

Modification and Underspecification: A Free Variable Account of Locative Modifiers*

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Abstract

The present paper offers evidence that there are two variants of adverbial modification that differ with respect to the way in which a modifier is linked to the verb's eventuality argument. So-called *external modifiers* relate to the full eventuality, whereas *internal modifiers* relate to some integral part of it. The choice between external and internal modification is shown to be dependent on the modifier's syntactic base position. External modifiers are base-generated at the VP periphery, whereas internal modifiers are base generated at the V periphery. These observations are accounted for by a refined version of the standard Davidsonian approach to adverbial modification according to which modification is mediated by a free variable. In the case of external modification, the grammar takes responsibility for identifying the free variable with the verb's eventuality argument, whereas in the case of internal modification, a value for the free variable is determined by the conceptual system on the basis of contextually salient world knowledge.

1. The Davidsonian Approach to Adverbial Modification

One of the merits of what has become known as the *Davidsonian paradigm* is that it provides a straightforward account of adverbial modification. If verbs introduce an eventuality argument, as was suggested by Davidson (1967), then adverbial modifiers can be analyzed as simple first order predicates that add information about the verb's eventuality argument.¹ Locative modifiers are generally considered to be a typical case in point. They specify the location of the referent they modify. In the case of adverbial modification this then is the set of eventualities referred to by the VP. According to this view, sentence (1) has a Semantic Form (SF)² as in (2), where *e* is a variable that ranges over eventualities, *LOC* is a relation between individuals (objects or eventualities) and spatial regions and the spatial function *IN* maps objects onto their inner region. According to (2) the signing of the contract by Eva is located in the inner region of the office. (Definites are abbreviated by an individual constant set in bold.)

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¹ The term "eventuality" was coined by Bach (1986) as a cover term for events, processes and states. Davidson (1967) himself uses the term "event" but cf. Kim (1969: 204): »When we talk about explaining an event, we are not excluding what, in a narrower sense of the term, is not an event but rather a state or a process«.

² Following Bierwisch (1982, 1996, 1997), Bierwisch & Lang (1989), Lang (1994), Dölling (1997, 2000) and related work, I assume that the difference between linguistic knowledge and world knowledge may best be accounted for by an analytic distinction at the level of meaning representation: the Semantic Form SF captures the strictly grammatically determined, context-invariant meaning of a linguistic expression. The conceptual structure CS elaborates SF in terms of context and world knowledge yielding a particular utterance meaning of the respective expression.

- (1) Eva signed the contract in the office.
- (2) $\exists e$ [SIGN(e) & AGENT (e, eva) & THEME (e, c) & CONTRACT(c) & LOC (e, IN (o)) & OFFICE (o)]

The advantages of this approach are, first, that it allows us to draw the inferences that relate to adverbial modifiers directly on the basis of the Semantic Form. That is, (3) follows from (2) simply by virtue of the logical rule of simplification.

- (3) Eva signed the contract.

And, second, it does not depend on special lexical entries designed especially for the needs of modification but conforms to independently established insights of lexical semantics according to which locatives, e.g., denote the property of being located in a certain spatial region irrespective of whether they happen to be used as arguments of locative verbs, as predicatives in copular sentences or as adnominal or adverbial modifiers; cf. e.g. Bierwisch (1988), Wunderlich (1991), Maienborn (1996, 1998). That is, the Davidsonian approach to adverbial modification meets the demands of compositional semantics.

The basic ingredients of the compositional machinery that are responsible for the derivation of the SF in (2) are laid out in (4) – (6). The semantic contributions of the locative and the VP are given in (4) and (5), respectively.³ The semantic operation that corresponds to modification can be isolated by a template MOD as in (6). MOD takes a modifier and an expression to be modified and yields a conjunction of predicates. This reflects the common understanding of intersective modification as it can be found (more or less explicitly) in Higginbotham (1985), Parsons (1990), Wunderlich (1997), Heim & Kratzer (1998) among many others; cf. also the contributions to this volume.

- (4) [PP in the office]: λx [LOC (x, IN (o)) & OFFICE (o)]
- (5) [VP Eva signed the contract]:
 λe [SIGN (e) & AGENT (e, eva) & THEME (e, c) & CONTRACT (c)]
- (6) MOD: $\lambda Q \lambda P \lambda x$ [P(x) & Q(x)]

The result of applying MOD to (4) and (5) is given in (7). Finally, existential quantification of the eventuality variable will lead to the SF in (2).

- (7) [VP [VP Eva signed the contract] [PP in the office]]:
 λe [SIGN (e) & AGENT (e, eva) & THEME (e, c) & CONTRACT(c) & LOC (e, IN (o)) & OFFICE (o)]

While I believe the general approach to adverbial modification outlined above to be basically correct I will argue that it is too coarse-grained in two respects: (a) It fails to cover the whole range of intersective modification. Besides supplying an eventuality predicate, adverbial modifiers may also relate more indirectly to the verb's eventuality argument. This calls for a revision or augmentation of the template MOD. And (b), it misses the influence

³ For the present purposes I will assume a VP-internal subject position but nothing hinges on this assumption.

that the syntactic position of a modifier bears on its interpretation. This calls for a compositional semantics that is more properly tuned to the syntax.

Sentence (8) may serve as a first illustration.

(8) Eva signed the contract on a separate sheet of paper.

The sentence in (8) displays a locative modifier which, unlike the locative in (1), does not express a location for the whole eventuality but supplies further details about the signing. According to sentence (8), not the whole event of signing the contract by Eva is located on a sheet of paper but only Eva's signature.

More generally speaking, I will argue that locative modifiers of the type exemplified in (8) express a spatial relationship that holds *within* the eventuality designated by the verb. For the sake of simplicity, I will dub these modifiers "internal modifiers" as opposed to "external modifiers", which apply to the eventuality argument as a whole; cf. (1). The actual target of an internal modifier will be shown to be semantically underspecified and may vary considerably. Its determination depends to a large extent on world knowledge. This raises the following questions:

1. What are the characteristics of semantically underspecified, internal modification?
2. What triggers underspecification and how is it resolved?
3. How do grammar and pragmatics conspire to produce the relevant interpretations?

The present paper gives an outline of an analysis of internal modifiers which tries to give (partial) answers to these questions. It is aimed at modifying the Davidsonian approach to adverbial modification such that besides external modifiers it can also account for internal modifiers while preserving the advantages of Davidson's original proposal (*viz.* inferences and lexical semantic parsimony).

The rest of this paper is organized as follows: In section 2, I will lay out the basic pattern of internal locative modifiers. The data that will be discussed are taken from German. Section 3 addresses the syntax and semantics of these modifiers. I will present a compositional account that is sensitive to the modifier's structural position. Section 4 addresses the pragmatics of internal modifiers. Using the formal framework of abduction, I will show how world knowledge affects the utterance meaning of internal modifiers. Finally, in section 5, I will offer some concluding remarks on the relation between modification and underspecification.

2. Some Observations about Internal Modifiers

Let us begin by looking at the characteristic properties of internal modifiers which set them apart from external modifiers exemplified in (1). Some German data are given in (9).⁴

- (9) a. Der Koch hat das Hähnchen in einer Marihuana-Tunke zubereitet.
The cook has the chicken in a Marihuana sauce prepared.
- b. Die Bankräuber sind auf Fahrrädern geflüchtet.
The bank robbers have on bicycles fled.

⁴ German example sentences are translated by word-for-word glosses. Idiomatic translations are only added if there is a major discrepancy between German and English.

- c. Paul steht auf dem Kopf.
 Paul stands on the head.
 'Paul is standing on his head.'⁵
- d. Maria zog Paul an den Haaren aus dem Zimmer.
 Maria pulled Paul at the hair out of the room.

First of all, all locative modifiers in (9) are ambiguous between an internal and an external reading but according to our world knowledge most of the external readings are rather bizarre. In (9a), e.g., we would have to assume that a cook is wading through floods of Marihuana sauce while preparing a chicken. For (9b) we would be forced to construct a fantasy scenario populated, e.g., by dwarfs crawling around on giant bicycles, and so on. So, unless there is explicit evidence, world knowledge discards the external reading of the locative modifiers in (9) in favor of the internal one. Yet, in some cases our world knowledge does not establish any preferences at all. For sentence (10), e.g., both readings of the locative modifier are available. According to the external reading, the event of making an appointment takes place in the museum. (It might be an appointment for going to the movies.) According to the internal reading, the modifier specifies the location of the appointed event.

- (10) Angela hat sich mit Bardo im Museum verabredet.
 Angela has REFL with Bardo in.the museum arranged-to-meet.

Interestingly, the distinct readings of (10) come with different accent patterns under neutral stress conditions.⁶ The external reading of the locative modifier is associated with primary sentence accent on the verb; cf. (10a). The internal reading requires primary sentence accent on the modifier; cf. (10b). (The constituent carrying primary sentence accent is marked by capital letters; secondary accent is indicated by stress on the accent bearing syllable.)

- (10) a. Angela hat sich mit Bardo im Muséum VERABREDET. *external reading*
 b. Angela hat sich mit Bardo im MUSEUM verabredet. *internal reading*

Thus, prosodic information gives us an important clue to the resolution of this kind of ambiguity. This suggests that the distinction between external and internal modifiers is rooted in the linguistic system. Hence, we can discard one possible reaction to the meaning differences between internal and external modifiers which might have come into mind, namely to propose a unified and therefore maximally underspecified semantic analysis that covers both cases. If we followed this line of argumentation, the only thing we could say about the semantics of locative modifiers would be that they were somehow related to the verb's eventuality argument. In this view, the distinction between internal vs. external modifiers would have no implications for the grammar but would be purely a matter of pragmatics. The prosodic data in (10) provide a first piece of evidence that the distinction between internal and external modifiers is indeed grammatically reflected and should therefore be accounted for in terms of compositional semantics.

⁵ Note that in German, unlike English, definites are a regular means for expressing pertinence. The internal reading of the locatives in (9c/d) is based on a pertinence interpretation of the DP.

⁶ For a discussion of the conditions on neutral stress in German cf., e.g., von Stechow & Uhmann (1986), Jacobs (1991, 1993), Féry (1993). Maienborn (1996) discusses the conditions for accent placement on (locative) modifiers.

One of the most striking features of internal modifiers is that their meaning contribution is interlinked with the eventuality referent of the verb in an intricate way and depends to a large extent on context and world knowledge. For instance, an appropriate interpretation of sentence (11a) and its variants in (11b) activates a large amount of background knowledge about roasting events. We need to know what the integral components of this cooking method are (heat source, container, medium, etc.) and how they are functionally arranged in order to decide whether an internal modifier makes sense or not.

- (11) a. Paul hat die Forelle an einem langen Spieß gebraten.
Paul has the trout on a long spit roasted.
b. in viel Öl / in einer großen Pfanne / auf einem Campingkocher / über dem Lagerfeuer
in much oil / in a large pan / on a camping stove / above the campfire

While (11a/b) are fine, our conceptual knowledge does not support an internal reading of the variants in (11c/d). They are ruled out because they cannot be coherently integrated into the conceptual structure of the corresponding event. While (11c) fails to provide suitable roasting utensils, the (11d) variants refer to the right utensils but place them in spatial configurations that prevent them from serving their intended purposes. Thus, the (11c/d) variants are conceptually ill-formed on the internal reading of the locative modifier leaving us with the external reading. ("§" marks conceptual ill-formedness.)

- (11) c. §in einer Marihuana-Tunke / §in Wasserdampf / §im Kühlschrank
in a Marihuana sauce / in steam / in.the fridge
d. §bei einem langen Spieß / §auf viel Öl / §neben dem Campingkocher
near a long spit / on much oil / besides the camping stove

The kind of knowledge that decides whether and how the meaning contribution of an internal modifier is successfully interlinked with the eventuality referred to by the verb is clearly extra-linguistic in nature. The linguistic system remains silent about these issues. That is, the Semantic Form of internal modifiers is underspecified in this respect. It does not decide what particular aspect of the corresponding eventuality is further elaborated on and, consequently, it does not determine which entity is ultimately located in the given spatial region.

The claim that internal modifiers are crucially underspecified at the level of SF is further substantiated by the observation that sentences like (9d), repeated here as (12), can be contextually specified in more than one way.

- (12) Maria zog Paul an den Haaren aus dem Zimmer.
Maria pulled Paul at the hair out of the room.

The case of (12) illustrates that the actual target of the locative cannot be determined at the level of SF but only with respect to context and world knowledge. The only suitable SF-referents in (12) (besides the verb's eventuality argument) are Maria and Paul, but none of them is a possible candidate for being the entity that is located at Paul's hair. Maria's hand would qualify as such according to our world knowledge, but the actual context might also provide evidence that Maria used her teeth, a pair of pinchers or something similar. Thus, the utterance meaning of an internal modifier depends crucially on the contextually relevant background knowledge. An adequate analysis should be able to account for this kind of semantic indeterminacy and its contextual resolution.

A particular puzzle concerning internal locative modifiers is raised by the observation that they tend to have an *instrumental* or *manner reading*. Consider, e.g., sentences (9a – c), repeated here as (13a – c).

- (13) a. Der Koch hat das Hähnchen in einer Marihuana-Tunke zubereitet.
The cook has the chicken in a Marihuana sauce prepared.
- b. Die Bankräuber sind auf Fahrrädern geflüchtet.
The bank robbers have on bicycles fled.
- c. Paul steht auf dem Kopf.
Paul stands on the head.
'Paul is standing on his head.'

The modifier in (13a) specifies a particular mode of preparing the food. Thus, it makes some sort of manner contribution. The modifier in (13b) supplies information about the means of transport that was used by the bank robbers. It could be replaced by a genuine instrumental phrase like *mit dem Taxi* ('with the cab'). In the case of (13c), you might even doubt whether the original locative meaning of the preposition is still present at all. In this case, there should be an entity that is located on Paul's head. What could that sensibly be? On the other hand, if the modifiers in (13) are genuine locatives, then where does this "instrumental/manner flavor" come from? These cases turn out to be a real challenge for an approach that relies on independently motivated and as far as possible unambiguous lexical entries.

The claim that internal locative modifiers may have instrumental or manner readings is substantiated by the observation that suitable questions asking about these modifiers are based on manner and instrumental interrogatives rather than locative ones. The questions in (14/15a) support an internal reading of the corresponding locative modifier whereas the b-versions enforce an external reading, whatever our world knowledge might say.

- (14) a. Wie/*Wo hat der Koch das Hähnchen zubereitet? *internal reading of (13a)*
How/Where has the cook the chicken prepared?
- b. *Wie/Wo hat der Koch das Hähnchen zubereitet? *external reading of (13a)*
How/Where has the cook the chicken prepared?
- (15) a. Wie/Womit/*Wo sind die Bankräuber geflüchtet? *internal reading of (13b)*
How/With what/Where did the bank robbers flee?
- b. *Wie/*Womit/Wo sind die Bankräuber geflüchtet? *external reading of (13b)*
How/With what/Where did the bank robbers flee?

The questions (16/17a) are ambiguous between an external and an internal reading. The answer in (16b) supports both readings whereas (17) facilitates disambiguation: our world knowledge strongly favors an internal reading for (17b) and it supports only an external reading of (17c).

- (16) a. Wo hat Angela sich mit Bardo verabredet?
Where did Angela REFL with Bardo arranged-to-meet?
- b. Im Museum.
In.the Museum.

- (17) a. Wo hat Angela Bardo gekitzelt?
Where did Angela Bardo tickle?
b. Unter den Füßen.
Under the feet.
c. Unter dem Apfelbaum.
Under the apple tree.

Note furthermore that besides *wo* ('where'), German allows for locative interrogatives that encode a particular spatial relation like *worin* ('in what', literally: 'where-in'), *worauf* ('on what', literally: 'where-on') etc. These interrogatives are subject to further semantic constraints. Most importantly for our concern, their external argument is sortally restricted to objects. Therefore, they cannot be used for asking about the location of an eventuality. That is, these interrogatives are only compatible with the internal reading of a locative modifier and rule out the external reading; cf. (18) and (19).

- (18) a. Worin hat der Koch das Hähnchen zubereitet?
Where-in has the cook the chicken prepared?
'What has the cook the chicken prepared in?'
b. In einer Marihuana-Tunke.
In a Marihuana sauce.
c. *In der Küche.
In the kitchen.
- (19) a. Worauf sind die Bankräuber geflohen?
Where-on did the bank robbers flee?
'What did the bank robbers flee on?'
b. Auf Fahrrädern.
On bicycles.
c. *Auf einer Insel.
On an island.

The data concerning interrogatives confirm that the distinction between internal and external modifiers is reflected by the linguistic system. The data (20) – (22) supply a further piece of evidence that internal modifiers are to be distinguished from external modifiers as well as from locative arguments.⁷

- (20) a. Paul flehte auf Knien um Gnade.
Paul craved on knees for mercy.
b. Paul flehte kniend um Gnade.
Paul craved kneeling for mercy.
- (21) a. Paul hat auf dem Tisch auf dem Kopf gestanden.
Paul has on the table on the head stood.
b. Paul hat auf dem Tisch kopfgestanden.
Paul has on the table headstood.
c. Paul hat auf dem Kopf *tischgestanden.
Paul has on the head tablestood.

⁷ I owe the data in (20) – (22) to Ewald Lang.

- (22) a. Paul lag auf dem Bauch im Dreck.
 Paul laid on the belly in.the dirt.
 b. Paul lag bäuchlings im Dreck.
 Paul laid "bellywise" in.the dirt.
 'Paul laid on his belly in the dirt.'
 c. Paul lag auf dem Bauch *drecklings.
 Paul laid on the belly "dirtwise".

(20) gives an example of a manner-like locative that has a synonymous adverbially used present participle. External modifiers never are subject to such a synonymy. The sentences in (21) and (22) illustrate some differences between internal modifiers and locative arguments of positional verbs. The German verb *kopfstehe*n (literally: 'to headstand') in (21b) can be analyzed as incorporation of the respective internal modifier in (21a). This option is not available for locative arguments; cf. (21c). And the adverbial *bäuchlings* in (22b) is derived from the internal modifier 'on one's belly'; cf. (22a). No such derivational process can take place in the case of locative arguments; cf. (22c). These data emphasize that there is a very intimate semantic/conceptual relationship between an internal modifier and the verb. Nevertheless, these locatives are definitely *modifiers*, i.e., they only enter a "loose" grammatical relationship with the verb. Unlike arguments, internal modifiers can be omitted without any harm and their admissibility cannot be predicted from grammatical properties of the verb; cf. Maienborn (1991) for a discussion of the conditions that govern the optionality of locative arguments.

In sum, there is ample evidence that internal modifiers are a class of their own. They do not locate the verb's eventuality referent but an entity that serves some function within this eventuality. A semantic analysis should account for the following observations:

1. Locative modifiers are potentially ambiguous, i.e. they have an internal as well as an external reading. Disambiguation is based on linguistic (cf. the prosodic data in (10)) and extralinguistic (world knowledge) constraints.
2. Internal modifiers are subject to semantic underspecification. The actual target of an internal modifier is not grammatically determined but depends on contextually salient world knowledge.
3. Internal modifiers may convey instrumental or manner information.

In the following, I shall outline an analysis of internal modifiers that does justice to their peculiar behavior but conforms to our tenets (a) that locatives invariably express a spatial relationship and (b) that modification is based on the conjunction of predicates.

3. A Compositional Semantics for Internal Modifiers

3.1. On the Syntax of Internal Modifiers

As a prerequisite for a compositional account of internal modifiers that distinguishes them from external modifiers we need to show that the semantic differences are paralleled by a syntactic distinction. If we can find a parallel syntactic difference, this might be exploited for the purposes of compositionality. I have shown in Maienborn (1996, 1998) that there is such a difference. The main findings concerning the syntax of internal modifiers as opposed to external modifiers are the following:

First, there is evidence that not only arguments but also modifiers have well-defined syntactic base positions. In the case of German, this is indicated by a series of base order tests based, e.g., on focus projection, quantifier scope, Principle C effects and remnant topicalization; cf. also Frey & Pittner (1998), Frey (2000), Pittner (2000).

Secondly, modifiers of a certain lexical type can exploit more than one base position. More specifically, locative modifiers encounter two potential base positions within VP.⁸ They may be base-generated either between the subject and the remaining arguments of the verb or below the verb's arguments in close proximity to the verb. (In the latter case, only predicatives and directional PPs may intervene between the locative and the verb.)

Thirdly, there is a strict correlation between the syntactic base position of a modifier and its semantic contribution. In the case of locatives, the higher base position is occupied by external modifiers while the lower base position is reserved for internal modifiers. Let us assume for convenience that external modifiers are analyzed syntactically as VP-adjuncts and internal modifiers as V-adjuncts; cf. Maienborn (1996: ch. 3) for a more detailed examination of the exact position of internal modifiers within the verbal complex. The relevant base order restrictions for German are given in (23). (">" stands for 'is placed higher in the hierarchical structure'.)

- (23) subject > external locative modifier > ... > direct object > internal locative modifier > V

The existence of different syntactic base positions provides a structural explanation for the potential ambiguity of a locative modifier. A sentence with an external modifier like (24a) has the underlying syntactic structure (24a'). The variant (24b), which has an internal modifier, is based on the syntactic structure (24b').

- (24) a. Luise hat auf der Treppe gepfiffen.
 Luise has on the stairs whistled.
 b. Luise hat auf den Fingern gepfiffen.
 Luise has on the fingers whistled.

- (24') a. Luise hat [_{VP} [_{PP} auf der Treppe] [_{VP} [_V gepfiffen]]]
 b. Luise hat [_{VP} [_V [_{PP} auf den Fingern] [_V gepfiffen]]]

We are now in the position to explain the prosodic differences observed in section 2; cf. (10). Under neutral stress conditions, a verb-adjacent modifier may only bear the primary sentence accent if it belongs to the verbal complex. Otherwise, primary accent falls onto the verb; cf. Maienborn (1996: 123ff). That is, a verb-adjacent internal modifier but not a verb-

⁸ Besides two potential base positions inside VP, there is a third integration site for locative modifiers outside VP at the CP periphery. Locative modifiers that take this third option belong to the class of so-called frame-setting modifiers. They do not relate to the verb's eventuality argument but restrict the overall proposition; cf. Maienborn (1996, 1998). Illustrations are given in (i) and (ii).

- (i) In Europa ist Fußball eine sehr beliebte Sportart.
 In Europe is soccer a very popular sport.
 (ii) In Chile genießt Pinochet diplomatische Immunität.
 In Chile enjoys Pinochet diplomatic immunity.

Frame-setting modifiers will not be discussed here, since they do not relate to the Davidsonian eventuality argument.

adjacent external modifier may receive primary sentence accent; cf. the accent distribution in (24").

- (24") a. Luise hat auf der Tréppe GEPFIFFEN.
 b. Luise hat auf den FINGERN gepfiffen.

These findings about the syntactic distribution of locative modifiers prove that the distinction between external and internal modifiers is firmly established in the linguistic system and may hence be accounted for in terms of compositional semantics.

3.2. A Free Variable Account of Internal Modifiers

Given the syntactic differences worked out above, we are now in the position to develop a structural explanation for the semantic differences between external and internal modifiers. The strategy will be to show that the semantic differences can be traced back to the different structural environments of the modifiers. As we have seen in section 1, the template MOD in (6) accounts properly for the semantic integration of external modifiers. MOD is repeated in (25) and its contribution to the compositional process is illustrated in (26).

(25) MOD: $\lambda Q \lambda P \lambda x [P(x) \& Q(x)]$

(26) Der Bankräuber ist auf der Insel geflohen.

The bank robber has on the island fled.

a. [_{PP} auf der Insel]: $\lambda x [\text{LOC}(x, \text{ON}(\mathbf{i})) \& \text{ISLAND}(\mathbf{i})]$

b. [_{VP} [_V geflohen]]: $\lambda x \lambda e [\text{FLEE}(e) \& \text{THEME}(e, x)]$

c. [_{VP} [_{PP} auf der Insel] [_{VP} geflohen]]:

$\lambda x \lambda e [\text{FLEE}(e) \& \text{THEME}(e, x) \& \text{LOC}(e, \text{ON}(\mathbf{i})) \& \text{ISLAND}(\mathbf{i})]$

The question is now: what kind of operation is responsible for the semantic integration of internal modifiers? According to our observations in section 2, internal modifiers are underspecified with respect to their actual target at the level of SF, i.e. at the level of the grammatically determined, context-invariant meaning constitution. I propose to account for this semantic indeterminacy by an *SF-parameter* for the located entity. Such a parameter is introduced as a free variable at the level of SF and must be instantiated in the course of determining the utterance meaning at the level of CS; cf. section 4. To begin with, let us assume a second template MOD' that accounts for the semantic integration of internal modifiers as in (27) with *v* as free variable.

(27) MOD': $\lambda Q \lambda P \lambda x [P(x) \& \text{PART-OF}(x, v) \& Q(v)]$

The relation PART-OF pairs entities with their integral constituents. In the case of eventualities, among these are, e.g., their participants. PART-OF will be spelled out at the level of CS; cf. section 4. The result of integrating an internal modifier via MOD' is illustrated in (28).

(28) Der Bankräuber ist auf dem Fahrrad geflohen.

The bank robber has on the bicycle fled.

a. [_{PP} auf dem Fahrrad]: $\lambda x [\text{LOC}(x, \text{ON}(\mathbf{b})) \& \text{BIKE}(\mathbf{b})]$

b. [_V geflohen]: $\lambda x \lambda e [\text{FLEE}(e) \& \text{THEME}(e, x)]$

c. [_V [_{PP} auf dem Fahrrad] [_V geflohen]]:

$\lambda x \lambda e [\text{FLEE}(e) \& \text{THEME}(e, x) \& \text{PART-OF}(e, v) \& \text{LOC}(v, \text{ON}(\mathbf{b})) \& \text{BIKE}(\mathbf{b})]$

According to the SF in (28c), an entity *v* which is involved in the fleeing event is located on the bicycle. This is all that can be said context-independently about the meaning contribution of the internal modifier. The identification of *v* and its exact role in *e* is an issue of the conceptual system.

Notice that modification mediated by a free variable is not a peculiarity of locatives but seems to be a more general option. Several proposals have been made recently that can be described as free-variable-accounts to certain kinds of modification. Among them are the analysis of German *mit*-PPs ('with'-PPs) in Strigin (1995) and Dölling's (1998, 2000) analysis of temporal modifiers that specify the resultant state of an event, such as *for 10 minutes* or the restitutive reading of German *wieder* ('again'); cf. also Jäger & Blutner's (2000) free-variable-account of the repetitive/restitutive ambiguity of *wieder*. In fact, these expressions can be shown to be internal modifiers from a syntactic point of view. That is, they have a syntactic base position in close proximity to the verb; cf. Frey & Pittner (1998), Frey (2000), Pittner (2000). Therefore, we expect them to behave compositionally like locative internal modifiers. While Strigin, Dölling and Jäger & Blutner widely neglect the syntactic properties of these modifiers, the present account predicts that adverbial modification mediated by a free variable is only licensed if the modifier is base generated within the verbal complex.⁹

As it stands now, our theory assumes that there are two separate templates, MOD and MOD', that govern the compositional semantic integration of modifiers. Yet, it is evident that these templates are closely related. A comparison shows, first, that both templates are based on conjunction. Hence, they both support the inferences that relate to adverbial modification. That is, MOD as well as MOD' warrants that (29) will follow from the respective SFs for the sentences (26) and (28).

(29) The bank robber fled.

Secondly, both templates relate the semantic contribution of the modifier to the referential argument of the modified expression. In the case of adverbial modification, this is the verb's eventuality argument. That is, external as well as internal modifiers, both provide an additional semantic constraint on the verbal referent. They differ with respect to the issue of whether this constraint applies directly to the verbal referent or indirectly, i.e., mediated by a free variable. Whereas MOD establishes a direct link, leaving no space for contextual variation, MOD' constrains the verbal referent indirectly via an SF-parameter that is subject to conceptual specification.

The close affinity of MOD and MOD' can be made explicit by a more restrictive formulation of the theory according to which modification is accounted for by a single, more abstract template that accounts for the commonalities of internal and external modifiers and a condition that rules its specification depending on the modifier's syntactic environment. That is, MOD and MOD' can be replaced by the template MOD* as given in (30).¹⁰

⁹ An issue that needs further clarification is the question whether modification mediated by a free variable as opposed to direct modification is also available in the realm of nouns and, if so, whether it is paralleled by an analogous syntactic difference. The proposal of Partee & Borschev (2000) for adnominal genitives points towards this direction.

¹⁰ The formulation in (30) is similar in spirit to the proposal in Dölling (2000). Yet, there are two major differences. First, following Dölling, an underspecified relation is inserted into the compositional process whenever a first-order predicate is integrated. According to the present proposal, this kind of underspecification is only licensed in the structural configuration of modification. Secondly, Dölling assumes that the resolution of underspecification is exclusively a matter of the conceptual system, i.e. in Dölling's framework the compositional semantics is not restricted by a constraint like (30b). The present proposal claims instead that the condition in (30b) is a genuinely linguistic constraint which applies to the compositional process, thus leading to a more restrictive semantics. See also Dölling (2000) for a comparison of the two approaches.

(30) a. MOD*: $\lambda Q \lambda P \lambda x [P(x) \ \& \ R(x, v) \ \& \ Q(v)]$

b. Condition on the Application of MOD*:

If MOD* is applied in a structural environment of categorial type X, then R = PART-OF, otherwise (i.e. in an XP-environment) R is the identity function.

MOD* introduces a free variable v and a relational variable R . If applied to an X-category, R is instantiated as PART-OF. This is the case of internal modifiers. If MOD* is applied in an XP-environment, R is instantiated as identity, i.e. v is identified with the referential argument of the modified expression. This is the case of external modifiers.

(30) provides the essentials of the proposed compositional semantics for modification, which was designed to overcome the deficiencies of the standard Davidsonian approach sketched in section 1: (a) besides external modifiers it also covers internal modifiers and (b) it is sensitive to a modifier's structural environment.

What remains to be clarified is whether the condition in (30b) must be stipulated or whether it can be derived from some more fundamental principles of natural language semantics. We might speculate, e.g., that internal modification, which relates to the internal structure of the referential argument, is only possible at the stage of word formation, whereas external modification, which applies holistically to the referential argument, requires the word formation process to be completed. This would explain why internal modifiers are only licensed in an X-environment while external modifiers are bound to an XP-environment. That is, ideally, we would not need to postulate a condition like (30b) in association with particular base adjunction sites for modifiers (cf. Wyner (1998) for a criticism of such a strategy in the realm of manner adverbs and the reply in Shaer (2000)) but the distribution of modifiers and their particular interpretations would follow from independent principles. In this sense, the formulation in (30) is still preliminary. What has been achieved with (30) is an isolation of the genuinely linguistic constraints on the interpretation of adverbial modifiers. In the case of internal modifiers, these linguistic constraints produce an SF that is subject to underspecification.

4. A Pragmatic Account of Underspecification

Let us turn now to the pragmatic resolution of the semantic indeterminacy that is built into the compositional semantics of internal modifiers. In order to determine the utterance meaning of an internal modifier, its SF-parameter for the located entity must be instantiated taking into account the contextually salient world knowledge. In short, I will argue that internal modifiers supply further information about a spatial configuration that is independently established within the conceptual structure (CS) of the eventuality referent to which they attach. More specifically, the SF-parameter is instantiated as a result of merging the spatial relation expressed by the locative with a spatial configuration that holds within the eventuality. Why should the internal structure of eventualities relate to spatial notions? The reason is the following: conceptual knowledge about eventuality types includes knowledge about functional relations holding among their participants. These functional relations are often based on spatial configurations. That is, participants must meet certain spatial conditions in order to perform their designated function. Here is where internal modifiers come in: they elaborate on implicit spatial conditions that are part of the verb's CS. Let us have a look at the conceptual machinery in some more detail.

4.1. Parameter Fixing by Abduction

Following Dölling (1997, 1998, 2000), I use abductive interpretation as a formal means of parameter fixing. Abductive reasoning is inference to the best explanation; cf. Hobbs et al. (1993). In abductive frameworks, the interpretation of a sentence consists in deriving its most economical explanation that is consistent with what we know. That is, abductive reasoning is based on reductive inferences rather than deductive ones. In our case, it takes an underspecified SF and tries to prove it from a conceptual knowledge base (CKB) that provides axioms, facts, and additional contextually legitimated assumptions. CKB is presumed to be mutually known by the speaker and the hearer. As a by-product, abductive reasoning leads to a parameter-fixed CS that "explains" SF with respect to CKB. The abductive inference pattern is given in (31).

$$(31) \quad \begin{array}{ll} P \rightarrow Q & \textit{conceptual knowledge} \\ \underline{Q} & \textit{underspecified SF} \\ P & \textit{parameter-fixed CS} \end{array}$$

With respect to the conceptual knowledge $P \rightarrow Q$, the parameter-fixed CS P could be a sensible explanation of the underspecified SF Q . That is, we try to find a conceptual explanation for our underspecified SF by backward chaining. Since (31) does not provide a valid inference mode, CKB might license more than one CS explanation for SF, i.e., there might be several utterance meanings that satisfy the SF conditions. (These could be weighted according to different criteria; cf. Hobbs et al. (1993) but I will neglect the rating of explanations.)

A crucial feature of abductive reasoning is so-called *factoring*, which serves to reduce redundancies thereby leading to more economical explanations. Factoring licenses the unification of compatible expressions if the result is consistent with the rest of what is known. Given an expression of the form (32a), factoring assumes the variables x and y to be identical, yielding an expression of the form (32b); cf. Hobbs et al. (1993: 83). This carries over to the identification of an existentially bound variable with a suitable constant; cf. (33). Factoring applies freely in the course of abductive interpretation.

$$(32) \quad \begin{array}{l} \text{a. } \exists \dots xy \dots [\dots \& P(x) \& \dots \& P(y) \& \dots] \\ \text{b. } \exists \dots x \dots [\dots \& P(x) \& \dots] \end{array}$$

$$(33) \quad \begin{array}{l} \text{a. } \exists \dots x \dots [\dots \& P(x) \& \dots \& P(\mathbf{a}) \& \dots] \\ \text{b. } \exists \dots [\dots \& P(\mathbf{a}) \& \dots] \end{array}$$

The general procedure of parameter fixing is the following: (1) We take an underspecified SF whose need for conceptual specification is indicated by SF-parameters and (2) try to instantiate these parameters with respect to our CKB by backward chaining and factoring where possible. (3) This yields a parameter-fixed CS. (4) In order to show that this CS is indeed a possible explanation for SF, we then try to prove SF from CS on the basis of the shared knowledge, making additional assumptions where necessary. These additional assumptions are taken to be the new information of the sentence.

4.2. Some Illustrations

In the following, I will go through some examples and show how the SF-parameter of an internal modifier is instantiated at CS. Let us start with the sample sentence (28), repeated in (34a). Its SF is given in (34b).

- (34) a. Der Bankräuber ist auf dem Fahrrad geflohen.
 The bank robber has on the bicycle fled.
- b. SF: $\exists e$ [FLEE (e) & THEME (e, **r**) & BANK-ROBBER (**r**) & PART-OF (e, v)
 & LOC (v, ON (**b**)) & BIKE (**b**)]

What kind of conceptual knowledge do we need in order to determine the utterance meaning of (34a)? To start with, let us assume that the interlocutors have some common knowledge about locomotion. For our purposes it will be useful to draw a distinction between *extrinsic movement* (EXTR-MOVE) and *intrinsic movement* (INTR-MOVE). The former relies on an extrinsic vehicle, the latter is based on intrinsic means of locomotion. Riding and driving, e.g., belong to the kind of extrinsic movement, while walking and jumping are intrinsic movements. Fleeing and chasing can be performed in either way. So, let us assume a CKB which provides an axiomatization of this bit of common sense knowledge about locomotion; cf. the axioms (35) – (39).

- (35) a. $\forall exz$ [MOVE (e) & THEME (e, x) & INSTR (e, z) & VEHICLE (z) & SUPPORT (z, x)
 \rightarrow EXTR-MOVE (e)]
- b. $\forall exyz$ [MOVE (e) & THEME (e, x) & INSTR (e, z) & $z \sqsubset x$ & $y=x-z$ & SUPPORT (z, y)
 \rightarrow INTR-MOVE (e)]
- c. $\forall ex$ [EXTR-MOVE (e) & THEME (e, x) \rightarrow MOVED-ITEM (e, x)]
- d. $\forall exyz$ [INTR-MOVE (e) & THEME (e, x) & INSTR (e, z) & $y=x-z$ \rightarrow MOVED-ITEM (e, y)]

The axioms in (35) establish the relevant difference between extrinsic and intrinsic movement: extrinsic movement involves a vehicle which is used as an instrument of locomotion. This vehicle must support (see below) the theme, otherwise the latter could not benefit from the vehicle's motion in the intended sense; cf. (35a). Intrinsic movement, by contrast, is given if a part of the object that undergoes movement is used as a means of locomotion. In this case, the moving part supports the rest of the object; cf. (35b). The item whose movement is dependent on the instrument (MOVED-ITEM) is the theme, in the case of extrinsic movement, and the theme minus the bodypart that serves as instrument, in the case of intrinsic movement; cf. (35c/d). (The axioms in (35) use the mereological notions *proper part* " \sqsubset " and *mereological difference* "-"; cf. e.g. Simons 1987.)

- (36) a. $\forall e$ [EXTR-MOVE (e) & ETC_{RIDE} (e) \rightarrow RIDE (e)]
- b. $\forall e$ [EXTR-MOVE (e) & ETC_{DRIVE} (e) \rightarrow DRIVE (e)]
- etc.

- (37) a. $\forall e$ [INTR-MOVE (e) & ETC_{WALK} (e) \rightarrow WALK (e)]
- b. $\forall e$ [INTR-MOVE (e) & ETC_{JUMP} (e) \rightarrow JUMP (e)]
- etc.

- (38) a. $\forall e [X\text{-MOVE}(e) \ \& \ \text{ETC}_{\text{FLEE}}(e) \rightarrow \text{FLEE}(e)]$
 b. $\forall e [X\text{-MOVE}(e) \ \& \ \text{ETC}_{\text{CHASE}}(e) \rightarrow \text{CHASE}(e)]$
 etc.

- (39) a. $\forall e [\text{EXTR-MOVE}(e) \rightarrow X\text{-MOVE}(e)]$
 b. $\forall e [\text{INTR-MOVE}(e) \rightarrow X\text{-MOVE}(e)]$

The axioms in (36) – (38) make use of so-called *ETC-predicates*. Hobbs et al. (1993: 85ff) introduce them as a tool for exploiting superset information in the course of abductive reasoning. The reason is the following: if we wanted to express, e.g., that riding eventualities are a subset of extrinsic-movements as in (36'a), we would not be able to use this information while backward chaining. ETC-predicates allow us to convert such axioms into biconditionals, which then can be used in either direction; cf. (36''a). Thus, ETC-predicates are place-holders for the *differentia specifica* that distinguishes a *species* from its *genus proximum*. It might be impossible or undesirable to spell them out completely but they can be assumed by abduction. (Therefore, we need only the direction given in (36a).) This is what makes them a useful tool for abductive reasoning.

- (36') a. $\forall e [\text{RIDE}(e) \rightarrow \text{EXTR-MOVE}(e)]$

- (36'') a. $\forall e [\text{EXTR-MOVE}(e) \ \& \ \text{ETC}_{\text{RIDE}}(e) \leftrightarrow \text{RIDE}(e)]$

The axioms in (36) cover genuinely extrinsic locomotions; (37) addresses locomotions that are intrinsic. The axioms in (38) account for locomotions that can be performed by extrinsic as well as intrinsic means with the aid of an auxiliary parameter X-MOVE whose possible values are given in (39). Let us add furthermore a piece of knowledge about common subkinds of vehicles:

- (40) a. $\forall x [\text{VEHICLE}(x) \ \& \ \text{ETC}_{\text{BIKE}}(x) \rightarrow \text{BIKE}(x)]$
 b. $\forall x [\text{VEHICLE}(x) \ \& \ \text{ETC}_{\text{TRAIN}}(x) \rightarrow \text{TRAIN}(x)]$
 etc.

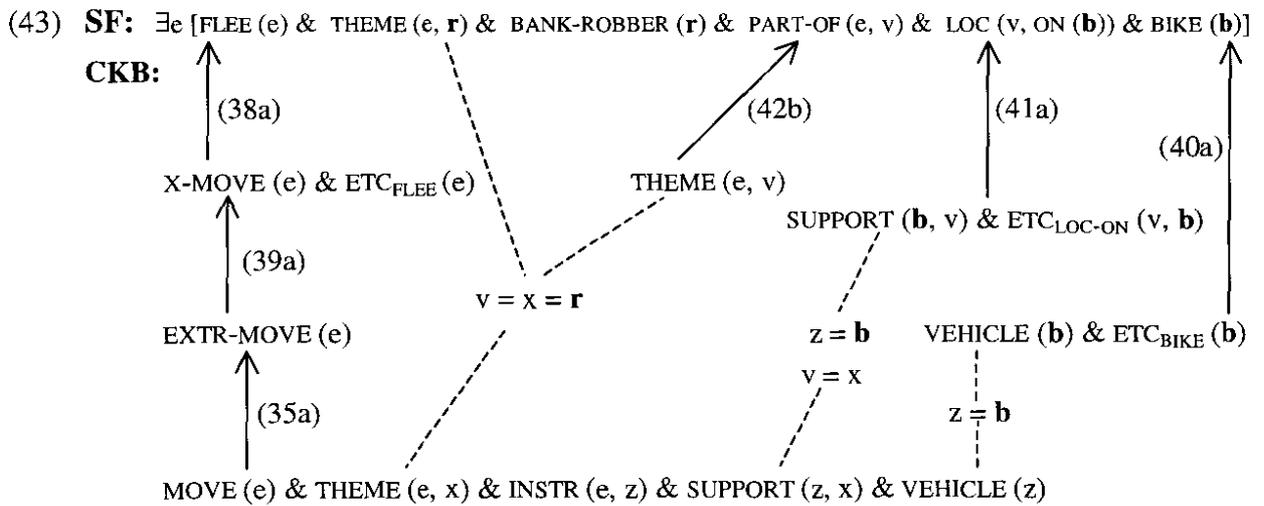
Besides this kind of knowledge about locomotion, our CKB includes the axioms in (41), which relate spatial configurations with functional concepts of containment and support. If an object y is located at the surface of an object x this is a subkind of x supporting y (i.e. x stops the effect of gravity on y); cf. (41a). If an object y is located at the inner region of an object x this is a subkind of x containing y (cf. (41b)), which itself is a subkind of support; cf. (41c).

- (41) a. $\forall xy [\text{SUPPORT}(x, y) \ \& \ \text{ETC}_{\text{LOC-ON}}(y, x) \rightarrow \text{LOC}(y, \text{ON}(x))]$
 b. $\forall xy [\text{CONTAIN}(x, y) \ \& \ \text{ETC}_{\text{LOC-IN}}(y, x) \rightarrow \text{LOC}(y, \text{IN}(x))]$
 c. $\forall xy [\text{SUPPORT}(x, y) \ \& \ \text{ETC}_{\text{CONTAIN}}(x, y) \rightarrow \text{CONTAIN}(x, y)]$

Finally, we need some axioms that specify what it means for an entity to be an integral part of an eventuality. The axioms in (42) guarantee that the participants of an eventuality qualify as its integral parts.

- (42) a. $\forall ex$ [AGENT (e, x) \rightarrow PART-OF (e, x)]
 b. $\forall ex$ [THEME (e, x) \rightarrow PART-OF (e, x)]
 c. $\forall ex$ [INSTR (e, x) \rightarrow PART-OF (e, x)]
 d. $\forall ex$ [MOVED-ITEM (e, x) \rightarrow PART-OF (e, x)]
 etc.

The axioms (35) – (42) provide a suitable background for the abductive interpretation of sentence (34a). Applying backward chaining and factoring to our initial SF (34b) yields a possible conceptual specification which identifies the discourse referent of *der Bankräuber* as value for the SF-parameter *v*. This is illustrated in the graph (43). (The relevant axioms are noted besides the arrows. Factoring is indicated by equations that are linked to the relevant literals by dotted lines.)



The respective parameter-fixed CS is given in (34c). If we replace the ETC-predicates by the literals that triggered them, we add a little redundancy but improve readability; cf. (34'c).

- (34) c. CS: $\exists e$ [MOVE (e) & ETC_{FLEE}(e) & THEME (e, **r**) & BANK-ROBBER (**r**) & INSTR (e, **b**)
 & VEHICLE (**b**) & ETC_{BIKE}(**b**) & SUPPORT (**b**, **r**) & ETC_{LOC-ON}(**r**, **b**)]
- (34') c. CS: $\exists e$ [EXTR-MOVE (e) & FLEE (e) & THEME (e, **r**) & BANK-ROBBER (**r**)
 & INSTR (e, **b**) & VEHICLE (**b**) & BIKE (**b**) & SUPPORT (**b**, **r**) & LOC (**r**, ON (**b**))]

This CS gives us a plausible utterance meaning for sentence (34a). It goes beyond the grammatically determined meaning in the following respects: (a) it specifies that the escape was taken by extrinsic means. As a consequence, (b) the bike is identified as the instrument of locomotion in the given event. This in turn leads (c) to an instantiation of the SF-parameter *v* by the discourse referent representing the bank robber.

Now we have derived a parameter-fixed CS for our sentence (34a). The last step of abductive reasoning consists in proving the underspecified SF (34b) from this CS. If we assume the new information of (34c) to be true and if we assume furthermore that our CKB provides uniquely identifiable discourse referents **r** and **b** for the bank robber and the bike, then there is a straightforward derivation of the SF (34b) from the CS (34c) by simplification and generalization of the constant **r** to the parameter *v*. Thus, CS is in fact a possible

specification of the underspecified SF with respect to CKB. This completes the abductive interpretation of our sample sentence.

Let me add a remark on factoring. This is an extremely powerful tool, of course, and we are well advised to develop strategies for controlling it. In fact, factoring should be constrained by overall principles of conceptual economy. A concrete version that addresses natural language interpretation (adapted from Lang 1985: 106) is formulated as a pragmatic condition on variable instantiation in (44).

(44) Pragmatic Condition on the Instantiation of Underspecified Variables:

An existentially quantified or free variable x is instantiated preferentially by a referent that is introduced by linguistic means, always provided that it meets the conditions on x .

The condition in (44) assures the primacy of linguistically introduced referents for the interpretation of natural language expressions and it warrants parsimony with respect to conceptual assumptions that are not independently motivated. In view of (44), the CS (34c) turns out to be an extraordinarily promising explanation for the underspecified SF, because it refers only to linguistically introduced referents.

The abductive interpretation of sentence (45a) proceeds along the lines of (34). The corresponding CS is given in (45c).

- (45) a. Der Bankräuber ist im Zug nach Rom geflüchtet.
The bank robber has in.the train to Rome fled.
- b. SF: $\exists e$ [FLEE (e) & THEME (e, **r**) & BANK-ROBBER (**r**) & GOAL (e, **rome**) & PART-OF (e, v) & LOC (v, IN (t)) & TRAIN (t)]
- c. CS: $\exists e$ [EXTR-MOVE (e) & FLEE (e) & THEME (e, **r**) & BANK-ROBBER(**r**) & GOAL (e, **rome**) & INSTR (e, t) & TRAIN (t) & CONTAIN (t, **r**) & LOC (**r**, IN(t))]

The variant (46) works differently. Suppose that the restaurant car is part of the train – although very plausible, this assumption is not really enforced by the linguistic system – then the train cannot figure as an instrument in the given event anymore. (I refrain from spelling out the corresponding axioms.) That is, the train fails to be identifiable with the inferred vehicle of extrinsic movement and, consequently, a suitable instantiation of the SF-parameter with respect to the CS of the verbal referent cannot be obtained. Thus, (46) is conceptually ill-formed under an internal reading of the locative modifier. It does support an external interpretation, of course.

- (46) §Der Bankräuber ist im Zug in den Speisewagen geflüchtet.
The bank robber has in.the train into the restaurant car fled.

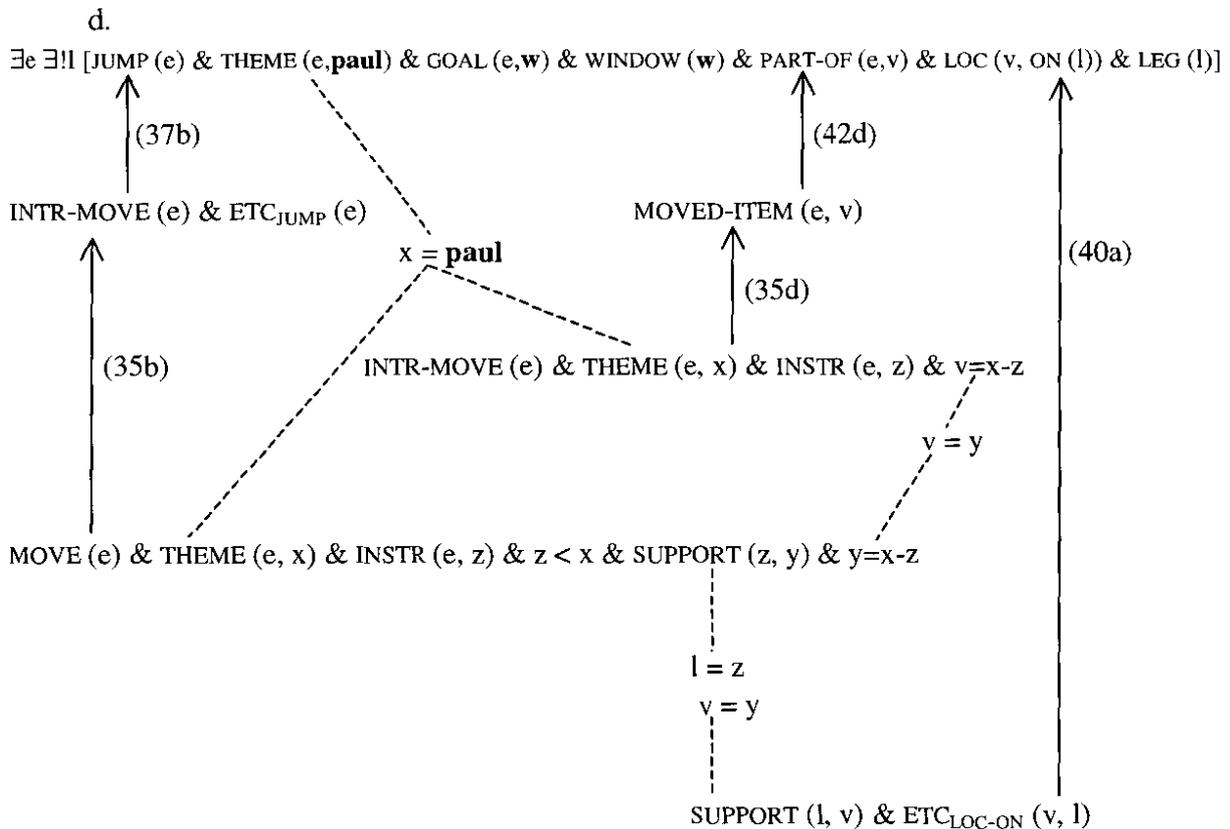
In (46), the integration of the locative into the conceptual structure of the verb is blocked by the linguistic context (by the interpretation of the directional PP, to be precise). In the case of (47), this conceptual clash is produced by a mismatch of the knowledge that is associated with the locative and the verb.

- (47) a. §Der Bankräuber ist neben dem Zug geflüchtet.
The bank robber has beside the train fled.
- b. §Der Bankräuber ist im Zug nach Rom gerannt.
The bank robber has in.the train to Rome run.

In (47a), there is no way to infer some kind of support between the train and the bank robber from the spatial relation expressed by the locative preposition *neben* ('beside'). That is, CKB does not contain any axiom that allows us to derive abductively SUPPORT (y, x) from LOC (x, BESIDE (y)). Hence, the train does not meet the necessary conditions for qualifying as instrument in the given eventuality. In (47b), on the other hand, the locative cannot be interpreted as supplying information about an extrinsic means of locomotion because the kind of movement determined by the verb is intrinsic. In both cases, no instantiation of the SF-parameter is obtained.

Let us have a closer look at the interpretation of internal modifiers in sentences referring to intrinsic movements. Take, e.g., (48a): its SF is given in (48b) and a straightforward conceptual specification with respect to the CKB developed above could be (48c); cf. the derivation in (48d).

- (48) a. Paul hüpfte auf einem Bein zum Fenster.
 Paul jumped on one leg to the window.
- b. SF: $\exists e \exists ! l$ [JUMP (e) & THEME (e, **paul**) & GOAL (e, **w**) & WINDOW (w) & PART-OF (e, v) & LOC (v, ON (l)) & LEG (l)]
- c. CS: $\exists e \exists ! l$ [JUMP (e) & THEME (e, **paul**) & GOAL (e, **w**) & WINDOW (w) & INSTR (e, l) & LEG (l) & l < **paul** & y = **paul-l** & MOVED-ITEM (e, y) & SUPPORT (l, y) & LOC (y, ON (l))]



The CS (48c) goes beyond the linguistically determined meaning representation (48b) in that it identifies the leg x as that part of Paul that is employed as intrinsic means of locomotion. For this purpose, the leg must support Paul's remaining body in the given event. That is, the SF-parameter v is conceptually specified as Paul's body minus one leg.

The interpretation of the sentences in (49) proceeds along the same lines. Conceptual knowledge about the underlying eventuality types involves constraints on the (canonical or typical) position of participants. These constraints refer to the part-whole organization of

human bodies and can be spelled out in terms of positional and dimensional properties of physical objects; cf. Lang (1989), Lang et al. (1991).

- (49) a. Paul steht auf dem Kopf.
 Paul stands on the head.
 'Paul is standing on his head.'
- b. Paul schläft auf dem Rücken.
 Paul sleeps on the back.
- c. Paul flehte auf Knien um Gnade.
 Paul craved on knees for mercy.

Take, e.g., sentence (49a): the internal modifier in (49a) definitely does not supply information about the location of the respective eventuality nor does it locate Paul. Rather, it provides information about Paul's position. One might conclude that the original locative meaning of the modifier was not at work at all. This would call for an additional lexical meaning designed for the positional use of locatives, thereby implementing polysemy with all its undesired concomitants into the system of locative prepositions. The current approach does not take this move. It takes the genuinely locative meaning contribution of the modifier seriously and tries to find a suitable instance of the relevant spatial relation in the course of conceptual reasoning. This leads to a CS for (49a) that includes a relation of support between Paul's head and his remaining body. That is, the internal modifier in (49a) indeed does not locate Paul, yet it does provide a location of Paul's remaining body relative to his head. Thus, even the cases that appear on first glance to challenge the assumption of a uniform meaning contribution of locatives can be explained by applying the very same conceptual mechanism that was illustrated here with examples from the domain of extrinsic and intrinsic movement to invariant lexical-semantic representations. (I will not give the details of the interpretations for (49) here because they need a certain amount of axiomatization in the conceptual domain of physical objects but cf. Maienborn (1996: 237ff) for a thorough analysis of (49a).)

Finally, I want to discuss a case where our CKB licenses more than one CS-instantiation of the SF-parameter *v*. Take, e.g., sentence (50a) and its SF in (50b).

- (50) a. Paul zieht Maria an ihrem Pferdeschwanz.
 Paul is pulling Maria at her pony-tail.
- b. SF: $\exists e$ [PULL (*e*) & AGENT (*e*, **paul**) & THEME (*e*, **maria**) & PART-OF (*e*, *v*)
 & LOC (*v*, AT (**pt**)) & PONY-TAIL (**pt**) & **pt** \sqsubset **maria**]

We need to augment our CKB in order to deal with (50). Some axioms for spatial contact are given in (51). (51a) links the predicates LOC and CONTACT: being located at the border region of an object (spatial function AT) is defined as a subkind of having contact with that same object. (51b) states that CONTACT is a symmetrical relation and (51c) guarantees part-whole inheritance. (" \sqsubseteq " stands for the mereological *improper part*.)

- (51) a. $\forall xy$ [CONTACT (*x*, *y*) & ETC_{LOC-AT} (*y*, *x*) \rightarrow LOC (*y*, AT (*x*))]
 b. $\forall xy$ [CONTACT (*x*, *y*) \rightarrow CONTACT (*y*, *x*)]
 c. $\forall xy$ [CONTACT (*x*, *y*) \rightarrow $\exists z$ [CONTACT (*x*, *z*) & *z* \sqsubseteq *y*]]

The axioms (52) and (53) supply some information about the eventuality type PULL. (52) states that pulling an object *y* is defined by exerting force (EXERT-FORCE) on *y* via an

instrument that is controlled by the agent and is in contact with *y*. The axioms in (53) address common sense knowledge about typical and/or admissible instruments like the agent's hand(s) or a pair of pinchers.

(52) $\forall exyz$ [EXERT-FORCE (*e*) & AGENT (*e*, *x*) & THEME (*e*, *y*) & INSTR (*e*, *z*)
& CONTACT (*z*, *y*) & CONTROL (*x*, *z*) & ETC_{PULL} (*e*) \rightarrow PULL (*e*)]

(53) a. $\forall exz$ [AGENT (*e*, *x*) & INSTR (*e*, *z*) & HAND (*z*) & $z \sqsubset x \rightarrow$ CONTROL (*x*, *z*)]
b. $\forall exz$ [AGENT (*e*, *x*) & INSTR (*e*, *z*) & PINCHERS (*z*) \rightarrow CONTROL (*x*, *z*)]
etc.

Abductive reasoning leads to two potential specifications of the SF in (50b) that differ with respect to the instrument that is used for pulling and, consequently, with respect to the value of the parameter *v*. Our CKB supports an instantiation of *v* with either the agent's hand (50c) or with pinchers (50d). Which of these conceptual specifications of (50b) will actually turn out to be the appropriate interpretation can only be determined in view of the relevant context.

(50) c. CS₁: $\exists ez$ [PULL (*e*) & AGENT (*e*, **paul**) & THEME (*e*, **maria**) & INSTR (*e*, *z*)
& HAND (*z*) & $z \sqsubset$ **paul** & CONTACT (*z*, **pt**) & PONY-TAIL (**pt**) & **pt** \sqsubset **maria**
& LOC (*z*, AT (**pt**))]
b. CS₂: $\exists ez$ [PULL (*e*) & AGENT (*e*, **paul**) & THEME (*e*, **maria**) & INSTR (*e*, *z*)
& PINCHERS (*z*) & CONTACT (*z*, **pt**) & PONY-TAIL (**pt**) & **pt** \sqsubset **maria**
& LOC (*z*, AT (**pt**))]

These were some illustrations of pragmatic parameter fixing that leads to conceptually specified utterance meanings for sentences with internal modifiers. The axiomatization of world knowledge I used here is still preliminary to say the least. Conceptual matters will certainly turn out to be much more complex. But this does not affect the outline of parameter fixing itself, which turns a grammatically determined SF into a contextually specified CS in accordance with a more or less carefully modelled conceptual knowledge base.

4.3. Some Concluding Remarks on the Conceptual Specification of Internal Modifiers

Let us take stock of what has been achieved so far. According to the proposal developed above, an internal modifier elaborates on independently established spatial constraints which are part of the conceptual knowledge that is associated with a certain eventuality type. Spatial relations are basic building blocks of functional notions. This explains the virtual ubiquity of conceptual integration sites for locatives and lends further support to the widely acknowledged thesis that spatial concepts are central to the mental organization of knowledge; cf. Talmy (1983), Landau & Jackendoff (1993), Bierwisch (1996), Bowerman (1996), Jackendoff (1996) among others. The study also suggests, and this is less commonplace, that eventualities, as accessed by natural language expressions, should not just be viewed as monolithic spatiotemporal entities but display a coherent functional organization in terms of participants, spatial constraints, part-whole relations, etc.; cf. Maienborn (2000). Thus, locative modifiers both enable and enforce a closer look into the internal structure of eventualities.

Having expounded the present account of internal modifiers, let us now revert to the main observations about their semantic peculiarities in section 2: semantic indeterminacy with respect to the located entity and the ability to convey instrumental or manner information.

The semantic indeterminacy of situation-internal modifiers was reconstructed by an SF-parameter that is subject to conceptual specification. Semantic indeterminacy was shown to hold in two respects. First, several entities may qualify as suitable instances of the SF-parameter according to our common sense knowledge. Consequently, sentences may turn out to have several utterance meanings; cf. the discussion of sentence (50a). Secondly, the set of appropriate parameter instances includes besides linguistically established referents like the theme in (34) and (45) also entities that do not show up in the grammatically determined meaning representation, viz. conceptually inferred entities like the agent's hand or some pinchers used as instrument in (50) or the theme's body minus one leg in (48). The present approach can account for all of these cases by a uniform conceptual mechanism of parameter fixing, operating on a compositionally determined, underspecified meaning representation.

What about the instrumental or manner reading that seems to be superimposed over the locative; cf. the discussion of (13) – (15) in section 2? It turns out to be simply a side effect of the conceptual parameter fixing. Note that in the course of abductive reasoning the internal argument of the locative may be identified via factoring with an independently established entity that serves some function within the corresponding eventuality. If this entity is used, e.g., as an instrument this carries over to the locative's internal argument and we obtain an instrumental reading of the locative; cf. e.g. (34). The manner reading basically follows the same pattern.¹¹ Thus, the approach developed here does not have to assume that locative prepositions may occasionally have a defective or in some sense mutated semantic content, but accounts for the peculiar interpretation of internal modifiers by emphasizing precisely this genuinely locative meaning component.

Finally, it is worth mentioning that the analysis of internal modifiers presented here is essentially guided by a modular conception of meaning constitution. On the one hand, there is a sharp distinction between a strictly grammatically determined, contextually invariant meaning skeleton, SF, and its conceptual augmentation in a particular context, CS. This is a crucial tool for revealing the genuinely linguistic aspects of natural language meaning and their interaction with extra-linguistic facets of human cognition. On the other hand, modularity also applies to the conceptual system. The analysis is based on three independent sources of conceptual knowledge: (a) knowledge about spatial relations, viz. the axioms given in (41) and (51), (b) knowledge about eventuality types in terms of participants serving particular functions and (c) knowledge about the part-whole organization of physical objects. That is, the present proposal is able to cope with the peculiarities of internal modifiers without having to postulate idiosyncrasy either in the linguistic system (by assuming additional lexical entries for locative prepositions) or in the conceptual system (by adding special purpose rules for the interpretation of internal modifiers). Rather, the grammar operates on unambiguous lexical representations for locative prepositions and produces a compositional meaning with a clearly shaped request for specification which is satisfied by consulting independently established knowledge of the conceptual system.

¹¹ The exact conditions under which the contribution of a locative is conceptualized as manner information rather than purely locative information remain to be worked out.

5. Conclusion

In this study, I have offered evidence that there are two variants of adverbial modification, which differ with respect to the way in which a modifier is linked to the verb's eventuality argument. External modifiers relate to the full eventuality, whereas internal modifiers relate to some integral part of it. Furthermore, I have shown that the choice between external and internal modification is dependent on the modifier's syntactic base position. External modifiers are base-generated at the VP periphery, whereas internal modifiers are base generated at the V periphery. These findings call for a refinement of the standard Davidsonian approach to adverbial modification. In particular, I have argued that the classical approach must be augmented by the notion of underspecification in order to account properly for the case of internal modification. By way of conclusion, let us see what kind of answers the present study provides to the questions concerning underspecification that were raised in section 1:

1. What are the characteristics of semantically underspecified, internal modification?
2. What triggers underspecification and how is it resolved?
3. How do grammar and pragmatics conspire to produce the relevant interpretations?

As concerns the first question, the discussion of the relevant data has revealed that internal modifiers are underspecified with respect to the located entity. The actual target of an internal modifier cannot be determined on the basis of grammatical knowledge alone but depends on the contextually salient world knowledge. Possible targets are given by the set of entities that are integral parts of the eventuality. That is, not just any entity that is arbitrarily related to the eventuality qualifies as a potential target for an internal modifier but only those entities whose function is crucial for the eventuality to take place. This explains why locatives are particularly well suited to internal modification and why they tend to convey instrumental or manner information: internal locative modifiers supply additional information about implicit spatial constraints that form the backbone of an eventualities functional skeleton.

As concerns the second question, the present study suggests that underspecification is triggered by a particular structural configuration. The kind of semantic indeterminacy that we observed here has no lexical roots. Taken in isolation, neither the locative nor the verb are underspecified in the relevant sense. The characteristic pattern of underspecification only shows up if they are combined via modification. Underspecification is resolved in the course of merging the modifier's meaning contribution with an independently established relation that is part of the conceptual structure of the eventuality. This underlines the parasitic nature of modifiers. Wherever they find a suitable integration site, they attach to it and supply additional and uncalled-for information.

Finally, what about the third question? How do grammar and pragmatics conspire to produce the relevant interpretations? The present study advocates a combined strategy that accommodates linguistic as well as extra-linguistic constraints. In particular, I claim that underspecification is essentially regulated by the grammatical system: the grammar confines underspecification to only those modifiers that attach to an X-environment. Modifiers in an XP-environment (i.e. external modifiers) are not subject to the observed semantic indeterminacy. Therefore, I suggest that adverbial modification is accounted for by a single, elementary semantic operation that is spelled out as underspecified or not according to the modifier's structural environment. This contradicts more liberal analyses according to which underspecification is introduced rather freely by the linguistic system and it is only

pragmatics that tells us which of the potential conceptual specifications is a suitable interpretation.

A key-role in the process of linking linguistic and extra-linguistic knowledge is taken by so-called *SF-parameters*. These are free variables that are installed under well defined conditions at SF and which are required to be instantiated at the level of CS. SF-parameters are a means of triggering and controlling the conceptual enrichment of a grammatically determined meaning representation: they delineate precisely the gaps within the Semantic Form that call for conceptual specification and they impose sortal restrictions on potential conceptual fillers. Thus, SF-parameters can be seen as a kind of interface between grammar and pragmatics. By giving detailed conceptual analyses of some illustrative examples, I hope to have demonstrated that SF-parameters and their conceptual specification via abduction are indeed a useful tool that allows us to gain a deeper understanding of the kind of knowledge that is involved in the determination of the utterance meaning of natural language expressions.

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