that the addressee believes $\neg p$ has to be inferable on the basis of contextually salient information p (see (14) and (15), repeated here as (28) and (29), respectively). Finally, *oba* is felicitous when the addressee has previously asserted a proposition entailing that she 'finds' $\neg p$ (see (16) and (17), repeated here as (30) and (31), respectively).

(26) Paula: Da Kini von Fronkreich is a Depp.

The king of France is an idiot.

Tom: In Fronkreich gibts (fei/?oba/doch) koan Kini nemma.

In France, there exists no king anymore.

(27) Paula: Da Chomsky, a berühmta Soziologe, is a Anarchist.

Chomsky, a famous sociologist, is an anarchist.

Tom: Da Chomsky is (fei/?oba/doch) koa Soziologe.

Chomsky is no sociologist.

(28) Tom: Des neie Buach vom Kehlmann is (fei/#oba/#doch) spitze!

The new book by Kehlmann is great!

- (29) Paula: S'gibt oifach koane gscheidn Biacha nemma.
There simply are no good books anymore.
 Tom: Des neie Buach vom Kehlmann is (fei/oba/doch) spitze!
The new book by Kehlmann is great!
- (30) Paula: Des neie Buach vom Kehlmann is spitze!
The new book by Kehlmann is great.
 Tom: Des is (#fei/#oba/doch) da letzte Schmarr'n.
It's complete nonsense.
- (31) Paula: I find des neie Buach vom Kehlmann spitze!
I find the new book by Kehlmann great.
 Tom: Des is (#fei/oba/doch) da letzte Schmarr'n.
It's complete nonsense.

While there are various analyses of the English equivalent of *aber/oba*, *but* (see, e.g., Lakoff, 1971; Winter and Rimón, 1994; Umbach, 2005), the use of *aber/oba* as a sentence adverb of speech act particle has received rather little attention (but see Kwon, 2005 and the references therein). As we will now show, the felicity conditions of *aber/oba* just repeated can be captured in a way that is in large parts very similar to our analysis of *fei*, but also differs from it in certain relevant aspects.

- (32) *aber* can be added felicitously to a sentence α denoting the proposition p in context C iff
- (i) a proposition q entailing $\neg p$ is salient and q is one of the possible answers to the current *question under discussion* (*QUD*), with p entailing another possible answer.
 - (ii) there is no recent assertion A by the addressee such that the at-issue content of A entails $\neg p$.

The condition in (32ii) is closely related to the second felicity condition of *fei* stated formally in (24ii) and informally in (23ii), with one crucial difference: According to (23ii)/(24ii), what is disallowed is the existence of a recent assertion such that the propositional content of the assertion in combination with the fact that the addressee has made that assertion entails that she believes $\neg p$. That formulation captures the observation that *fei* is infelicitous not only in cases such as (30), where the addressee has asserted a proposition entailing $\neg p$ – in that case, that the new book by Daniel Kehlmann is not nonsense – , but also in cases such as (31), where she has asserted a proposition entailing that she ‘finds’ $\neg p$. The condition in (32ii), in contrast, is formulated in such a way that it allows cases of the latter kind,³ and only disallows cases of the former kind.

³ Note that Umbach (in press) argues that ‘subjective judgments [such as the complements of *finden* ‘find’] present their propositions as mere opinions, not intended to enter the common ground’ (Umbach, in press: 28 of final draft). As they are not intended to enter the common ground, they do not open up new issues for discussion, i.e. they do not affect the table. This would mean that, according to Umbach, they do not raise any QUDs, which in turn would mean that *oba* should not be licensed in a reaction to subjective statements as in (30), contrary to what we find. Our analysis is, however, in line with Reis (2013), who proposes that *finden* ‘find’ triggers the presupposition that there is an open issue that is under debate. In other words, there is a QUD that is presupposed by using the word *finden* ‘find’. We assume that it is this QUD that is addressed by the reaction with *oba* in (31).

The condition in (32i) differs more fundamentally from the one in (23i)/(24i). It captures both the infelicity of *oba/aber* in cases such as (28) and its felicity in case such as (29), and the observation that *oba*, in contrast to *fei*, is infelicitous if the presuppositions or conventional implicatures of a previous assertion by the addressee entail $\neg p$. The crucial point is the requirement that both the prejacent p and the contextually salient proposition q entailing $\neg p$ constitute possible answers to the *current question under discussion* (QUD). This notion goes back to Roberts (1996; see Klein and von Steutterheim, 1987; van Kuppevelt, 1995 for similar views) and is based on the following idea: It is not only utterances in oral conversations that answer explicit or implicit questions, but also sentences in all kinds of written texts. In cases where the QUD is implicit, the task of the addressee/reader is to identify the QUD that the respective sentence answers on the basis of its focus-background structure, where the explicitly given or inferable parts correspond to the background and the new parts to the focus: The focal part replaces the *wh*-term contained in the implicit QUD, thus picking one from the set of possible answers. The given or inferable material, the background, in contrast, corresponds to the remaining part of that subquestion.

Now, the assumption that the contextually salient proposition contradicting the prejacent of *oba* has to be a possible answer to the current QUD automatically rules out cases where the propositional content of the prejacent of *oba* contradicts the presupposition of a previous utterance of the addressee, as in (26): Being presupposed and thus at least being treated as if it was already part of the Common Ground by the one who utters the respective sentence, a presupposed proposition can by definition not answer the QUD (which, in the case of (26) can only be a question such as *What is the king of France like?*, but not a question such as *Is there a king in France?*). Simons et al. (2010) (see also Beaver et al., 2017) show, based on contrasts like the one between (33) and (34), that also conventional implicatures, in contrast to the at-issue content of a sentence, can never answer the current QUD:

- (33) Tom: Where did Mary buy her new dress?
 Susan: Mary, who lives in Potsdam, bought it at a store in Berlin.
 Susan: #Mary, who bought it at a store in Berlin, lives in Potsdam.
- (34) Tom: Where does Mary live?
 Susan: Mary, who bought her new dress at a store in Berlin, lives in Potsdam.
 Susan: #Mary, who lives in Potsdam, bought her new dress at a store in Berlin.

The felicity conditions stated informally in (32) above and stated more formally in (35) thus successfully capture the distribution of *aber/oba*.

- (35) *aber/oba* can be added felicitously to a sentence α denoting the proposition p in context C iff
- (i) $\exists q[\forall w[q(w) \rightarrow \neg p(w) \wedge \text{prominent}(q, \text{time}(C))] \wedge q \in \text{QED}_{\text{time}(C)} \wedge \exists r \in \text{QUD}_{\text{time}(C)} [\forall w[p(w) \rightarrow r(w)]]]$,
 where $\text{QUD}_{\text{time}(C)}$ is the question under discussion at the time of C .
- (ii) $\neg \exists e[\text{Assertion}(e)(w^*) \wedge \text{Agent}(e, \text{ADR}) \wedge \text{recent}(\tau(e)) \wedge \text{Content}(e) = q \wedge \forall w[q(w) \rightarrow \neg p(w)]]]$.

It would be worth pursuing the relation between the conjunction uses of *oba/aber* and its uses as a discourse particle. Interestingly, Umbach (2005) proposes an analysis of the conjunction *but* which is also based on the notion of QUD. Very roughly, and simplifying considerably, she assumes that *but* is felicitous iff each of the two clauses conjoined by *but* answers one of two polar questions serving as the subquestions of an (usually implicit) superquestion, with one of the two questions being answered positively and the other negatively. Further investigating the relation between our analysis of *oba/aber* as a sentence adverb or discourse particle and Umbach's (2005) analysis of the conjunction *but* is a topic that we have to leave for future research.

We will now turn to the perlocutionary acts of utterances with *aber/oba* and *fei*, i.e. examples (19) and (20), repeated here as (36) and (37).

- (36) (Tom just sat down on a chair next to Melanie.)
 Melanie to Tom: Do sitzt (*fei/oba/doch*) imma d'Miriam.
This is where Miriam usually sits.
- (37) Child: Wos gibt's zum Mittagessen?
What have you cooked for lunch?
 Mother: Lachs mit Spinat.
Salmon with spinach.
 Child: I mog (*fei/oba/doch*) koan Spinat ned!
I don't like spinach!

The pragmatic effect of the *oba*-reaction in (36) directly follows from our analysis that *oba* is licensed only if the corresponding utterance addresses a current QUD. In case of (36), there is no explicit preceding discourse and thus no obvious QUD. By sitting down on the chair next to Melanie, there is, however, an implicit question that is raised, namely whether this seat is taken or not and whether Tom is allowed to sit there or not. It is this question that is addressed by Melanie's reaction and answered negatively. This is why the reaction in (36) with *oba* is understood as an implicit demand to change seats. With *fei*, on the other hand, there is no implicit QUD that needs to be addressed. The fact that Tom sat down on Miriam's place simply indicates that he apparently believes this seat is not taken (in general and not taken by Miriam in particular), which licenses the utterance with *fei*.

As for (36), the reasoning is parallel. As the semantics of *oba* requires that there is a QUD that is addressed by the corresponding utterance, the child's reaction with *oba* triggers a presupposition that there is such a QUD. In case of (37) it would most sensibly be a question such as *Do I like this?* or *Can I eat this?* as a follow-up to *What have you cooked for lunch?*. The child's reaction with *oba* would then be interpreted as answering the question whether what the mother prepared for lunch is something that he likes or can eat, indicating that the answer is *no*. Hence, the reaction receives the character of a demand to the mother to prepare something different for the child. Again, with *fei*, there is no such connotation, because an utterance with *fei* does not have to address a current QUD.

5. Conclusion and outlook

In this paper we have compared the felicity conditions of the Bavarian discourse particle *fei* and the sentence adverb or modal particle *oba/aber*.

One issue we have not addressed and which is still an open question is why *oba/aber* is licensed and used very frequently in reactions to demands or requests.

- (38) Mother: Du sollst deine Hausaufgaben machen.
 You have to do your homework.
 Child: Ich mach aber keine Hausaufgaben!
 I won't do my homework!

It is not clear whether imperatives can be taken to induce QUDs and, if so, which ones. One could speculate that they trigger the QUD of whether the addressee does what is demanded or not (see Gutzmann, 2012: 99). If that is the case, this would explain why the reaction in (38) is fully acceptable – it addresses the QUD whether the child will obey and answers it negatively.

We leave a comprehensive analysis of *aber/oba* in reactions to imperatives for future research.

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QUD effects on epistemic containment principle: An experimental study¹

Sunwoo JEONG — *Department of Linguistics, Stanford University*

Abstract. The Epistemic Containment Principle (ECP) requires that epistemic modals take wider scope than strong quantifiers such as *every* or *most* (von Fintel and Iatridou, 2003). Although fairly robust in its realization, a few systemic classes of counterexamples to the ECP have been noted. Based on these, previous work has argued for two claims: subjective modals obey the ECP, whereas objective ones don't (Tancredi, 2007; Anand and Hacquard, 2008); and *every* respects the ECP, whereas *each* violates it (Tancredi, 2007). This paper argues that explicit Questions Under Discussion (QUDs; Roberts, 1996; Ginzburg, 1996) also systematically influence the ECP: scopal orderings that provide relevant answers to the given QUDs are preferred, and this tendency can override the ECP. To support this claim, the paper presents an experimental study. The results corroborate the existence of systematic QUD effects on the ECP, and support the view that the ECP is derived from a confluence of various pragmatic and lexical biases.

Keywords: Epistemic Containment Principle (ECP), epistemic modals, Question Under Discussion (QUD), quantifiers, scopal ambiguity, experimental semantics.

1. Introduction

The Epistemic Containment Principle (henceforth ECP) is a widely known descriptive and theoretical claim according to which epistemic modals must take wider scope than strong quantifiers such as *every* or *most* (von Fintel and Iatridou, 2003). The ECP can capture, for instance, why a sentence like (1) sounds infelicitous. As the scopal ordering that would have yielded a felicitous meaning (1b) is in effect ruled out by the ECP, the only possible interpretation that is left is (1a), which results in an unlikely meaning ((1a) is tenable only if multiple people can collectively constitute 'the murderer').

- (1) #*Every student might be the murderer.* (von Fintel and Iatridou, 2003)
a. MIGHT \succ EVERY: #It is possible that every student is the murderer.
b. #EVERY \succ MIGHT: For every student x, it is possible that she is the murderer.

Although fairly robust in its realization, a few systemic classes of counterexamples to the ECP have been noted. They involve the distinction between subjective vs. objective epistemic modals, and differences in quantifier types.

- (2) a. Objective vs. subjective (doxastic)
Objectively speaking, every student might be the murderer. (Tancredi, 2007)
b. Quantifier type
Each student might be the murderer. (Tancredi, 2007)

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For instance, epistemic modals that quantify over objective knowledge states have been shown to allow quantifiers to scope over them, as indicated by the felicity of (2a). Based on this, Tancredi (2007) concluded that only subjective epistemic modals (which he calls ‘doxastic’ and assumes to be the default interpretations) that quantify over the speaker’s subjective belief states observe the ECP (cf. Lyons, 1977; Anand and Hacquard, 2008). In addition, quantifiers such as *each* have been shown to be able to violate the ECP, as indicated by the felicity of (2b).

These counterexamples raise questions about the nature and the status of the ECP. First, is the ECP a hard-wired structural constraint, as von Stechow and Iatridou (2003) had initially conceptualized,² or is the intuition behind it better characterized as a gradient tendency, as Anand and Hacquard (2008) suggest? Secondly, if the ECP can be reduced to a kind of gradient preference, how robust is this preference, and what factors come into play in shaping this preference? Answering these questions will go some way towards explaining why exactly the ECP arises in the first place, and how it connects with the more general tendency for epistemic modals to scope wide.

The aim of this paper is to engage with these questions by pursuing two specific empirically tractable goals. The first is to measure the robustness of the intuition behind the ECP via quantitative methods. The second is to introduce a new contextual factor that also seems to systematically influence the realization of the ECP, namely, Questions Under Discussion (henceforth QUDs; Roberts, 1996). The paper argues that listeners tend to prefer scopal orderings that provide relevant answers to the given QUDs, and that this preference can override the ECP.

To achieve these goals, an experimental study is presented. The results of the study corroborate the significant effects of QUDs on the ECP, while also demonstrating that violations of the ECP can occur even for subjective modals and for the quantifier *every*. Based on these data, the paper propounds the view that the ECP arises from a combination of various pragmatic and lexical biases. The resulting account is shown to have broader implications for thinking about the scopal preferences of epistemic modals, as well as how context comes into play in shaping these preferences.

2. QUD effects on the ECP: Probing the intuition

Suppose that the same sentence from (1), repeated in (3b), was uttered in answer to an explicit question in (3a).

- (3) a. *Which of the four students is the murderer?*
 b. *Every student might be the murderer.*

The sentence sounds distinctly better in (3) than in (1), although the quantifier *every* and the subjective modal interpretation have remained constant. This relative felicity seems to stem from the fact that the ECP-violating EVERY \succ MIGHT interpretation provides a directly relevant answer to the explicit QUD in (3).

² As a structural constraint, the ECP is characterized by von Stechow and Iatridou (2003) as follows: At LF, a quantifier cannot bind its trace across an epistemic modal.

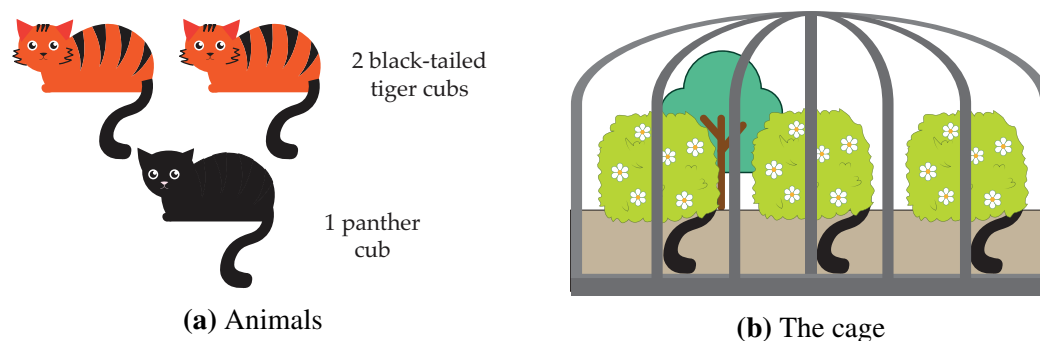


Figure 1: Ron is at a zoo. Ron knows for certain that the cage is currently housing exactly two tiger cubs and exactly one panther cub. Ron also knows for certain that the animals look as in (a). Ron peers through the cage, which looks as in (b).

QUDs (Roberts, 1996; cf. Ginzburg, 1996) signal what is at-issue, and provide a systematic way of capturing the information structure in the discourse. They have been argued to be at the heart of a variety of linguistic phenomena such as focus and focus-sensitive expressions (Beaver and Clark, 2008), projection behavior (Simons et al., 2010), and the meaning contribution of diverse discourse particles. This work indicates that the at-issueness status as prescribed by QUDs has far reaching repercussions for a wide range of linguistic expressions and the way they are interpreted. Given this, it seems reasonable to expect that QUDs would also impact scopal disambiguation processes. In particular, scopal orderings that provide relevant answers to the QUDs are likely to be preferred over ones that don't (cf. Gualmini et al., 2008).

By linking this broader QUD intuition with the ECP phenomenon, we may entertain the following hypothesis: Suppose that the ECP can be recast as a kind of default but defeasible scopal disambiguation strategy or preference which is derived from more primitive lexical and pragmatic biases. Since it operates as a mere preference rather than a structural constraint, we expect it to be overridden by independent scopal preferences arising from QUDs when the two are in conflict, if the preferences stemming from QUDs are stronger. The QUD-based scopal preferences are likely to be stronger when the QUDs are explicitly spelled out.

Let us henceforth call this the QUD hypothesis and probe our intuitions about it with the aid of a paradigm that doesn't involve felicity judgments. (The same paradigm is implemented in a larger scale in the experimental study presented in sec. 4.) For instance, consider the context outlined in Fig. 1. In this context, suppose that Ron utters the modal statement given in (4):

- (4) **“Every bush might have a tiger.”**
- a. MIGHT \succ EVERY: FALSE
It is possible that every bush has a tiger.
 - b. EVERY \succ MIGHT: TRUE
For every bush x , it is possible that x has a tiger.

Given the context in Fig. 1, the presence vs. absence of the ECP can be probed by examining whether Ron's answer is interpreted as true or false. Given what Ron knows and believes, Ron's statement in (4) is interpreted as true only under the ECP violating scopal ordering (4b), but

false under the ECP observing one (4a).³ This holds regardless of which QUD (4) is addressing. Since Ron knows that there are only 2 tigers in total, it is not possible that all three bushes have tigers (4a). In other words, in *none* of Ron's epistemically and doxastically accessible worlds is it the case that every bush has a tiger. In contrast, since Ron also knows that tigers and panthers have identical looking tails, for each bush *x*, it is equally possible that *x* has a tiger (4b). In other words, Ron's epistemically and doxastically accessible worlds include worlds in which any given bush *x* has a tiger. In sum, if Ron's statement in (4) is evaluated as true, it indicates that the ECP was violated, and if it is evaluated as false, it indicates that the ECP was observed.⁴

Building on this basic premise, let us now introduce explicit QUDs. Suppose that Ron produced his model statement in (4) as an answer to one of the two explicit questions in (5) and (6). The question was raised by his friend Luna who arrived late at the scene (and is thus more ignorant than Ron about the number and the shape of tigers involved).

- | | |
|--|--|
| <p>(5) HOW-QUD:
 <i>“How many of the three bushes
 have a tiger?”</i></p> | <p>(6) WHICH-QUD:
 <i>“Which of the three bushes
 has a tiger?”</i></p> |
|--|--|

The emerging intuition is that our true vs. false judgment of Ron's statement in (4), which maps onto the violation vs. observation of the ECP, respectively, depends crucially on the type of explicit QUD that (4) is addressing. In answer to the question in (5), henceforth the HOW-QUD, Ron's statement is more likely to be evaluated as false, suggesting that the QUD is nudging us towards the ECP-observing scopal interpretation. In answer to the question in (6) however, henceforth the WHICH-QUD, Ron's statement is more likely to be evaluated as true, suggesting that the QUD is nudging us towards the ECP-violating scopal interpretation. Intuitively, the reason for this seems to be as follows: the ECP-violating interpretation (4b) provides a relevant answer to the WHICH-QUD but not to the HOW-QUD, whereas the ECP-observing interpretation (4a) provides a relevant answer to the HOW-QUD but likely not to the WHICH-QUD (cf. see sec. 3). In sum, ECP-violating interpretations seem to become more accessible when they can provide relevant answers to the explicit QUDs.

If the intuition outlined so far is on the right track, it suggests that the QUD bias does indeed override the ECP, which in turn suggests that the ECP is at best a defeasible bias rather than a categorical constraint. The hypothesized QUD effect also seems to crosscut other factors that have been known to influence the ECP. The sentence in (4) includes the quantifier *every* but still seems to allow for the ECP-violation depending on the QUD. Likewise, given the context of ignorance (Fig. 1b) and in the absence of explicit adverbials like ‘objectively speaking’,

³ One may wonder if providing true/false judgments to subjective/doxastic modal statements is an unintuitive task. However, people do seem to be able to make truth value judgments about subjective epistemic modal statements, although the body of knowledge/beliefs against which such a modal statement is evaluated may shift (von Fintel and Gillies, 2011). Since we, as readers, are led to share identical beliefs as those of Ron's (w.r.t. the tigers and the bushes) by virtue of Fig. 1, the proposed equivalence between true vs. false judgments and ECP violation vs. observation would hold regardless of this potential shift.

⁴ This equivalence holds under the assumption that Ron's knowledge and belief states described in Fig. 1 are fully taken into account when generating the relevant modal base for the statement. See sec. 4.3.2 for more discussion about the validity of this assumption.

the sentence in (4) most likely elicits the default subjective/doxastic modal interpretation but nevertheless seems to allow for the ECP-violation depending on the QUD.

The experimental study to come (sec. 4) aims to provide quantitative support for the QUD hypothesis described so far by implementing a paradigm like Fig. 1 and (4)–(6). Before presenting the experiment however, let us first get a better handle on why the proposed relevance relations hold between the WHICH-QUD and the ECP-violating interpretation (4b) on the one hand, and the HOW-QUD and the ECP-observing interpretation (4a) on the other.

3. Defining relevance for modalized statements

The QUD hypothesis in sec. 2 was formulated on the basis of the assumption that EVERY \succ MIGHT propositions like (4b) provide relevant answers to certain types of questions like (6), while MIGHT \succ EVERY propositions like (4a) provide relevant answers to other types of questions like (5). These judgments seem to be corroborated by native speaker intuitions, but we may want to formulate them in a more precise manner as they will figure as core background assumptions in the experiment.

There are several ways of gauging whether a given proposition counts as a relevant answer to a question. Since it is not the main goal of the paper to argue for a specific theory of relevance, we will consider three possible ways of defining ‘relevance’ and establish that the hypothesized relevance relations are predicted by all of them, although to different degrees.

A proposition is standardly analyzed as being a relevant answer to a question Q if it identifies or rules out a member of the question denotation Q (cf. Groenendijk and Stokhof, 1984; Roberts, 1996; Dayal, 2016). However, hedged/modal answers (e.g., *might p*, *I think that p*, etc.) can also count as relevant answers to simple/non-modal questions (e.g., *whether p?*), although modal propositions do not themselves identify/rule out any member of such Q s. In these cases, what matters seems to be the prejacent: if the prejacent of the modal statements identify/rule out a member of Q , they count as relevant answers. We will therefore posit the following core premise across all three accounts: In the case of a modal statement, the proposition with which we evaluate its relevance to a given question is its prejacent p (see Beaver and Clark (2008) and Kaufmann (2016) for similar views).

Following this assumption, let us zoom in on the prejacent of the ECP-observing (4a) and ECP-violating (4b) when evaluating their relevance to different QUDs. They are presented again in (7) and (8) in a more detailed form; B stands for the modal base and the underlined parts pick out the prejacent. The prejacent of (7) is straightforward; it is the proposition: *every bush has a tiger*. Determining the prejacent of (8) requires more flexibility: when a modal takes a narrow scope as in (8), the propositional argument of the modal contains a free variable x , resulting in: *x has a tiger*. In this case, we define its prejacent as follows: any member of the set of propositions that results when the free variable x of the propositional argument is assigned to a member of the restrictor of *every*. To give a unified account, we also posit that the prejacent of (7) is the sole member of an analogous prejacent set in (7b), which is a singleton set.

- (7) *might* \succ *every*
- MIGHT(B)(every bush(λx (a tiger(λy (x has y))))))
 - prejacent set: $\{ \llbracket \text{every bush has a tiger} \rrbracket^g \}$
- (8) *every* \succ *might*
- every bush(λx (MIGHT(B)(a tiger(λy (x has y))))))
 - prejacent set: $\{ \llbracket \text{bush}(x) \wedge \text{has a tiger}(x) \rrbracket^{g[x \rightarrow b]} : b \in D_e \}$

With these assumptions in place, one way of defining relevance is as in (9b).⁵

- (9) a. **Q**: a set of propositions that are possible answers to Q (cf. Hamblin 1971)
 b. **Relevance** (ver. 1): A proposition p is a relevant answer to a question Q iff: $p \in Q$

Assuming that a given question Q denotes a Hamblin set Q , i.e., a set of contextually constrained possible answers to Q as in (9a), the HOW-QUD in (5): *How many of the 3 bushes have a tiger?* would have the denotation in (10a), and the WHICH-QUD in (6): *Which of the 3 bushes has a tiger?* would have the denotation in (10a), where $\llbracket \text{bush} \rrbracket = \{b_1, b_2, b_3\}$.

- (10) a. $\llbracket \text{HOW-QUD} \rrbracket = \{ (\llbracket \text{no bush has a tiger} \rrbracket), \llbracket \text{one bush has a tiger} \rrbracket, \llbracket \text{two bushes have a tiger} \rrbracket, \llbracket \text{three bushes have a tiger} \rrbracket \}$
 b. $\llbracket \text{WHICH-QUD} \rrbracket = \{ \llbracket \text{has a tiger} \rrbracket(b_1), \llbracket \text{has a tiger} \rrbracket(b_2), \llbracket \text{has a tiger} \rrbracket(b_3), \llbracket \text{has a tiger} \rrbracket(b_1 + b_2), \llbracket \text{has a tiger} \rrbracket(b_2 + b_3), \llbracket \text{has a tiger} \rrbracket(b_1 + b_3), \llbracket \text{has a tiger} \rrbracket(b_1 + b_2 + b_3) \}$

From (9b), it follows that the ECP-observing (7) is a relevant answer to both the HOW-QUD in (5) and the WHICH-QUD in (6): The prejacent p of (7) is a member of the denotations of both QUDs as the proposition $\llbracket \text{every bush has a tiger} \rrbracket$ is contextually equivalent to $\llbracket \text{three bushes have a tiger} \rrbracket$ and $\llbracket \text{has a tiger} \rrbracket(b_1 + b_2 + b_3)$. In contrast, the ECP-violating (8) is only a relevant answer to the WHICH-QUD but *not* a relevant answer to the HOW-QUD. This is because all of its possible prejacent from (8b), e.g., $\llbracket \text{has a tiger} \rrbracket(b_2)$, are members of $\llbracket \text{WHICH-QUD} \rrbracket$, whereas none of them are members of $\llbracket \text{HOW-QUD} \rrbracket$.

We remain agnostic about whether the denotation of the HOW-QUD should include $\llbracket \text{no bush has a tiger} \rrbracket$; the same prediction comes out irrespective of this choice. We also take the conservative approach of assuming that the partitive wh-phrase ‘Which of x ’ is associated with the domain of not just atomic individuals but also plural ones; if only atomic individuals are allowed, as is standardly assumed to be the case for ‘Which x ’ (Dayal, 2016), then the denotation of WHICH-QUD would be $\{ \llbracket \text{has a tiger} \rrbracket(b_1), \llbracket \text{has a tiger} \rrbracket(b_2), \llbracket \text{has a tiger} \rrbracket(b_3) \}$ and the current account would predict an even stronger asymmetry: that the ECP-violating (8) is *only* relevant to the WHICH-QUD and the ECP-observing (7) is *only* relevant to the HOW-QUD.

Relevance can also be defined in terms of partitions introduced by a given question (Groenendijk and Stokhof, 1984). A partition of Q can be derived from a Hamblin set Q (Fox, 2017),

⁵ Note that (9b) does not impose that the relevant answer be a true answer. The notion of ‘relevance’ that we are after is only concerned with whether the proposition is directly germane to a given question.

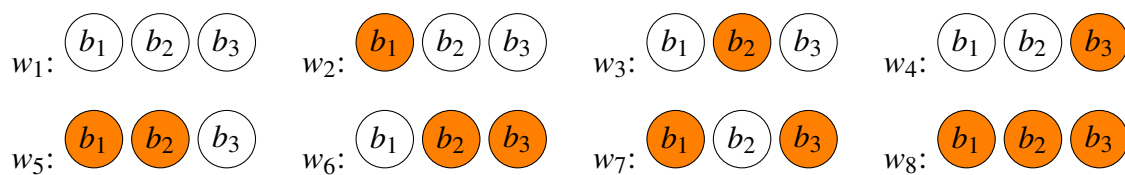


Figure 2: Possible worlds in which there is a total of 3 bushes in the domain. Orange-colored circles represent bushes with a tiger; empty circles represent bushes without a tiger.

as shown in (11a). Unlike propositions in Hamblin sets that can pick out overlapping worlds, partitions cut up the worlds into equivalence classes. Each cell in the partition(Q) correspond to an exhaustive answer. Oftentimes, answers to questions are non-exhaustive in form but understood exhaustively. Given this, we may posit an exhaustivity operator as in (11b) which (roughly) strengthens p to *only* p (F^+ stands for focus alternatives), and define relevance as in (11c). Simply put, p is a relevant answer to Q if upon strengthening to $\text{EXH}(p)$, it identifies a cell in $\text{partition}(Q)$.

- (11) a. **Partition(Q):** a set of equivalence classes under the relation:
 $w \sim w'$ iff $\forall p \in Q[p(w) = p(w')]$ (Groenendijk and Stokhof, 1984; Fox, 2017)
- b. $\llbracket \text{EXH } \phi \rrbracket = \llbracket \phi \rrbracket \wedge (\bigwedge_{P \in \llbracket \phi \rrbracket_{F^+}} \neg P)$ (Klinedinst and Rothschild, 2011: 11)
- c. **Relevance** (ver. 2): p is a relevant answer to Q iff: $\text{EXH}(p) \in \text{Partition}(Q)$

From (11c), it follows that the ECP-observing (7) is a relevant answer to both the HOW-QUD in (5) and the WHICH-QUD in (6), whereas the ECP-violating (8) is only a relevant answer to the WHICH-QUD, but not the HOW-QUD. To see more concretely why this holds, let us imagine the possible worlds in Fig. 2 as constrained by the context. Given these possible worlds, the partitions introduced by the $\llbracket \text{HOW-QUD} \rrbracket$ and the $\llbracket \text{WHICH-QUD} \rrbracket$ are as in (12a) and (12b).

- (12) a. $\text{Partition}(\llbracket \text{HOW-QUD} \rrbracket) = \{\{w_1\}, \{w_2, w_3, w_4\}, \{w_5, w_6, w_7\}, \{w_8\}\}$
- b. $\text{Partition}(\llbracket \text{WHICH-QUD} \rrbracket) = \{\{w_1\}, \{w_2\}, \{w_3\}, \{w_4\}, \{w_5\}, \{w_6\}, \{w_7\}, \{w_8\}\}$

Given (12a) and (12b), the exhaustified prejacent of the ECP-observing (7), presented in (13a), is a member of both $\text{Partition}(\llbracket \text{HOW-QUD} \rrbracket)$ and $\text{Partition}(\llbracket \text{WHICH-QUD} \rrbracket)$. In contrast, any exhaustified prejacent of the ECP-violating (8), one of which is exemplified in (13b), is a member of $\text{Partition}(\llbracket \text{WHICH-QUD} \rrbracket)$ but crucially not a member of $\text{Partition}(\llbracket \text{HOW-QUD} \rrbracket)$. This combined with (11c) predicts the same kind of asymmetry captured by the previous account.

- (13) a. $\text{EXH}(\llbracket \text{every bush has a tiger} \rrbracket) = \{w_8\}$ (cf. $\llbracket \text{every bush has a tiger} \rrbracket = \{w_8\}$)
- b. $\text{EXH}(\llbracket \text{has a tiger} \rrbracket(b_1)) = \{w_2\}$ (cf. $\llbracket \text{has a tiger} \rrbracket(b_1) = \{w_2, w_5, w_7, w_8\}$)

The two accounts outlined so far already generate the asymmetric relevance relations we need. However, the asymmetry predicted by both seems to be weaker than expected, as the ECP-observing (7) is predicted to provide relevant answers to both QUDs. The prejacent of (7) actually seem like an odd answer to the WHICH-QUD (6), but this intuition is not captured by the accounts (unless, as noted above, we posit a domain of atomic individuals for (6)). Intuitively, (7) sounds odd in response to (6), because the questioner of (6) seems to assume

some kind of non-maximality: she thinks that a unique bush or at most two bushes have tigers. The prejacent of (7) goes against this assumption, while the prejacent of (8) satisfies it. Such an intuition can be incorporated into the third account in (14b), which posits $\text{Partition}(Q, cs_Q)$. This partition retains only the cells in $\text{Partition}(Q)$ that are consistent with the questioner's assumptions, as in (14a). This account predicts a stronger asymmetry, where the ECP-observing (7) only provides a relevant answer to the HOW-QUD (this is because unlike $\text{Partition}(\llbracket \text{WHICH-QUD} \rrbracket)$, $\text{Partition}(\llbracket \text{WHICH-QUD} \rrbracket, cs_Q)$ no longer contains $\{w_8\}$), and the ECP-violating (8) only provides a relevant answer to the WHICH-QUD.

- (14) a. **Partition**(Q, cs_Q): $\{P \cap cs_Q : P \in \text{Partition}(Q)\} \setminus \{\emptyset\}$ where cs_Q stands for the context set (set of possible worlds) consistent with the questioner's assumptions
 b. **Relevance** (ver. 3): p is a relevant answer to Q iff: $\text{EXH}(p) \in \text{Partition}(Q, cs_Q)$

The discussion in this section suggests that the relevance intuitions we began with are warranted and can be spelled out in different ways. Having established the needed relevance relations, the next section presents the main experimental study.

4. Experiment

The experiment presented in this section tests the QUD hypothesis outlined in sec. 2. The paradigm it adopts is largely identical to the one already presented in Fig. 1 and (5)–(4) in sec. 2. In the experiment, participants familiarized themselves with a series of situations by reading the prompts and the associated visual stimuli. Against varying contextual backdrops, the main speakers in the target trials uttered sentences of the form: *every X might have a Y*. The sentence was either uttered out of the blue (no clear surrounding dialogue) or in response to an explicit QUD. The situation and the visual stimuli were set up in such a way that the sentence uttered by the main speaker would be interpreted as true only under the ECP-violating scopal ordering (EVERY \succ MIGHT) but false under the ECP-observing scopal ordering (MIGHT \succ EVERY). The main task of the participants was to judge whether the sentences spoken by the main speakers were true or false. In sum, as adumbrated in sec. 2, the core assumption that underlies this experimental design is that we can track participants' ECP violating interpretations in an intuitive way by examining their True/False responses.

4.1. Methods

4.1.1. Participants

600 native speakers of American English were recruited as participants from Amazon Mechanical Turk. They were paid \$0.50 to participate.

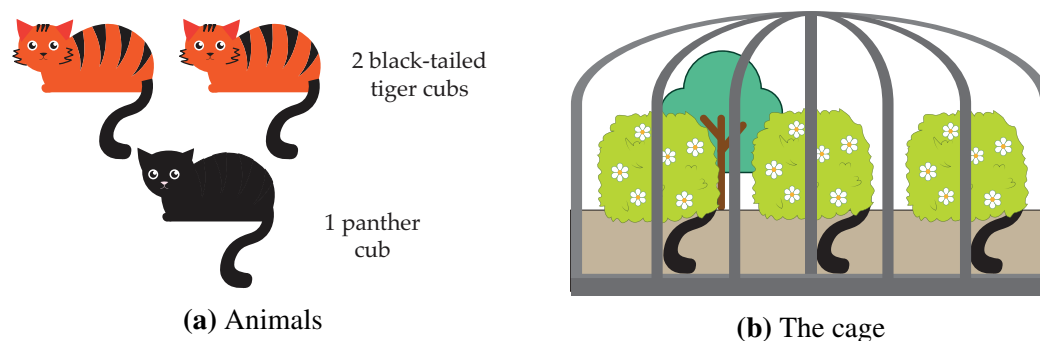


Figure 3: Sample visual stimuli for the three target conditions: HOW, WHICH, and NOQUD
Context prompt: Ron is at a zoo. Ron knows for certain that the cage is currently housing exactly two tiger cubs and exactly one panther cub. Ron also knows for certain that the animals look as in (a). Ron peers through the cage, which looks as in (b).

4.1.2. Materials

The visual stimuli and the prompts for each trial had different configurations depending on whether it was a target condition or a baseline condition. There were three target conditions and three baseline conditions.

The three target conditions, HOW, WHICH, and NOQUD, were associated with an identical range of visual stimuli and context prompts, but differed in the presence vs. absence of an explicit QUD and the type of QUD. The visual stimuli shared the basic paradigm exemplified in Fig. 1. All stimuli established situations in which the main speakers accounted for objects (tiger cubs, cherry toppings, butterfly cocoons, etc.) distributed across containers (bushes, icecream sundaes, beakers, etc.).⁶ For ease of reference, an example of the visual stimuli and a condensed version of the prompt that we already saw in Fig. 1 are reproduced in Fig. 3.

To ensure that a full correspondence is established between ECP violations and True responses on the one hand, and ECP observations and False responses on the other, the speakers' epistemic states were made clear via the visual stimuli and the prompt. In each situation, the speakers were shown to definitively know the cardinality of the items (1 or 2 items distributed across 3 containers) as well as the fact that there is visual ambiguity in identifying them. This information served to constrain the epistemic/doxastic modal bases (Kratzer, 1981) in intended ways, so that as long as the participants incorporated them in their interpretations, the associated modal statements would be evaluated as true under the ECP violating ordering (EVERY \succ MIGHT) but false under the ECP observing one (MIGHT \succ EVERY).

Along with these prompts and visual stimuli, the three target conditions introduced the QUD manipulations summarized in (15). The WHICH condition introduced WHICH-QUDs in the format of *Which of X has a Y?*, such as: *Which of the three bushes has a tiger?* The HOW condition introduced HOW-QUDs in the format of *How many of X have a Y?*, such as: *How many of the three bushes have a tiger?*, and the NOQUD condition did not have any explicit

⁶ The link to the actual experiment is provided in the appendix.

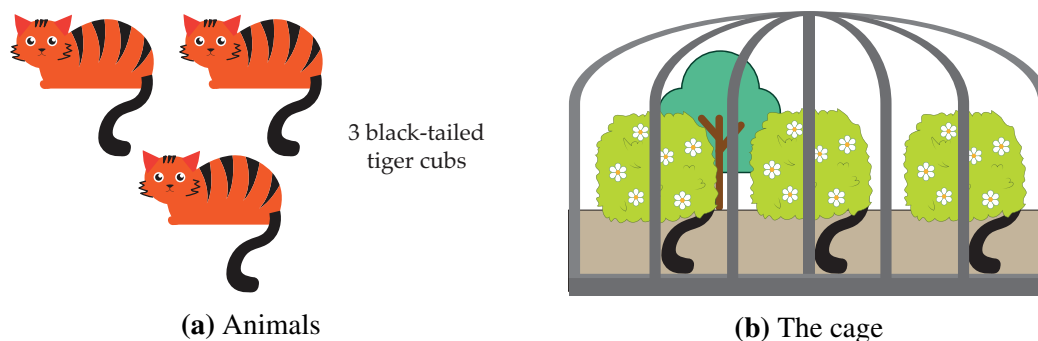


Figure 4: Sample visual stimuli for the TRUE baseline condition

Context prompt: Ron is at a zoo. Ron knows that the cage is currently housing exactly three tiger cubs. Ron also knows that the tigers look as in (a). Ron peers through the cage, which looks as in (b).

QUDs. If an explicit QUD was present, it immediately preceded the target modal sentence.

(15) Three target conditions

a. WHICH condition

A friend arrives and asks the main speaker: *“Which of X has a Y?”*

The main speaker replies: *“Every X might have a Y.”*

b. HOW condition

A friend arrives and asks the main speaker: *“How many of X have a Y?”*

The main speaker replies: *“Every X might have a Y.”*

c. NOQUD condition:

(no explicit QUD; no mention of another friend)

The main speaker says: *“Every X might have a Y.”*

In addition to these three target conditions, the experiment also included three baseline conditions: TRUE, FALSE, and NO-M. As we will see later, these provided analytically useful points of comparison and ensured that the experimental design worked in the intended way. First, in the TRUE condition, visual stimuli and context prompts were designed to generate modal bases that would render the associated modal statements True under *both* the ECP-observing scopal ordering *and* the ECP-violating scopal ordering. The modal statements that were presented were identical to those from the target conditions: *Every X might have a Y*. The statements were uttered by the speaker in the absence of any explicit QUD. A sample prompt and visual stimuli using the same items from Fig. 3 are given in Fig. 4. In this context, Ron’s utterance: *Every bush might have a tiger*. would be evaluated as True regardless of the choice in scopal ordering.

Second, in the FALSE condition, visual stimuli and context prompts were designed to generate modal bases that would render the associated modal statements False under *both* the ECP-observing scopal ordering *and* the ECP-violating scopal ordering. Again, the modal statements that were presented were identical to those from the target conditions: *Every X might have a Y*, and the statements were uttered by the speaker in the absence of any explicit QUD. A sample prompt and visual stimuli are given in Fig. 5. In this context, Ron’s utterance: *Every bush might have a tiger*. would be evaluated as False regardless of the choice in scopal ordering.

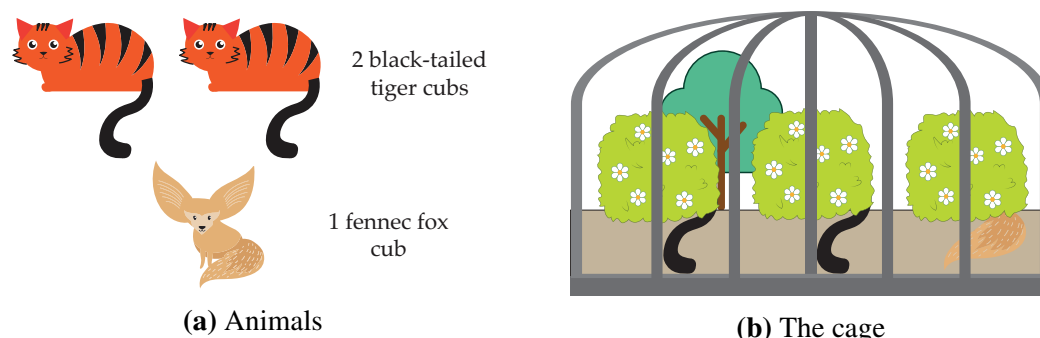


Figure 5: Sample visual stimuli for the FALSE baseline condition

Context prompt: Ron is at a zoo. Ron knows that the cage is currently housing exactly two tiger cubs and exactly one fennec fox cub. Ron also knows that the animals look as in (a). Ron peers through the cage, which looks as in (b).

In particular, the last bush in the cage in Fig. 5b clearly has a fox tail and is incompatible with hiding a tiger; it thus renders the associated modal statement False even under the ECP-violating scopal ordering.

Finally, in the NO-M condition, a range of visual stimuli and prompts that were identical to the ones in target conditions (e.g., Fig. 3) was presented. However, the sentences uttered by the main speakers were non-modal statements in the form of: *Every X has a Y*, such as: *Every bush has a tiger*. Given the context (in particular, the cardinality information such as Fig. 3a), these non-modal statements (which are equivalent to the prejacent of the modals in the ECP-observing MIGHT \succ EVERY interpretations) would be evaluated as False.

4.1.3. Procedure

The experiment had five trials. One of the trials was a filler trial, and the remaining four were target and baseline trials. Each participant saw all three target conditions (WHICH, HOW, NO-QUD) and one of the three baseline conditions (TRUE, FALSE, NO-M). Each of the five trials was associated with five distinct scenarios and visual stimuli, such that no participant saw the same type of scenario/item across conditions/trials.

The filler trials involved cases where the questioner asks identification questions such as *Which pot has a dessert lotus shoot?*, and the main speaker responds with unambiguously true or false answers (given the visual information) involving neither modals nor quantifiers; e.g., *The pot in the middle has a dessert lotus shoot*. Responses to fillers were later checked to confirm that participants paid attention to the experimental tasks.

In each trial, participants answered the questions summarized in (16) after familiarizing themselves with the set-up and the target utterance. The main task was the True/False judgments in (16a), but there was also a gradient rating task (16b) as well as an optional free response question (16c). The experiment lasted an average of 8 minutes.

(16) **Questions in each trial**

- a. Q1: Is what [the speaker] said True or False? (forced choice)
- b. Q2: How confident are you about your response to Q1? (ratings from 0–100)
- c. (Optional) Any comments?

4.2. Predictions

Given the relevance relation argued for in sec. 3, the following predictions emerge for the target conditions: (i) The WHICH condition will elicit significantly more True responses, i.e., more ECP violations, than the HOW condition. (ii) The NOQUD condition will pattern in between the WHICH condition and the HOW condition, as participants may reconstruct a range of different QUDs. The predictions for the baseline conditions are straightforward: the TRUE condition is expected to elicit predominantly True responses; the FALSE and the NO-M condition are expected to elicit predominantly False responses.

4.3. Results

Participants' True/False responses (in %) depending on the 6 conditions are plotted in Fig. 6, along with a summary of the conditions (Table 1). The vertical axis represents the 6 conditions, and the horizontal axis represents percent values. True responses are coded in green, and False responses in red. Error bars represent 95% confidence intervals.

The data were analyzed using a mixed effects logistic regression model with by-participant random intercepts, predicting True/False responses (dependent variable) from the 6 conditions (independent variable). By-situation random intercepts were initially posited as well, but were later dropped as they did not capture any significant variance. The model was fitted using the *lmerTest* package (Kuznetsova et al., 2016) in *R* (R Core Team, 2015). A summary of the fixed effects can be found in the link in the appendix.

4.3.1. Target conditions: QUD effects on the ECP

As predicted, the WHICH condition elicited significantly more True responses, which translates into more ECP violations, than the HOW condition ($\beta = -0.41$, $SE = 0.13$, $z = -3.11$, $p < 0.01$). Fig. 6 captures this: the green bar (True responses) in the WHICH condition is distinctly higher than the one in the HOW condition. In comparison, there was no significant difference between the NOQUD condition and the HOW condition, and between the NOQUD condition and the WHICH condition. While these differences were not significant, Fig. 6 demonstrates that the bars of the NOQUD condition fall somewhere in-between those of the WHICH condition and the HOW condition, as expected.

conditions	QUD and sentence stimuli
NO-M	(No explicit QUD) <i>Every X has a Y.</i>
FALSE	(Fig. 5; no explicit QUD) <i>Every X might have a Y.</i>
HOW	<i>How many of X have a Y?</i> <i>Every X might have a Y.</i>
NOQUD	(No explicit QUD) <i>Every X might have a Y.</i>
WHICH	<i>Which of X has a Y?</i> <i>Every X might have a Y.</i>
TRUE	(Fig. 4; no explicit QUD) <i>Every X might have a Y.</i>

Table 1: Summary of conditions

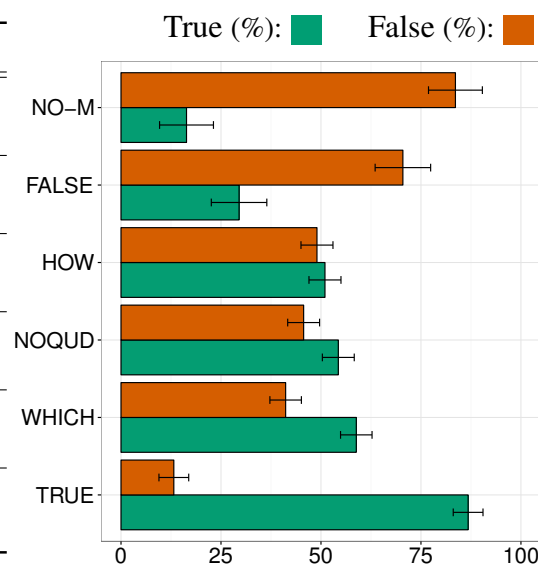


Figure 6: Percent True/False

In sum, the results support the main hypothesis that QUDs significantly affect the ECP: Scopal orderings that provide relevant answers to the QUDs are favored, and this tendency can override the ECP preference (as in the case of the WHICH condition).

More globally, all three target conditions including the HOW condition elicited non-negligible proportion of True responses, indicating ECP-violations. Fig. 6 demonstrates that the proportions of True responses for all three target conditions are above 50%. This is unexpected if the ECP operated as a categorical constraint or even as a strong bias. If this was the case, then we would expect the ECP to be near-categorically observed as long as certain preconditions are satisfied (e.g., in the HOW condition where the QUD bias aligns with the ECP bias and the statements involve subjective interpretations and the quantifier *every*), predicting near-categorical False responses for such conditions. To probe the implications of the surprisingly robust number of True responses, let us conduct a more detailed examination of the baseline conditions and participants’ free responses.

4.3.2. No-M vs. False condition: unrealistic modal bases

The availability of True responses across all three target conditions suggests that the ECP may be violated more easily than previously assumed. In order for us to arrive at this conclusion however, we first need to rule out alternative explanations. In particular, is it possible that the core experimental assumption, namely, that True responses are fully equivalent to violations of the ECP, was not always met? This assumption was grounded on the fact that the experimental trials always provided explicit information about the speakers’ epistemic states. As long as this information was included in creating the modal bases, the ECP-observing orderings could not possibly yield True evaluations; only ECP-violating orderings would allow them.

Nevertheless, participants might occasionally have granted more leeway in constructing the modal bases than is strictly allowed from the visual information. If this is the case, then some of the True responses in the target conditions may correspond not to genuine ECP violations, but rather to cases where participants posited unrealistic modal bases. For example, given a scenario like Fig. 3, certain participants might have included in the modal base worlds in which the ECP-observing prejacent ‘every bush has a tiger’ is true, despite the fact that the visual information and the speaker’s epistemic/doxastic state clearly ruled this out.⁷

Is there a way of probing whether such exceptional interpretations occurred, and if so, how often? Comparing the two baseline conditions: FALSE and NO-M might provide a window into this issue. The FALSE condition, as expected, elicited primarily false responses (more than 70%). However, it also allowed for significantly more true responses than the NO-M condition ($\beta = -1.00$, $SE = 0.35$, $z = 2.83$, $p < 0.01$). This is not expected if we assume that participants always fully included the contextual/visual information when construing the modal bases of the speakers: in the FALSE condition such as Fig. 5, the information in Fig. 5b rules out the ECP-violating interpretation being true, while the information in Fig. 5a (shared by the target conditions) rules out the ECP-observing interpretation being true.⁸ Nevertheless, the FALSE condition occasionally allowed True responses, suggesting that participants may not always have taken this information fully into account. Based on this, we may conclude that analogous cases of laxer construal of modal bases existed, albeit to a small degree, in the three target conditions as well.

4.3.3. Target vs. False condition: no ECP?

However, the significant number of True responses in the three target conditions cannot all be reduced to exceptional cases where participants posited laxer, unrealistic modal bases. If this were the case, we would at least expect these conditions to pattern with the FALSE condition. In other words, the rate at which such laxer construals occurred (and manifested as True responses despite observing the ECP) would be at best equivalent to the FALSE condition, and most likely lower.⁹ As it turns out however, not only the WHICH condition, but also the NOQUD and the HOW condition elicited significantly more True responses than the FALSE condition (e.g., comparing the HOW condition with the FALSE condition: $\beta = 1.17$, $SE = 0.22$, $z = 5.23$, $p < 0.001$). This suggests that significant parts of the True responses in all three target conditions are indeed reflections of genuine ECP violations.

This state of affairs is corroborated further by participants’ free responses. A few comments that unambiguously confirm the availability of the ECP violating scopal interpretations (*every*

⁷ Since the target modal sentences did not have any explicit adverbials like ‘based solely on *X*’ (cf. Portner, 2007), it seems highly unlikely that this happened frequently.

⁸ The partial visual information given in Fig. 5b introduces weaker, more defeasible information than the information about cardinality given in Fig. 5a. So it is also possible that many of the True responses in the FALSE condition reflect participants’ uncertainty about the information given in Fig. 5b, rather than indicate that participants reconstructed unrealistic modal bases.

⁹ This is because as mentioned in footnote 8, the information about cardinality such as Fig. 3a is a much stronger piece of information and is thus harder to ignore than the partial visual information such as Fig. 5b.

\succ *might*) are presented in (17).¹⁰ All 3 target conditions elicited some amount of free responses in the vein of (17), confirming the general availability of ECP violations across conditions.

- (17)
- a. “I think she means each statue has the potential to have a blue sapphire not that all of them will.”
 - b. “It is tricky to know if George means there are 3/3 moss butterflies or (if he means) each beaker (could) possibly contain one.”
 - c. “this is true because you don’t know which one it is. Obviously one of them doesn’t have a maraschino cherry but it’s possible that the one you choose will.”
 - d. “Every bush *MIGHT* have one until you find the two and then the last bush would not have one.”

In sum, the results for the three target conditions suggest that the ECP violating interpretations are more available than previously assumed, and confirm the main hypothesis that the QUD-based scopal biases boost this availability further.

4.3.4. Target vs. True condition: evidence for the ECP

Faced with this rather pervasive availability of ECP-violating scopal orderings, one may begin to wonder if our intuitions about the ECP were perhaps illusory. However, the results of the experiment also suggest that some kind of bias that works towards creating the intuition behind the ECP does exist. If the ECP-violating scopal orderings were as available as the ECP-observing ones, then we would expect the three target conditions to pattern more like the TRUE condition (modulo the effects of QUDs), as participants would have had full access to the scopal ordering that renders the statement true. Since people tend to prefer interpretations that render the statement true when there is ambiguity (Gualmini et al., 2008; cf. Meyer and Sauerland, 2009), we would expect participants to predominantly choose the ECP-violating ordering if there weren’t any bias against it. However, all three conditions also elicited significantly fewer True responses than the TRUE condition (e.g., comparing the WHICH condition with the TRUE condition: $\beta = -1.92$, $SE = 0.21$, $z = -9.07$, $p < 0.001$); and the proportion of True responses for the three target conditions fell somewhere in-between the FALSE condition and the TRUE condition, differing significantly from either of the baselines. This suggests that there exists some kind of gradient preference towards the ECP-observing scopal ordering that is activated to a different degree depending on various factors (one of which, as we saw, is the QUD).

4.3.5. Variability of the intuition behind the ECP

To some extent, scopal preferences varied depending on the language user. Comments like (17) indicate that certain participants had no trouble resorting to ECP-violating scopal interpretations. In comparison, comments like (18) indicate that other participants were more strongly

¹⁰ The full list of free responses is provided in the .csv file that can be accessed via the link in the appendix.

biased against them.¹¹

- (18) a. “*Interesting. This depends on how you interpret ‘every pot might...’ I would lean towards (this meaning) that all 3 pots would have a desert lotus shoot and not just that each pot might potentially have a desert lotus root.*”
 b. “*The more I think about it I guess every bush MIGHT have a tiger cub but it just is not the correct way to say this.*”

Participants’ certainty ratings (i.e., their answers to Q2) also provide indirect evidence for the existence of this variability.¹² If participants shared essentially the same kind of scopal preference, and if the contrast between True vs. False responses (and also between the comments in (17) and (18)) are just manifestations of their stochastic decisions when faced with ambiguity, we would expect their certainty ratings for the three target conditions to be significantly lower than those for the three baseline conditions. However, no significant difference in certainty ratings emerged across the 6 conditions when a mixed effects regression model was fitted (with certainty ratings as the dependent variable and conditions as the independent variable; and with by-participant random intercepts). This suggests that proponents of (17) vs. (18) were certain about their respective intuitions, which varied significantly from each other.

5. Discussion

The current experimental study provides evidence for the view that the ECP is at best a de-feasible/gradient bias whose manifestation is subject to a variety of factors (cf. Anand and Hacquard, 2008), one of which is the QUD.

Does this ‘ECP bias’ have an independent presence, or can it be reduced to a combination of more primitive lexical and pragmatic biases? The paper suggests that the latter option is more likely, and that the ECP bias primarily reflects lexical biases associated with various quantifiers and/or modals. It is widely known that epistemic modals like *might* tend to take wide scopes. It is also known that different types of quantifiers are susceptible to the ECP to different degrees: *each* seems to more easily allow ECP violations than *every* (Tancredi, 2007);¹³ and *every* in turn seems to more easily allow ECP violations than *all*.¹⁴ This state of affairs can be straightforwardly captured if one posits that quantifiers come pre-equipped with different scopal preferences. More specifically, they prefer or allow wide scopes in the following order: *each* > *every* > *all*. Since *might* prefers to take wide scope and *every* doesn’t, something like the ECP bias is predicted to emerge. Such a view is indirectly supported by

¹¹ In addition to user-dependent variation, other factors such as intonation also seem to influence the activation of ECP, as indicated by comments such as “*It depends on if she emphasizes the word ‘every’ or ‘might’.*”

¹² Since each participant only did a single trial for each condition, we cannot know if a given participant would have provided consistent responses across multiple trials of the same condition. If this turned out to be the case, and if distinct groups of answer patterns were to emerge, we would have more direct evidence.

¹³ This intuition was confirmed via a separate experimental study that mainly tested the effects of evidential adverbials on the ECP. Since the study is not directly relevant to the main argument of the current paper, it is not presented here. However, the results as well as the experiment itself can be found in the link in the Appendix.

¹⁴ The present account would predict that ECP-violations would be even less available for the quantifier *all* (compared to *every*), although not entirely inaccessible if other contextual cues like QUDs strongly point towards ECP-violating interpretations.

participants' comments like (19). These highlight the role of lexical alternatives in shaping how the ECP bias manifests itself across different types of quantifiers.

- (19) a. *The correct phrase should be 'each pot might have a desert lotus shoot'. The word 'every' implies that all pots inclusively together have desert lotus shoots.*
 b. *The leaves on both kinds of plants have the same appearance. So it's possible that any of the pots could have a lotus shoot. Though saying 'every' isn't as clear as saying 'any'.*

For instance, (19a) suggests that *each* is a better choice than *every* for conveying $\forall \succ \diamond$, most likely because *each* is associated with a stronger bias towards taking a wide scope than *every*; it is thus a less ambiguous option for signaling the intended meaning. The availability of *each* in conveying the ECP-violating proposition seems to give rise to additional pragmatic inferences that further strengthen the ECP bias associated with *every*: Listeners may reason that if the speaker had intended to convey the ECP-violating proposition, she likely would have used *each*. Since she opted for *every* instead, she most likely intends to convey the ECP-observing proposition (unless QUDs or other contextual information indicate otherwise).

As a final note, we may want to discuss what to make of the apparent discrepancy between the current experimental results (which highlight the defeasibility of the ECP) and the strong ECP intuitions initially reported in von Stechow and Iatridou (2003). There are various possible explanations for this. First, the implicit QUDs evoked by von Stechow and Iatridou (2003)'s examples might have been more along the line of HOW-QUDs than WHICH-QUDs. Second, providing explicit questions (which were absent in von Stechow and Iatridou (2003), although the contextual settings they introduced were fairly rich otherwise) along with the modal statements might have been the real game-changer and thus greatly boosted the availability of ECP violating interpretations in the experiment. Finally, the participants in the current experiment might have become more attuned to the latent ECP-violating scopal ordering through the course of their exposure to statements involving quantifiers and modals across multiple trials. The paper remains agnostic as to what could have been the most important source of the discrepancy. The main take-away seems to be that the ECP-violating interpretations cannot be entirely ruled out, although in many cases, diverse factors will conspire against them.

6. Conclusion

This paper presented an experimental study of the effects of explicit QUDs on the ECP. Based on the experimental results, it argued that the ECP can be recast as a gradient scopal preference which arises from a confluence of more primitive lexical and pragmatic biases.

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7. Appendix

Links to all the experiments, data, and statistical models can be found at:
<https://github.com/sunwooj/ecp/>

Experimenting with imposters: What modulates choice of person agreement in pronouns?¹

Elsi KAISER— *University of Southern California*

Justin NICHOLS— *University of Southern California*

Catherine WANG— *University of Southern California*

Abstract. Imposters are grammatically third-person expressions used to refer to the first-person speaker or second-person addressee (e.g. ‘the present authors’ when used to refer to the first-person writer, ‘Mommy’ or ‘Daddy’ when used by parents for self-reference in child-directed speech). Current analyses of imposters differ in whether they derive the unusual referential properties of imposters using syntactic means or attribute them to semantic and pragmatics. We aim to shed light on these competing approaches by means of a psycholinguistic experiment focusing on first-person imposters that investigates the kinds of pronouns (first-person vs. third-person) used to refer to imposter antecedents. Our results show that manipulating the prominence of the first-person speaker does not significantly boost the acceptability of first-person pronouns in imposter-referring contexts. However, our results suggest that a purely syntactic approach may not be sufficient either, as psycholinguistic processing factors also appear to be relevant.

Keywords: person agreement, agreement mismatch, pronoun, imposters, psycholinguistics, accessibility, prominence.

1. Introduction

Language often draws a sharp distinction between speaker, addressee and others in terms of the grammatical category of person. However, sometimes this neat division breaks down and third-person expressions are used to refer to the speaker or the addressee. This phenomenon is illustrated in (1a,b), where the speaker refers to themselves with expressions like ‘Grandma’ and ‘this reporter.’ These expressions occur with third-person verb agreement in English, but their intended interpretation is the first-person *I* (speaker).

- (1) a. *Grandma* needs to rest a bit! (*said by grandmother to daughter*)
b. At the time, CBS News and *this reporter* fully believed the documents were genuine.
(Dan Rather, talking about himself, from Collins and Postal, 2012:1)

These elements are often called imposters, which are defined by Collins and Postal (2012) as notionally first- or second-person DPs that are grammatically third person. More generally, an imposter can be defined as “A notionally X person DP that is grammatically Y person, X≠Y” (Collins and Postal, 2012:5). Thus, imposters’ grammatical person does not match their semantic or notional person (see also Collins, 2014 for a crosslinguistic discussion of imposters in a variety of languages).

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First-person and second-person imposters in English occur in a variety of contexts and registers, as exemplified in (1-3). As the examples show, imposters occur both in informal child-directed speech and in the more formal academic register. This phenomenon is not confined to a particular register.

(2) *First-person imposters*

- a. At the same time, the present authors had been asking ourselves whether there should be a model of cooperative governance (www.grocer.coop)
- b. The undersigned authorizes my student to participate in authorized DoDEA school study trips... (DoD Education Activity form)
- c. ...the emphasis on restoring functions, as opposed to designing projects around the benefits themselves, seems sensible and appropriate to this reviewer. From my limited perspective... (<http://tahoe.ca.gov/>)

(3) *Second-person imposters*

- a. Would little Jimmie like another ice-cream cone? (Collins and Postal, 2012:7)
- b. How is my darling tonight? (Collins and Postal, 2012:7)

The structure of this paper is as follows: In Section 2, we review two competing views of imposters that differ in terms of how much of imposters' unusual behavior is attributed to syntax vs. semantics and pragmatics. In Section 3, the person agreement properties of English singular and plural imposters are discussed. As we will see, English plural imposters can antecede both first- and third-person pronouns and reflexives, whereas singular imposters, at least in some contexts, appear to be limited to third-person pronouns. To further assess the acceptability of first- and third-person pronouns with imposter antecedents and to see whether increasing the prominence of the first-person speaker referent boosts the acceptability of first-person pronouns, we conducted a psycholinguistic experiment. The method and design are presented in Section 4, and the results are discussed in Section 5. Section 6 concludes the paper.

2. Two views of imposters

The split between imposters' grammatical and notional properties—the fact that they seem to be grammatically third-person, at least when it comes to verb agreement in English, while being notionally first- or second person—poses challenges for theories of agreement. How can we capture this two-faced behavior of imposters? Broadly speaking, prior work has attributed the unexpected behavior of imposters either to (i) special syntactic properties of imposter DPs—what Collins and Postal (2012) call the *syntactic view*—or (ii) to special semantic or pragmatic properties of imposters—what Collins and Postal call the *notional view*.

One possibility is that imposters are syntactically normal third-person DPs (e.g. Baker, 2008; Siewierska, 2004; see also Stirling and Huddleston, 2002). Under this view, these grammatically third-person DPs are special in their interpretational/referential component, since they can refer to a first- or second-person referent. Under this view, any special agreement properties that imposters exhibit must stem from somewhere other than syntax—e.g. semantics / pragmatics / discourse—because syntactically, they are the same as normal

(non-imposter) third-person DPs. Collins and Postal (2012) refer to this approach as the notional view, and summarize it as follows:

- (4) Notional view: “Imposters are syntactically regular 3rd person DPs with the *semantic/discourse* property that they denote either the speaker(s) (in the same sense as 1st person pronouns do) or the addressee(s) (in the same sense that 2nd person pronouns do).” (2012:78, emphasis in original)

Baker (2008) discusses examples like (5a,b) and states that “ordinal non-pronominal DPs are never first or second person, even when they refer to the speaker or hearer” (p.126).

- (5) a. [CP S_i [TP[NP_iThe man who is/*am talking to you] is hoping to get some money.
b. Sorry honey, but Daddy is/*am too tired to play with you tonight.

According to Baker, a speaker-referring, first-person imposter like ‘the man who is talking to you’ can have the same index as the speaker (which he denotes with S in 5a). However, he describes this as “a definite description that refers to the speaker without being dependent on S” (Baker, 2008:127). In essence, under his account, imposters can refer to the speaker (i.e., can have the same index as the speaker) but are syntactically normal third-person DPs.

Using examples like (6a,b), Siewierska (2002) notes that expressions like ‘mummy’ and ‘Johnny’ can be used to refer to the speaker and the addressee, “but they cannot be said to express the discourse roles of speaker and addressee, as there is nothing in the words *mummy* and *Johnny* to suggest that they are speaker and addressee respectively” (Siewierska. 2002:2). She continues that “only *I* and *you* and not *mummy* and *Johnny* are expressions of the first and second persons” (Siewierska, 2002:2). Thus, according to Siewierska, imposters are grammatically third person, similar to Baker’s view (see also Stirling and Huddleston, 2002).

- (6) a. I will spank you.
b. Mummy will spank Johnny.

Siewierska notes that “In principle, there is no limit to the nature of the lexical expressions that a speaker may use to refer to herself” (Siewierska, 2002:2). However, Collins and Postal (2012) note that it is not the case that *any* third person DP can freely be interpreted as speaker-referring (or addressee-referring). For example, in (7a-b), ‘Uncle Carl’ cannot be an imposter, whereas in (7c) it can be interpreted as a first-person (speaker-referring) imposter. Thus, an open question for the notional view is what determines whether a DP can be interpreted as an imposter or not—in other words, what are the constraints that ensure that Uncle Carl can be interpreted as an imposter in (7c) but not in (7a-b).

- (7) a. Are you Uncle Carl?
b. Uncle Carl is my neighbor.
c. Uncle Carl really needs to take a nap.

Collins and Postal (2012) argue against the notional view of imposters, and in favor of an analysis where the behavior of imposters stems from special syntactic properties. Under this view, the behavior of imposters is syntactically determined, and not due to semantics or

discourse (see also Collins, 2014). Simplifying considerably, the basic idea is that imposter DPs are structurally complex and include null indexical first (or second) person pronouns, in addition to the overt (visible) third-person DP. This plays a crucial role in allowing imposters to antecede both first-person and third-person pronouns, as exemplified in (8). Here, it seems that both *themselves* and *ourselves* are grammatical—i.e., the syntactically third-person imposter can antecede either a first-person or a third-person reflexive pronoun. (We discuss these patterns more in Section 3).

(8) *Said by father to child:*

Not now! Ask Auntie Jane to show you the garage. Daddy and Uncle Jim are enjoying {themselves/ourselves} on the beach. (adapted from Collins and Postal 2012)

More specifically, Collins and Postal (2012) analyze imposters as being derived from appositive precursor structures such as ‘we, the present writers’ or ‘I, your faithful correspondent’, such that imposter DPs have a null ‘core’ DP that expresses the notional first (or second) person pronoun as well as a visible DP that expresses the third-person form. For the purposes of the present paper, we assume that imposters (under the syntactic view) are indeed structurally complex, but the exact nature of that structure is not crucial for the claims we are making here.

A full summary of Collins and Postal’s system is beyond the scope of this paper, but crucially, it is a syntactically-defined system: The tension between the grammatical and notional person patterns of imposters is encoded in the structure of the imposters themselves by means of a covert indexical, and the person agreement patterns (Section 3) are derived by means of the syntactic notion of antecedence and the possibility of agreeing with both primary and secondary sources (syntactically defined).

3. Person agreement with imposters: Reflexives and possessive pronouns

Although English imposters consistently trigger third-person verb agreement (5), the person agreement patterns—as exhibited by reflexives and possessive pronouns—are less consistent. Specifically, it seems that plural imposters (e.g. *the present authors*) or coordinated imposters (e.g. *Mommy and Daddy*) can antecede both third- or first-person pronouns and reflexives, whereas singular imposters can only antecede third-person pronouns and reflexives (see also Collins and Postal, 2012; Collins et al., 2009; for a crosslinguistic overview, see Collins, 2014).

Let us first consider the data for plural imposters. As shown in (9), both third-person and first-person possessive pronouns and reflexives seem to be acceptable. In all cases in this paper, the intended interpretation is the one where the relevant pronoun or reflexive is coreferential with the imposter (i.e., does not refer to a third person). The possibility of using either first- or third-person reflexives is available with both ‘regular’ reflexives (9c) as well as inherent reflexives (9b). (We focus here on speaker-referring imposters and first-person pronouns, but the same observations and questions arise with addressee-referring imposters and second-person pronouns.)

- (9) a. *Said by father to child:*
Mommy and Daddy need to take {their/our} shoes off first!
- b. *Said by father to child:*
Not now! Ask Auntie Jane to show you the garage. Daddy and Uncle Jim are enjoying {themselves/ourselves} on the beach. (adapted from Collins and Postal 2012:114)
- c. *Said/written by authors:*
In this reply, the present authors attempt to defend {themselves/ourselves} against the scurrilous charges which have been made (Collins and Postal 2012:vii)

Based on the first/third person alternation that is allowed by plural imposters, we might expect singular imposters to show the same flexibility when it comes to pronoun person agreement. However, the situation is less clear than one might expect. Collins and Postal note that singular imposters (e.g. *Daddy, this reviewer*) seem to require third person pronouns and reflexives. They report that first person pronouns and reflexives sound worse in these contexts.² This intuition is supported by a small-scale experiment with fifteen participants conducted by Collins, Guitard and Wood (2009).

- (10) a. *Said by father to child:*
Daddy needs to drink {his/*my} coffee first!
- b. *Said by father to child:*
Not now! Ask Auntie Jane to show you the garage. Daddy is enjoying {himself/*myself} on the beach. (adapted from Collins and Postal, 2012)
- c. *Said by a speaker who refers to himself as 'this reporter':*
This reporter sees himself/*myself as a managing editor in the future. (Collins and Postal, 2012:20)

However, as Collins and Postal (2012:20-21) acknowledge, there are also naturally-occurring examples from the web where singular posters antecede first-person anaphors, as illustrated in (11) (Examples cited by Collins and Postal, 2012).

- (11) a. This reviewer found myself frustrated at times with the various storylines (from an Amazon review)
- b. while yours truly treated myself to a few ice cold Miller Lites (from sportingnews.com)
- c. This reporter sent myself to cover Bill Clinton's lecture at the Dorothy Pavilion (from www.louisepalanker.com)

Furthermore, Baker (2008:128) suggests that the acceptability of first-person pronouns with singular imposters may depend on whether imposter c-commands the pronoun. In the absence

² Collins & Postal distinguish imposters from what they call 'camouflage DPs' (see also Collins, Moody & Postal, 2008). One subclass of camouflage DPs are Social Hierarchy Camouflage Constructions such as *your majesty, your honor*. Collins & Postal (2012:74) note that in SHCC, the notional core is overt and occurs in possessor position: In *your majesty*, for example, the notional core is the second person addressee *you* (compare to *yours truly* or *my lord*, where the possessive pronoun does not match the notional referent). It seems that unlike imposters, camouflage DPs easily allow person alternation in the singular as well (ex.i). A discussion of why this is possible with camouflage DPs is beyond the scope of the present paper.

(i) [Your majesty]_i should praise yourself_i /herself_i. (Collins, 2014:1)

of c-command, he reports that singular imposters can antecede first-person pronouns, and described (12a) with the first-person pronoun as “more or less possible” (p.128):

- (12) a. *Father says*: Because Daddy_k forgot something at the office, he_k has/I_{?k} have to go back there.
 b. *Father says*: Daddy_k has to go back to the office because he_k/I*_k forgot something there.

Thus, it is not yet well-understood (i) whether—or under what conditions and what syntactic configurations—singular imposters can antecede first-person pronouns, and (ii) why plural imposters seem to be able to antecede first-person pronouns more easily than singular imposters. Collins (2014) notes that “the singular/plural asymmetry with imposters remains a mystery, and accounting for it is one of the greatest challenges for future work” (Collins, 2014:24, see also Podobryaev, 2014; 2017 for related discussion of an asymmetry in the person feature assignment of plural vs. singular personal pronouns). Before considering the behavior of singular imposters in more depth, we consider how, according to Collins and Postal (2014), plural imposters can exhibit both first- and third-person agreement.

3.1. Multiple agreement options with plural imposters

How can plural imposters in English antecede both first- and third-person pronouns? Collins and Postal note that it is unclear how the notional view can capture these agreement patterns: If imposters are syntactically regular third-person DPs, it is unclear how they can bind first-person reflexive pronouns,³ if we assume that reflexives agree with their antecedents in terms of ϕ -features.

According to Collins and Postal (2012)’s syntactic view, the pronominal agreement patterns stem from the availability of more than one possible antecedent in the syntactic structure. They propose, building on prior work, that the left periphery contains null DPs for AUTHOR (aka Speaker) and ADDRESSEE. The AUTHOR DP is first person, and can be singular or plural (depending on the situation), and, correspondingly, the ADDRESSEE DP is second person, and can also be singular or plural. The AUTHOR and ADDRESSEE DPs are represented in an expanded left periphery (Rizzi 1997) or as arguments of a covert performative clause (Collins 2014, see also Speas and Tenny, 2003; Haegemann and Hill, 2013 on the Speech Act Projection). These null DPs are present even if the sentence does not contain first or second person pronouns.⁴

Crucially, to capture agreement patterns such as those in (9), Collins and Postal claim that a pronoun can agree with a primary or a secondary source. A full summary of their analysis is beyond the scope of this paper, but in essence, in (13), a pronoun can agree with (i)

³ Unlike the clear distinction between anaphoric vs. pronominal forms that is visible on object-position nominals (e.g. *herself* vs. *her*), English possessive pronouns do not morphologically distinguish reflexive and non-reflexive configurations, in contrast to languages like Swedish (see also Kuno, 1987:80 for discussion).

⁴ However, some researchers argue against the syntactic encoding of speech-act-participant related projections at the left periphery (see e.g. Gärtner & Steinbach, 2006). In order to argue for a purely syntactic approach to imposters, the representation of AUTHOR (speaker) and ADDRESSEE presumably needs to be syntactically encoded, so when discussing the syntactic view we treat them as null DPs in the left periphery.

AUTHOR as its ultimate antecedent, yielding first-person *our* (ex.13a) or *ourselves* (ex.13b) or with (ii) its immediate antecedent ‘Mommy and Daddy, yielding third-person *their* (ex.13a), or *themselves* (ex.13b). In this system, both the ultimate and immediate antecedent are defined as sources in configurations like (13) and thus pronominal agreement with either one is possible.

In contrast to proponents of the notional view, Collins and Postal claim that all pronouns (except expletives) have linguistic antecedents (Collins, 2014:4)—i.e., a first-person form like ‘our or ‘ourselves’ in (13) does not, under their approach, refer to an extra-linguistic referent but instead has a syntactically-present antecedent.

- (13) a. [[DP AUTHOR] Mommy and Daddy need to finish {their/our} coffees first.]]
 b. [[DP AUTHOR] Mommy and Daddy are enjoying {themselves/ourselves} on the beach.]]

3.2. Choosing between multiple agreement options

The observation that plural imposters seem compatible with both first and third person agreement raises the question of what influences the choice of one over the other. Collins and Postal do not address this question in detail, and Akkuş (2017) notes that the choice of first vs. third-person pronoun does not correlate with truth-conditional differences. Indeed, if we assume a purely syntactic view of imposters, then both agreement options—(i) agreement with the ultimate AUTHOR antecedent and (ii) agreement with the immediate linguistically-overt third person antecedent—are equally available, as both are syntactically possible.

However, prior work on the general topic of pronoun use and interpretation (albeit mostly in cross-clausal contexts with multiple possible antecedents) suggests that differences in antecedent accessibility/prominence guide pronoun interpretation. More specifically, many researchers have suggested that referents which are cognitively more accessible/prominent in language users’ minds at a particular point in the discourse are more likely to be chosen as antecedents of pronouns (e.g. Ariel, 1990; Gundel et al., 1993, and many others). Even though multiple referents can be activated in people’s mental representations of the discourse, some are more highly activated than others. Work on pronoun interpretation suggests that—other things being equal—pronouns tend to be interpreted as referring to the most salient referents.⁵ This might lead one to expect that in imposter structures such as (13), the pronoun will tend to agree with whichever antecedent—the ultimate AUTHOR (speaker) antecedent or the immediate ‘Mommy and Daddy’ antecedent—is more prominent.

But what influences the prominence/accessibility of potential antecedents? Work on cross-sentential pronoun interpretation has identified multiple factors, including (i) recency of mention (e.g. Givón, 1983)—more recently mentioned entities are more accessible/prominent than less-recently mentioned ones—as well as (ii) syntactic prominence—referents realized in subject position are more accessible/prominent than referents in other syntactic positions (e.g.

⁵ The salience/accessibility-based patterns observed in the pronoun resolution literature are gradient preferences and biases, not absolute principles or requirements.

Brennan et al., 1987). Various other factors such as verb semantics and discourse coherence have also been identified.

We conducted a psycholinguistic experiment designed to manipulate the prominence of the AUTHOR—in other words, the speaker of the sentence—to see if this influences people’s preference for first-person pronouns. We tested sentences where the main clause was (or was not) preceded by a subordinate clause—which we will call the ‘preamble’—that explicitly mentions the speaker(s) in subject position by means of a pronoun (ex.14).

- (14) a. **Mommy and Daddy** have to finish {**our/their**} coffees.
 b. Before **we** take you to daycare, **Mommy and Daddy** have to finish {**our/their**} coffees.

In light of prior work showing that pronouns prefer prominent antecedents, combined with findings showing that recency of mention and realization in subject position boost referent prominence, we might expect first person pronouns to be more likely in (14b) than in (14a)—or in terms of acceptability, we may find that participants rate (14b) with *our* as more acceptable or natural than (14a) with *our*. Third-person pronouns are presumably equally acceptable in both contexts, as they match the grammatical third-person status of the imposter.

3.3. Singular imposters: Acceptability of first-person vs. third-person pronoun

In addition to testing plural imposters (ex.14a,b), we also investigated singular imposters, to gain more clarity into whether they can antecede first-person pronouns in addition to third-person pronouns. Collins and Postal (2012) report first-person pronouns as being ungrammatical with singular imposters, but acknowledge that corpus examples with first-person pronouns exist (see (11)). A small-scale study by Collins et al. (2009) tested an item in a configuration where a possessive first- or third-person pronoun (in an idiomatic, inalienable-possession construction, ‘lose my/his cool’) refers to a singular imposter (‘this reporter’) and obtained an average rating of 1.573 out of a maximum rating of 3. Although it is not yet clear if this pattern will generalize to other sentences and other types of possession relations, it further highlights the unclear status of pronoun patterns with singular imposters. In addition, Baker (2008) notes that presence vs. absence of c-command may play a role. In sum, the status of singular imposters anteceding first-person pronouns in English is not clear.

Thus, we investigated whether the presence of a preamble clause that mentions the AUTHOR by means of the first-person pronoun “I” in subject position makes first-person pronouns more acceptable in sentences like (15). If the choice of a first-person vs. third-person pronoun is modulated by the accessibility/prominence of the first-person AUTHOR—a prediction compatible with the notional view but one that does not follow from the syntactic view—we expect to effects of the presence/absence of the preamble clause.

- (15) a. **Mommy** has to finish {**my/her**} coffee.
 b. Before **I** take you to daycare, **Mommy** has to finish {**my/her**} coffee.

4. Experiment

We conducted an acceptability-rating experiment to investigate (i) whether the acceptability of first-person vs. third-person pronouns with third-person imposters is modulated by the prominence/salience of the AUTHOR antecedent and to (ii) test whether singular imposters can antecede both first- and third-person pronouns and (iii) whether this is influenced by the prominence of the AUTHOR antecedent. We tested the acceptability of first-person and third-person possessive pronouns with plural and singular imposter antecedents, with and without preamble clauses that mention the AUTHOR by means of an overt first-person pronoun.

We tested possessive pronouns rather than reflexive pronouns, because it was easier to generate a large number of target sentences with possessives without needing to use lower-frequency or more marked verbs which might inadvertently catch participants' attention or sound unusual for reasons orthogonal to imposters. In all of our critical sentences, the imposter NP c-commands the possessed noun, as shown in (13-14).⁶

4.1. Method

4.1.1. Participants

Forty adult native English speakers from the University of Southern California community participated.

4.1.2. Materials and design

We manipulated (i) number (singular and plural imposters and pronouns), (ii) person (first and third person pronouns) and (iii) context (presence/absence of preamble clause that mentions the speaker/AUTHOR). The subject of the sentence was either a singular third-person imposter (e.g. *Mommy, Grandpa*) or a coordinated DP yielding a plural (e.g. *Mommy and Daddy*). Thus, the plurals we tested were all coordinated structures. The possessive pronouns were correspondingly either singular or plural—and, crucially, either first-person (*my, our*) or third person (*her/his, their*). In addition to manipulating person and number, we also manipulated the context—specifically, whether or not the main clause was preceded by a temporal clause containing a first-person pronoun (*I, we*) that refers to the speaker (AUTHOR). This yields a 2x2x2 design (8 conditions, presented with a standard Latin-Square design). The experiment included 32 target items and 36 filler items. The imposters used in targets and fillers included terms referring to parents (*Mom, Dad, Mommy, Daddy*) and grandparents (*Grandma, Grandpa*).

⁶ As mentioned above, Baker (2008) suggests that configurations where the imposter does not c-command the pronoun may be more likely to allow first-person pronouns with third-person imposters. We did not investigate non-c-command configurations in our work, and leave this as a question for future research.

In this experiment, we used parent- and grandparent-referring imposters in child-directed speech. This is because pre-testing showed that college-aged U.S. English speakers (i.e., the group that our participants belong to) are familiar with this type of imposter use. In future work, we plan to explore imposters in more formal academic registers, such as “the present authors,” after ensuring that we can identify enough participants familiar with this usage.

All targets and fillers were preceded with information about who says the sentence to whom, as illustrated in (16). This is important as it ensures that the relevant nouns are interpreted as imposters, rather than ‘normal’ nouns referring to third-person, non-speaker referents. To encourage participants to attend to the clause indicating who says the sentence, they were asked open-ended recall questions during the experiment about who said the preceding sentence, and had to answer these questions without seeing the sentence again.

(16a) NoContext_SG_3

Father says to child:

Daddy has to finish **his** coffee.

NoContext_SG_1

Father says to child:

Daddy has to finish **my** coffee.

(16b) Context_SG_3

Father says to child:

Before **I** take you to daycare, **Daddy** has to finish **his** coffee.

NoContext_SG_1

Father says to child:

Before **I** take you to daycare, **Daddy** has to finish **my** coffee.

(16c) NoContext_PL_3

Father says to child:

Daddy and Mommy have to finish **their** coffees.

NoContext_PL_1

Father says to child:

Daddy and Mommy have to finish **our** coffees.

(16d) Context_PL_3

Father says to child:

Before **we** take you to daycare, **Daddy and Mommy** have to finish **their** coffees.

Context_PL_1

Father says to child:

Before **we** take you to daycare, **Daddy and Mommy** have to finish **our** coffees.

When designing the stimuli, we aimed to minimize the likelihood that a first-person plural possessive could be construed as referring to possession involving the addressee (child) in

addition to the parents/grandparents. This is important, because we want to probe whether first-person pronouns can be anteceded specifically by the imposter. Thus, we wanted to avoid situations where the addressee is also one of the possessors, as this could trigger use of first-person plural ‘our,’ as illustrated in (17).

(17) *Anne says to Beth:* Carla needs to pack our_{Anne’s + Beth’s} bags.

Thus, we used possessives such as ‘their/our coffees’ or ‘their/our work shirts’—i.e., things that are likely to be possessed only by the parents or grandparents—and tried to avoid joint family objects such as ‘our car’ or ‘our house’ whose ownership could also involve the child.

In addition to 32 targets, the study also included 36 filler items. The fillers were also presented as said by a parent or grandparent to a child, and some of them also contained imposters. However, unlike targets, the fillers did involve possessive constructions where the possessor refers to the imposter. The fillers were designed to elicit a range of acceptability judgments.

4.1.3. Procedure

Investigating coreference judgements by means of psycholinguistic experiments with naïve participants can be challenging. The term ‘coreference’ is not familiar to non-linguists, and introducing notation such as coindexing can be confusing. In our experiments, we build on the seminal paper of Gordon and Hendrick (1997). They report a series of six experiments on Binding Theory that investigate the coreference judgments of native English speakers who are “naïve to contemporary syntactic theory” (Gordon and Hendrick, 1997:325). Following Gordon and Hendrick, we presented our participants with sentences where certain words were bolded and underlined,⁷ and asked them to rate the acceptability of the sentence when those two words refer to the same person or thing. On target trials, the subject, the possessive pronoun and, if a preamble clause was present, the first-person pronoun in preamble, were bold and underlined. (See 14-16). All text was in black font.

Participants were instructed to rate how acceptable each sentence sounds if the bolded and underlined expressions refer to the same person or thing, using a five-point scale (1 = completely unacceptable, 5 = completely acceptable). Gordon and Hendrick (1997) successfully used this kind of method (both with binary yes/no responses and with a six-point scale) for probing acceptability of coreference when investigating people’s judgements of Binding Principles A and B. In subsequent work, Keller and Asudeh (2001) set out to replicate some of Gordon and Hendrick’s results using a similar method, except with the critical words presented in capitals rather than bold font, and using Magnitude Estimation rather than a binary yes/no acceptability response or a Likert-scale type response. They

⁷ Gordon and Hendrick (1997) used bold font without underlining. Keller and Asudeh (2001) showed that using words in ALL CAPITALS without bold font also works (see also Collins et al. 2009 on using + before and after words, e.g. +herself+). We used both bold font and underlining (but no capitals) because on some modern fonts, boldface by itself is not very distinctive. We wanted to ensure that there was no confusion about which words were bolded and underlined.

successfully replicated Gordon and Hendrick's results, further confirming that this kind of task can be successfully used to test coreference judgements in an experimental setting.

In our study, before the main experiment, the experimenter discussed a series of example items with the participant, to ensure that participants understand the task. Participants were also told that a colloquial tone/register should not be interpreted as unacceptable, because we did not want the informal tone of child-directed speech to be judged negatively. In addition, to ensure that the first-person "I" or "we" in the preambles is interpreted as intended, we also included example items which showed that in sentences with three bolded and underlined words, participants should consider all three and should only rate a sentence as acceptable if all three can refer to the same person or thing.

The filler items in the study were designed so that in some, the bolded and underlined words were coreferential (expected rating on the five-point scale is high); in others, the bolded and underlined words could not corefer (expected rating is low); and in some others, the bolded and underlined words could be construed as coreferential but did not need to be. This was done to prevent participants from developing a response strategy or a default bias for one kind of response.

4.2. Predictions

According to the *syntactic view*, both the local and the ultimate (AUTHOR) antecedent are syntactically equally available to antecede the possessive pronoun. Thus, the discourse salience/prominence of the speaker/ultimate antecedent is not expected to have any effect on pronominal agreement, and both third-person and first-person pronouns are predicted to be equally acceptable, at least with plural imposters. Thus, under this view, (i) the presence/absence of the preamble clause is not expected to influence acceptability judgements, and (ii) the pronoun manipulation (first vs. third person) is also not expected to influence acceptability of plural imposters. The situation is less clear for singular imposters: Collins and Postal (2012) judge singular imposters to be ungrammatical with first person pronouns, but others disagree. Thus, it is not clear whether we should expect an interaction between number and pronoun person.

According to the *notional view*, imposters are syntactically normal third-person DPs and their special referential behavior stem from their semantic or pragmatic properties. Under this approach, one might well find that in a context where the first-person AUTHOR (the speaker of the sentence) is very prominent, due to having been recently mentioned in subject position with a first-person pronoun, we may find that first-person pronouns are judged to be more acceptable than in a context where the AUTHOR is less prominent. In other words, we may find an interaction between presence/absence of preamble clause and whether the pronoun is first or third person: The third-person pronoun will (presumably) be acceptable in all contexts, as it matches the 'surface form' of the imposter, whereas the first-person pronoun may be more acceptable in the presence of the AUTHOR-boosting preamble clause. It is important to acknowledge that the notional view does not explicitly predict an effect of the presence/absence of the AUTHOR-mentioning preamble clause, but would be more compatible with such a finding than the syntactic view would. As regards potential

differences between plural vs. singular imposters, the notional view (at least a simple version thereof) does not straightforwardly lead us to expect any differences based on number.

5. Results and discussion

Figure 1 shows the average acceptability ratings for each of the eight conditions. The data were analyzed using mixed-effect regression models (lmer, R, R Core Team, <http://www.R-project.org/>). Following a widespread convention, effects are reported as significant when $|t| \geq 2$.

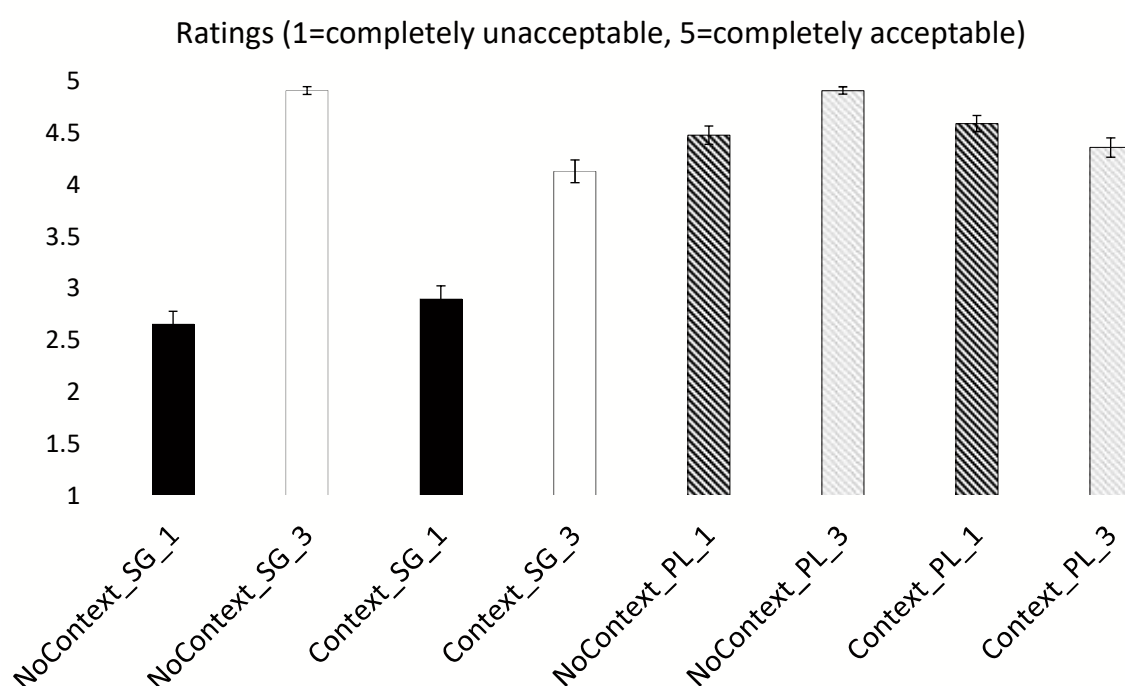


Figure 1. Mean acceptability ratings in each condition, based on a five-point scale (1=completely unacceptable, 5=completely acceptable. Error bars show +/- 1 SE.

5.1 Singular imposters: Comparing first- and third-person pronouns

Let us first consider the left half of the figure, which shows the conditions with singular imposters (with singular first- or third-person pronouns). Conditions with third-person pronouns are rated significantly more acceptable than conditions with first-person pronouns: More specifically, Context_SG_3 is rated significantly more acceptable than Context_SG_1, and NoContext_SG_3 is rated significantly more acceptable than NoContext_SG_1. This shows that, both with and without an AUTHOR-boosting preamble clause, people significantly prefer third-person pronouns with singular imposters over first-person pronouns.

One of the questions we posed at the start of the paper is whether first-person pronouns are acceptable with imposter antecedents or not. It is important to keep in mind that a five-point scale does not allow us to directly determine whether a certain sentence is grammatical or

ungrammatical. Although sentences with singular imposters that antecede first-person pronouns are judged *less* grammatical than the third-person variants, their average ratings are nevertheless between 2.5 and 3 on the five-point scale (as can be seen in the figure), and thus around the midpoint of the scale (3). A five-point scale does not allow us to identify specific cut-offs for grammatical vs. ungrammatical sentences, but the fact that our study yielded ratings near the mid-point of the scale—as opposed to ratings averaging around 1—suggests that first-person pronouns anteceded by imposters are not strikingly ungrammatical but are significantly less acceptable/less grammatical than third-person pronouns.

As a whole, these findings are in line with the intuitions, reported in prior work, that third-person pronouns are the default option for singular imposters in English, and that first-person pronouns are more marked.

5.2. Plural imposters: Comparing first- and third-person pronouns

Turning now to the right half of the figure, which shows the conditions with plural imposters, it is immediately clear that overall ratings are relatively high in all plural-pronoun conditions: All means are 4 or higher, on the five-point scale. Statistical analyses show that the Context_PL_3 and Context_PL_1 conditions do not differ significantly from each other: With an AUTHOR-boosting preamble clause that mentions ‘we’, sentences where an imposter antecedes ‘our’ are rated equally acceptable as sentences with ‘their’. Thus, the first vs. third person asymmetry observed with singular imposters is absent here.

In conditions with no preamble clause, we find that NoContext_PL_3 is rated as significantly more acceptable than NoContext_PL_1 ($|t| > 2.8$). We say more about this below. For now, suffice it to say that in the NoContext condition, sentences where the pronoun agrees with the local, linguistically overt antecedent (third person) are rated as significantly more acceptable than sentences where the pronoun agrees with the ultimate AUTHOR antecedent (first person).

5.3. Effects of the AUTHOR-boosting context manipulation?

What about effects of context? Here, our specific question concerns the conditions with first-person pronouns, because we want find out whether the presence of an AUTHOR-boosting preamble sentence improves the acceptability of first-person pronouns with imposters. Acceptability of third-person pronouns is not under debate (as prior work agrees that English imposters can antecede third-person pronouns). We also do not expect acceptability of third person pronouns to benefit from the presence of a first-person/AUTHOR-boosting context.

With singular imposters and first-person pronouns, we find no effects of the context manipulation: The presence of an AUTHOR-boosting preamble clause does not make sentences with first-person pronouns significantly more acceptable than their contextless counterparts (Context_SG_1 and NoContext_SG_1), though—intriguingly—the effect is numerically in the right direction. Context_SG_1 is rated numerically as more acceptable than NoContext_SG_1 ($t = 1.845$, where $|t| = 2$ is widely viewed as the minimum threshold for

significance). Despite these hints of a potential context boost, the conditions with first-person singular pronouns receive the lowest ratings out of all eight conditions.

With plural imposters and first-person plural pronouns (Context_PL_1 and NoContext_PL_1), statistical analyses show no effect of the context manipulation, which is expected based on the patterns in Figure 1: Both conditions receive ratings around 4.5, regardless of the presence or absence of the AUTHOR-boosting clause.

What about sentences with third-person pronouns? Recall that the third-person conditions are not crucial to our AUTHOR-boosting hypothesis, which focuses on the acceptability of first-person pronouns. Nevertheless, if we look at how the presence/absence of the preamble clause influences sentences with third-person pronouns, statistical analyses reveal that with both singular and plural imposters, we find that sentences with (singular or plural) third-person pronouns are rated higher in the NoContext than Context conditions ($|t|'s > 3$). This is presumably because the Context conditions with the AUTHOR-boosting preamble clause with the first person pronoun “we” involve a clash between the first-person pronoun in the preamble clause and the third-person pronoun in the second clause, which decreases acceptability.

Overall, the presence of an AUTHOR-mentioning preamble clause does not increase acceptability in any condition: Either we find no significant effects (with singular imposters) or we find effects in the opposite direction (with plural imposters).

5.4 Implications for theoretical accounts of imposters

The finding that explicit mention of the AUTHOR by means of a subject-position first-person singular or plural pronoun does not boost the acceptability of first-person pronouns with imposter antecedents goes against the hypothesis we formulated on the basis of the notional view and existing work on reference resolution.

However, other aspects of our results pose challenges for the syntactic view. One challenge comes from the finding that in plural pronoun conditions without a context clause, the linguistically overt third-person antecedent is the preferred target for agreement—i.e., sentences with third person possessive pronouns are rated as more acceptable than sentences with first person possessive pronouns. This is unexpected under the syntactic view, which posits that both the first person AUTHOR (ultimate antecedent) and the third person immediate antecedent are available. Indeed, the finding that the *linguistically local, overt antecedent* is preferred over the covert, notional antecedent—which, according to Collins and Postal (2012), is represented by a null DP in the left periphery—suggests that processing factors related to locality (the ultimate AUTHOR antecedent is less local) as well as overtness (the AUTHOR DP is not linguistically overt) may be at play. This suggests that a purely syntactic approach by itself is likely to be insufficient. Broadly speaking, locality-based effects are widely observed in different domains of language processing, and prior work has also found that different referring forms have consequences for the subsequent prominence of their referents, so it would not be surprising to find similar effects here.

Furthermore, another potential challenge for a purely syntactic approach to imposter agreement comes from the finding that in conditions with a preamble mentioning the first-person AUTHOR by means of “we”, use of the third-person pronoun “their” elicits lower acceptability ratings than use of first-person “our”. We suggest that this may be due to the person mismatch between “we” and “their”: In a context where a first-person pronoun has been established (by the preamble) as the discursively-preferred means of referring to the imposter, switching to a third-person pronoun is dispreferred—even though the third-person pronoun matches the ‘surface form’ of the imposter. Under a purely syntactic account, something more would need to be said in order to explain how such a person clash would impact acceptability, given that both first- and third-person antecedents are available for the possessive pronoun to agree with.

6. Conclusions

In this paper, we investigated the agreement properties of imposters—expressions that are grammatically third-person but are used to refer to the first-person speaker or the second-person addressee (e.g. Mommy’ or ‘Daddy’ when used by parents for first-person self-reference in child-directed speech). Current analyses of imposters differ in whether they derive the referential properties of imposters using syntactic means (the syntactic view) or attribute them to semantic and pragmatics (the notional view).

In this paper, we took some initial steps to shed light on these competing approaches by means of a psycholinguistic experiment, focusing on first-person imposters. We tested the acceptability of first-person vs. third-person pronouns used to refer to singular and plural imposter antecedents, and also manipulated the discourse accessibility of the first-person speaker by means of a preamble clause.

We tested whether boosting the prominence of the first-person AUTHOR (speaker of the sentence) by explicit mention by means of “I” or “we” makes subsequent first-person pronouns more acceptable with imposter antecedents. A purely syntactic view of imposters does not directly lead us to expect any effects of this prominence-boosting approach. In contrast, although prominence/accessibility is not explicitly discussed by prior proponents of the notional view, potential, prominence-boosting effects would be compatible with that approach.

Our results suggest that manipulating the prominence of the first-person speaker does not significantly boost the acceptability of first-person pronouns in imposter-referring contexts, although we observe hints of numerical effects in the predicted direction with singular imposters. Furthermore, our results suggest that a purely syntactic approach may not be sufficient either, as psycholinguistic processing factors related to locality and the null/overt distinction also appear to be relevant. However, further work is necessary to better understand the effects, and this is an important direction for future work. In light of prior psycholinguistic work on locality effects and consequences of referential form for referent prominence, our findings point to a close interplay between processing factors and syntactic representations.

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