Influence of animacy and grammatical role on production and comprehension of intersentential pronouns in German L1-acquisition[1]

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In anaphora resolution theory, it has been assumed that anaphora resolution is based on a reversed mapping of antecedent salience and anaphora complexity: minimal complex anaphora refer to maximal salient antecedents. In order to examine whether and by which developmental steps German children gain command of this mapping maxim we conducted an experiment on production and comprehension of intersentential pronouns including the three pronoun types zero, personal, and demonstrative pronoun. With respect to antecedent salience, the experiment varied syntactic role (subject/object) and in/animacy. Six age groups of children (age range from 2;0 to 6;0) and an adult control group has been tested. The hypothesis arising from the mapping maxim is that zero pronoun correlates with more salient antecedents than personal and demonstrative pronoun, the latter correlating with the least salient antecedents. The results are: In production, children first establish the opposition of zero pronoun with animate antecedents vs. demonstrative pronoun with inanimate antecedents. In a next step, syntactic role comes into play and a more complex system opposing the three presented pronoun types is established. In comprehension, however, the effect of pronoun type remains weak and antecedent features remain a strong factor in reference choice. However, also adults employ pronoun type and antecedent features. The oldest children and the adults show variation in personal pronoun resolution according to the animacy pattern of the potential antecedents. In case of identical animacy features, the subject is the preferred candidate; in case of distinct animacy features, there is a tendency to choose the object antecedent.

[1] The presented study was worked out in close cooperation with Natalia Gagarina and Milena Kuehnast who conducted parallel experiments on Russian and Bulgarian (see Gagarina this volume; Kuehnast this volume), and with Insa Gülzow who did a great deal of the experiments on German. Further, I would like to thank our students Franziska Bewer, Britta Grabherr, Robert Hoffmann, and Jenny Ewert. Elena Andonova provided first statistical analyses on a preliminary version of the data for which I am very thankful, although these statistics will not appear in this paper.

1 Questions and Hypotheses

The numerous and diverse approaches on anaphora resolution currently proposed converge on the assumption that one of the core criteria in the disambiguation of anaphoric reference is the salience of referents in the mental representation of a situation (e.g., Gundel et al 1993; Ariel 2004; Grosz et al. 1995). Restricting the scope of possible referents to linguistically prementioned referents, salience can be determined by linguistic structural features, e.g., grammatical role, word order, definiteness, agreement etc., or by semantic features, i.e., properties of the antecedent, such as semantic inference relations, semantic role, topicality, animacy, etc. Very likely, salience is determined by interaction of a bunch of such criteria. Some of them have been proposed to be especially relevant or, at least, sufficient in order to appropriately generate the resolution of certain types of anaphora. With respect to pronominal anaphora the following criteria are discussed: syntactic role, syntactic or semantic parallelism, old-new information (theme-rheme-/topic-focus-structure). Distinct solutions are proposed on what is the decisive hierarchy of these criteria in salience determination.

A further topic is the classification of anaphoric capacities of the diverse pronoun types. Does each pronoun type have distinct and stable features of 'anaphoricity'? Or is there rather a pragmatic resolution process including variation in the anaphoric relations of an anaphora in dependence on actual feature constellations? The widely accepted assumption of a reversed mapping of antecedent salience and anaphora complexity, i.e., maximal salient antecedents are referred to by minimal complex anaphora and minimal salient antecedents by maximal complex anaphora (see Givón 1983; Levinson 2000), hints at a pragmatically based solution of anaphoric reference. A prerequisite to more detailed elaboration of this 'reversed-mapping hypothesis' is the determination of the range of features relevant for antecedent salience and their hierarchical ranking(s).

For the time being, there are more questions than answers in the field of (pronominal) anaphora resolution. Given this situation, it might be helpful to have a look at language acquisition which provides the opportunity to go back to, very likely, less complex stages of language processing. We suppose that basic structures of linguistic domains are acquired before internal differentiation takes place by incorporation of further specifications. Thus, early phases of language acquisition might provide insights, for instance, in what are primary and what are merely secondary features in salience determination or in what are primary anaphoric capacities of the different types of anaphora.

The experimental investigation reported in this paper aims at answering the following question or, at least, at providing insights in what are possible

methods and relevant problems in answering the question: Does the antecedent features syntactic role and animacy provide cues for production and/or comprehension of zero, personal, and demonstrative pronouns? It is worth noting, that zero pronoun is ungrammatical in German. However, it has been chosen for two reasons: Firstly, the experiment has been conducted on German, Russian, and Bulgarian in order to investigate across-language and language-specific aspects of intersentential pronoun use. In Russian and Bulgarian, zero pronoun is a grammatical type of anaphora. Secondly, even children acquiring non-pro-drop languages as German tend to omit the subject phrase in the early phases. The question arises how children deal with this gap in anaphoric reference. Do they treat it in line with the reversed-mapping hypothesis?

Syntactic role, i.e., the opposition between subject and object role, has been chosen because certain approaches (e.g., classical Centering Theory; Grosz 1995, Beaver 2004) propose a subject preference in pronoun resolution (especially for the personal pronoun). Other approaches propose a preference for either old (Strube & Hahn 1999) or new information (Haijcova et al. 1993) including the possibility of object preference. The animacy feature has been chosen because for instance Mandler (1992) suggests a high preference for animacy distinctions in early cognitive development of children.

Starting from the reversed-mapping hypothesis, the three pronoun types zero, personal, and demonstrative pronoun are proposed to show the following anaphoric capacities:

(1) *Hypothesis on anaphoric capacities*
- (a) If there occurs any relevant pattern for the ungrammatical *zero pronoun*, it correlates with the most salient antecedent.
- (b) The *demonstrative pronoun* correlates with the least salient antecedent.
- (c) The anaphoric capacity of the *personal pronoun*, theoretically, lies somewhere in the middle. Taking into account the ungrammaticality of the zero pronoun in German, the personal pronoun should correlate with higher salient antecedents.

With respect to salience ranking, the following questions will be examined:

(2)
- (a) Are subject antecedents more salient than object antecedents or vice versa?
- (b) Are animate antecedents more salient than inanimate antecedents or vice versa?
- (c) Is there an interaction of syntactic role and animacy in salience ranking?

Special emphasis will be given on the course of development over age and the comparison of the children's behaviour with that of the adult control group. The general hypothesis is that we will find age-related changes in the correlation of pronoun type and antecedent features. On the base of what has been said above on increasing complexity by consequent differentiation of linguistic domains in

the course of acquisition, we will investigate the following hypotheses on developmental steps in the correlation of pronoun types and antecedent features:

(3) *Hypotheses on developmental steps*

(a) Younger children (about up to age 4;0) exhibit a bipolar opposition in the anaphoric capacities of the three pronoun types unifying the anaphoric capacity of two pronoun types, either zero/personal vs. demonstrative or zero vs. personal/demonstrative pronoun. Older children (of about age 4;0 to 5;6) and adults exhibit a more complex pattern of oppositions containing specific anaphoric capacities for each pronoun type.

(b) Younger children's opposition of the anaphoric capacities of the pronoun types relies on only one of the two antecedent features (syntactic role or animacy) whereas older children and adults use both of them.

In section 2, we will introduce the experimental method and materials. After that, the results on pronoun production will be presented (section 3) and discussed (section 4). Section 5 and 6, respectively, present and discuss the results on pronoun comprehension. Section 7 gives a short summary on results and open questions.

2 Experimental method and material

The experiment was performed as a combined production and comprehension experiment. In a playing situation with two experimenters, the child was presented with 12 short stories representing 12 experimental conditions (see below). The stories were presented to the child by the first experimenter using toy puppets. Each story included two protagonists and ended with an 'antecedent sentence' expressing an interaction of these two protagonists. The 'antecedent sentence' was immediately followed by an 'anaphoric sentence' containing the pronoun and an information which was true for both protagonists (e.g., being blue or being happy). Thus, an ambiguous situation occurred with respect to the reference of the pronoun. No semantic cues, gender cues, or other cues for pronoun reference were given. Pronoun production was elicited by asking the child to repeat the last, i.e., the anaphoric sentence to a distracted puppet (played by the second experimenter) who was introduced to the child as absent-minded and hard of hearing. Pronoun comprehension was evaluated by a clarification question asked by the distracted puppet (*who*-question) immediately following the child's sentence repetition.

(4) *Example of the experimental settings:*

Exp 1:	Das ist der Bär und hier ist der Ball.	That's the bear and that's the ball.
	Der Bär spielt gern Fussball.	The bear likes to play football.
	Jetzt liegt der Ball vor dem Bären.	Now, the ball is in front of the bear.
antecedent sentence:	Der Bär tritt den Ball.	The bear is kicking the ball.
anaphoric sentence:	Er ist weiss.	He is white. (notice: both are white!)
Exp 2 (distracted puppet):	Oh, wie bitte?	Pardon?
	Ich hab nicht verstanden.	I did not get it.
Child: PRODUCTION	Er ist weiss.	He is white.
Exp 2:	Wer ist weiss?	Who is white?
Child: COMPREHENS.	Der Bär.	The bear.

The correlation of the antecedent properties in/animacy and syntactic role, i.e., subject/object, in the application of zero, personal, and demonstrative pronouns results in a 2x2x3 category setting. The 2x2 correlation of the antecedent properties required four types of antecedent sentences (table 1).

Table 1. Types of antecedent sentences

	antecedent features	**example**	
A	+anim sbj : +anim obj	der affe umarmt den hund	'the monkey is hugging the dog'
B	–anim sbj : +anim obj	der ball berührt den bären	'the ball is touching the bear'
C	–anim sbj : –anim obj	der traktor schiebt den bus	'the tractor is pushing the bus'
D	+anim sbj : –anim obj	der elefant fährt den traktor	'the elephant is driving the tractor'

Each of these four sentence types occurred in combination with all three types of pronouns (table 2).

Table 2. Types of anaphoric sentences

pronoun type	**example**		**example**	
zero	ist weiss	'is white'	lacht laut	'is loughing loud'
personal	er ist weiss	'he is white'	er lacht laut	'he is loughing loud'
demonstrative	der ist weiss	'this is white'	der lacht laut	'this is loughing loud'

Two sets (cohorts) of 12 test items were constructed, one half of the children of each age group were tested with the one and the other half with the other set. The children are grouped into 6 age groups covering the age of 2;0 to 6;0.

Table 3. Age groups and number of subjects in the production task

age group	2;6 - 2;11	3;0 - 3;5	3;6 - 3;11	4;0 - 4;5	4;6 - 4;11	5;6 - 5;11	adults
number of tested subjects	27	25	25	21	22	25	38
number of analysed subjects	16	18	20	20	19	21	32

Excluded from the analyses of pronoun production are all subjects showing the following types of behaviour in more than 80% of the repetitions, i.e., in 11 or 12 stimuli:

(a) giving no answer,
(b) producing one and the same pronoun type,
(c) producing a complete noun phrase instead of a pronoun (e.g. *der bär ist blau* 'the bear is blue'),
(d) the combination of (a) + (b) or of (a) + (c),
(e) giving other types of answers.[2]

Table 4. Age groups and number of subjects in the comprehension task

age group	2;6 - 2;11	3;0 - 3;5	3;6 - 3;11	4;0 - 4;5	4;6 - 4;11	5;6 - 5;11	adults
number of tested subjects	27	24	25	21	22	25	38
number of analysed subjects	22	21	20	19	18	18	28

Excluded from the analyses of pronoun comprehension are all subjects who:

(a) showed a subject or object bias,
(b) a bias to answer that the situation is true for both participants,
(c) gave less than 4 subject/object answers on the *who*-question.[3]

[2] **Table 3a**. Numbers of excluded subjects per age and criterion (production task)

	2;6	3;0	3;6	4;0	4;6	5;6	adults
a)	2	1					
b)	8x zero	5x zero	3x zero 1x personal 1x demonstr.		1x zero 2x personal	1x personal	
c)						2	5
d)				1			1
e)	1					1	

[3] **Table 4a**. Numbers of excluded subjects per age and criterion (comprehension task)

	2;6	3;0	3;6	4;0	4;6	5;6	adults
a)	4x SBJ	1x OBJ	1x SBJ 2x OBJ	2x SBJ	4x SBJ	6x SBJ 1x OBJ	4x SBJ 4x OBJ
b)	1	1					1
c)		1	2				1

As emphasized above, the main goal of this paper lies in detecting developmental steps and relevant tendencies in the correlation of syntactic role and animacy with anaphoric use of the three pronoun types. Because of the complexity of the involved parameters and the fact that development does not exclusively proceed in statistically significant steps, we concentrate here on observable tendencies and lines of development over the investigated age groups. All analyses are based on calculation of percentages.

3 Results of the production experiment

3.1 General repetition scores

The most intriguing results in pronoun production are expected from deviations of the presented and the repeated pronoun. Such deviations are numerous in the younger children, they decrease in the older ones, and adults, finally, only exceptionally deviate from the presented pronoun. Therefore, before analysing the missmatching repetitions (section 3.3), the general repetition scores (section 3.1) and the general distribution of the repeated pronouns over the four sentence types (section 3.2) shall be highlighted.

Taking all repetitions as 100%, correct repetition of all anaphoric sentences would result at 33,3% for each of the three pronoun types. However, besides pronominal deviation from the presented pattern, children produced DPs like *der bär* ‘the bear’, *der ball* ‘the ball’. Bare nouns did not occur. Sometimes children gave no answer or produced something different. In figure 1, all productions of the required pronouns and of DPs are calculated as 100%. All other types of productions are excluded from the analysis.

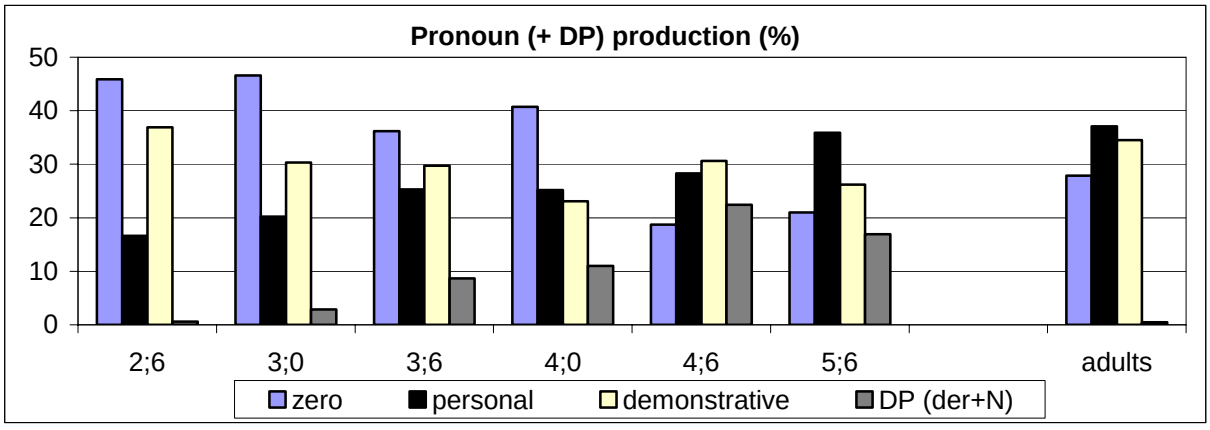


Figure 1. Production of pronoun types and DPs in the repetition task

Up to age 4;0, children produce more zero than personal and demonstrative pronouns, that means they tend to omit the subject pronoun in the repetition of the anaphoric sentence.

(5)	Exp.:	der elefant fährt den traktor	the elephant is driving the traktor
		er ist blau	he/it is blue
	EXP 2:	wie bitte? was war los?	pardon? what happened?
	CHI:	(ist) blau[4]	(is) blue

The youngest children (age 2;6) prefer to produce zero and demonstrative pronouns over personal pronouns. In contrast, the oldest children (age 5;6) preferably produce the personal pronoun. In that, they behave similar to the adults who show a tendency to replace zero by personal pronouns although they, in general, only minimally deviate from the presented pattern.

An unexpected or at least unwanted feature is the production of DPs which increases with age. The structure of the experiment, i.e., the immediately following comprehension part induced by the *who*-question, caused the anticipation of this question and led the children to insert the answer to the *who*-question in the production task producing for instance *der bär ist weiss* 'the bear is white' instead of *∅/der/er ist weiss* '∅/he/this is white' or *der schal ist lang* 'the scarf is long' instead of *∅/er/der ist lang* '∅/it/this is long'.

3.2 Pronoun repetition in relation to sentence types

The influence of syntactic role and in/animacy on pronoun production will be evaluated first by comparing the distribution of each pronoun type over the four sentence types (see table 1). Starting with the zero pronoun, figures 2, 3, and 4 present the results for each pronoun type.

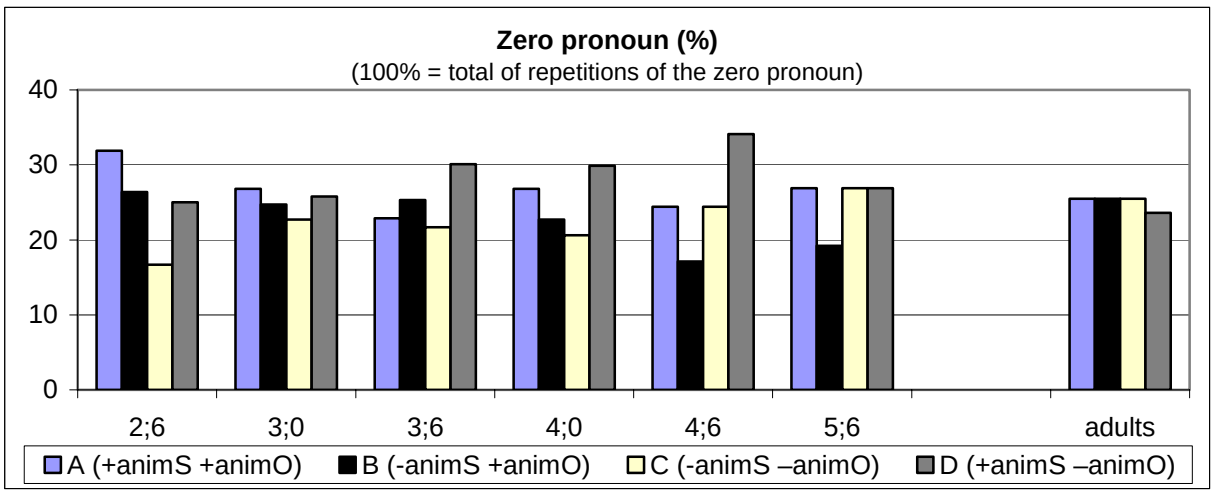


Figure 2. Distribution of the zero pronoun over sentence types per age group

At a first glance, no sentence type seems to especially attract the zero pronoun. However, there is a clear contrast between children's and adults' behaviour.

[4] Sometimes also the copula was omitted, especially by the younger children.

Adults show a well-balanced distribution. In comparison, children show preference and even avoidance tendencies which change with age. From age 2;6 to 4;6, preference tendencies change from sentence type A to D. Only the 5;6-year-olds do not show any preference tendency. Tendencies to avoid the zero pronoun change from sentence type C to B between age 2;6 and 5;6. Table 5 extracts the maximal contrasts in distribution of the zero pronoun and presents the included feature oppositions. Further, it allows to infer developmental steps in the production of the zero pronoun.

Table 5. Oppositions and developmental steps in the production of the zero pronoun

most frequent in:	A		D			∅	
	2;6	3;0	3;6	4;0	4;6	5;6	adults
least frequent in:	C				B		∅
opposition of: (antecedent properties)	A vs. C animate vs inanimate		D vs. C animate S vs. inanimate		D vs. B animate S vs. inanimate S	avoid. in B no prefer. but avoidance with inanimate S	∅
developmental steps:	**step 1**		**step 2**		**step 3**	**step 4**	**target stage**

The zero pronoun tends to be related first to the in/animacy opposition and later on to the combination of in/animacy and syntactic role.

In step 1, animacy is the only decisive distribution cue: Zero pronoun tends to be preferred when (one of) the potential antecedents is/are animate and tends to be avoided (low frequent) when (one of) the potential antecedents is/are inanimate. In step 2, syntactic role becomes relevant in preferred use by focusing on animate subjects in the presence of inanimate objects (D). Relevance of syntactic role increases further in step 3: In addition to the preference for animate subjects, zero pronouns tend to be avoided with inanimate subjects in the presence of animate objects (B). Step 4, performed by the oldest age group, exhibits the disappearance of any preference. However, there is a tendency to avoid zero pronouns in the condition ‘inanimate subject – animate object’ (B).

In the production of personal pronouns, again, adults do not exhibit different frequencies in the four sentence types, whereas children do.

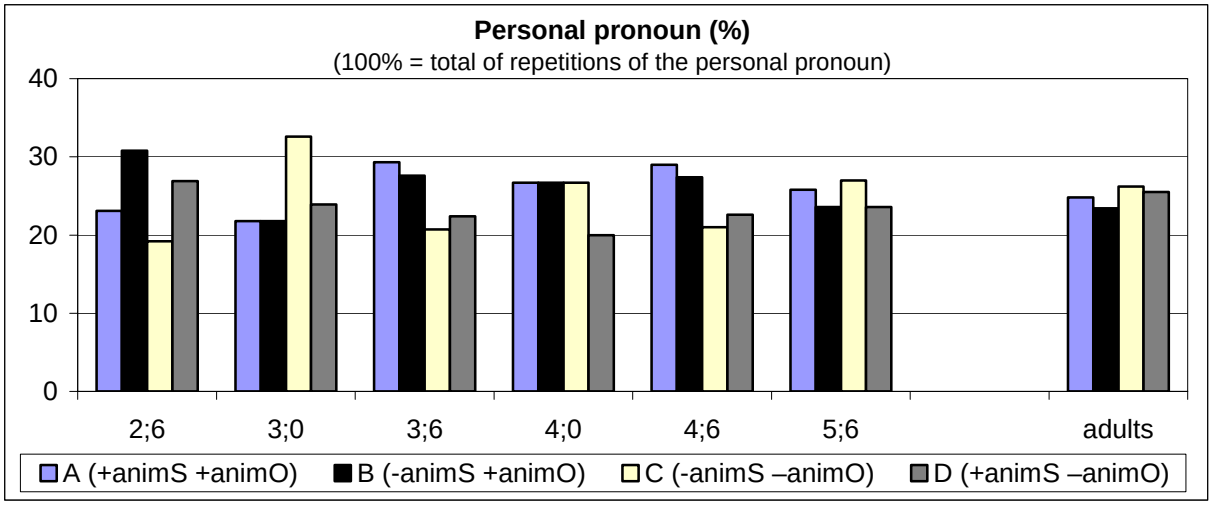


Figure 3. Distribution of the personal pronoun over sentence types per age group

However, even with the children the differences in the distribution over sentence types are comparably small. Only weak oppositions and developmental changes can be stated.

Table 6. Oppositions and developmental steps in the production of the personal pronoun

most frequent in:	B	C	A/(B)	∅	A/(B)	∅	
	2;6	3;0	3;6	4;0	4;6	5;6	adults
least frequent in:	C	A/B	C/(D)	D	C/(D)	∅	
opposition of: (antecedent properties)	unclear (reversed pattern)		A/B vs. C/D animate (O) vs. inanimate (O)			∅	
developmental steps:	**step 1**		**step 2**			**target stage**	

The two youngest age groups produce only a small number of personal pronouns (see figure 1). Avoidance of the personal pronoun is the most pronounced tendency in step 1. In step 2, production tends to correlate with animacy and syntactic role. It is slightly preferred when the potential antecedent is animate, especially when the object referent is animate (A/B). In contrast, the personal pronoun tends to be avoided when the potential antecedent is inanimate, especially when the object referent is inanimate (C/D). In the oldest age group, preference and avoidance tendencies have disappeared and children display adult behaviour.

In the distribution of the demonstrative pronoun, again, adults do not show any tendency of preference or avoidance whereas children do.

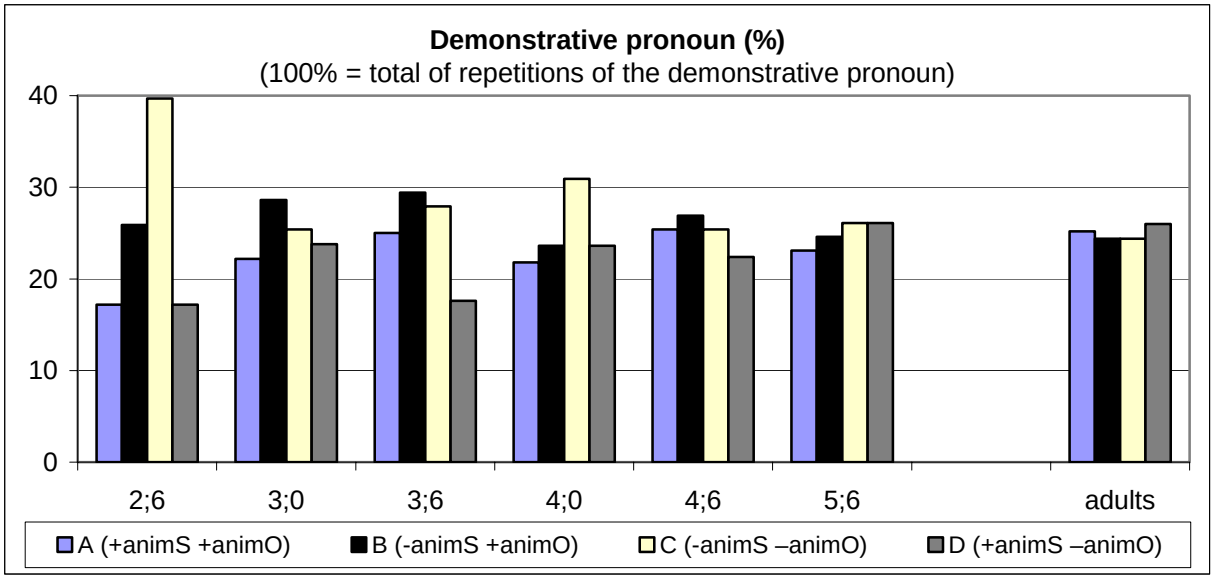


Figure 4. Distribution of the demonstrative pronoun over sentence types per age group

The youngest age group shows an exceptionally high preference to produce the demonstrative pronoun in sentence type C, i.e., when both antecedents are inanimate. Up to age 3;6, the demonstrative pronoun is more frequent in sentence types B and C than in sentence types A and D, i.e., when the subject antecedent is inanimate. Later on, this opposition becomes weaker. However, up to age 4;6, frequency remains most high either in B or in C.

Table 7. Oppositions and developmental steps in the production of the demonstrative pronoun

most frequent in:	C	B		C	B	∅ ~	
	2;6	3;0	3;6	4;0	4;6	5;6	adults
least frequent in:	A/D	A	D	A	D	∅ ~	
opposition of: (antecedent properties)	C vs. A/D inanimate vs. animate (S)	B/C vs. A/D inanimate (S) vs. animate (S)				∅	
developmental steps:	**step 1**	**step 2**				**target stage**	

As it was the case with the zero pronoun, production of the demonstrative pronoun tends to be based on the animacy feature in the youngest children. However, it is the opposite distribution. Production tends to be preferred when the potential antecedents are inanimate and to be avoided when they are animate. Further, syntactic role appears to be relevant earlier than with the zero pronoun. In step 1, production of the demonstrative pronoun is most frequent when the potential antecedents are both inanimate, but it is least frequent when the poten-

tial antecedent, and especially the subject, is animate. In step 2, syntactic role becomes relevant also for preferred production: the demonstrative pronoun is most frequent when the potential antecedent, and especially the subject, is inanimate. At age 5;6 – but starting already at age 4;6 – sentence type oppositions have disappeared and children behave similarly to adults.

In the next section, the observed tendencies will be further elaborated by an analysis of the incorrectly repeated pronouns and their distribution over sentence types.

3.3 Incorrect pronoun repetition

Figure 5 presents the total amount of incorrectly repeated pronouns, as well as the rate of incorrect zero, personal and demonstrative pronouns.

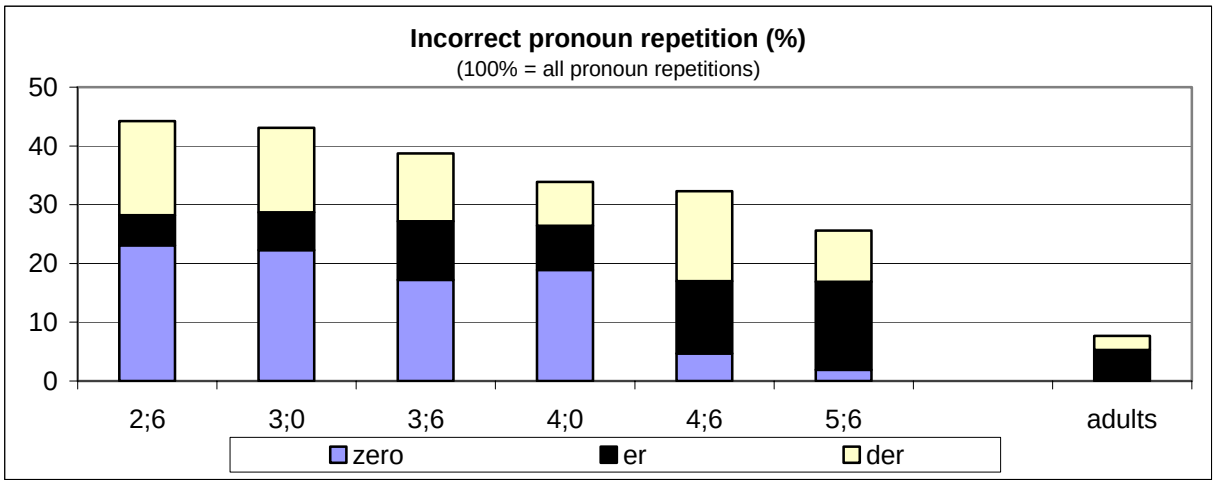


Figure 5. Incorrect repetitions of the zero, personal, and demonstrative pronoun per age group

Incorrect repetitions are most frequent with the youngest children (69 out of 156 repetitions) and decrease over time. The 5;6-year-olds produce significantly fewer incorrect repetitions than the 2;6-year-olds. However, even with the 5;6-year-olds one third of all repetitions are incorrect (53 of 206). In opposition, adults only exceptionally replace the presented pronoun (29 of 378).

The zero pronoun is the most frequent type among incorrect repetitions up to age 4;0. In the beginning (age 2;6 and 3;0), demonstrative pronouns are more frequently incorrect than personal pronouns. From age 3;6 to age 4;6, the portion of these two types is balanced. With the oldest age group and the adults, incorrect personal pronouns become more frequent than incorrect demonstrative pronouns. It is worth noting that the seemingly low frequency of incorrect personal pronouns in the younger children is related to its infrequent use in general. Figure 6 presents the rate of incorrect repetitions for each pronoun type.

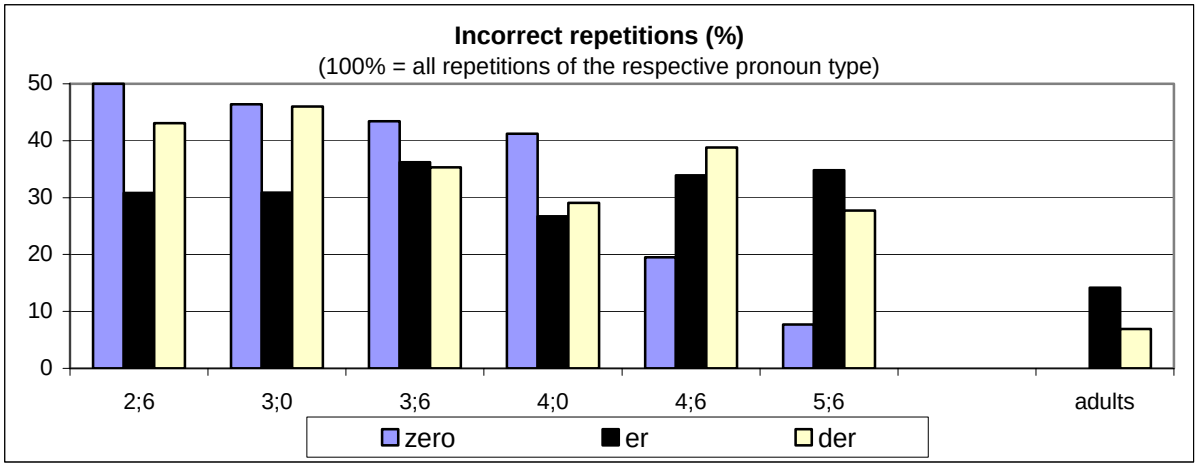


Figure 6. Incorrect repetitions in relation to the total of repetitions of each pronoun

Incorrect productions of the ungrammatical zero pronoun decrease drastically after age 4;0. The portion of incorrect personal pronouns, in contrast, remains stable and that of demonstrative pronouns decreases slightly. Figure 5 and 6 suggest that the patterns of incorrect repetitions are similar within age group 2;6 and 3;0 and within age group 3;6 and 4;0. Since this has been confirmed by separate analyses of each group, we will put these groups together in the following analyses.

Figures 7 to 9 present the distribution of incorrect repetitions over sentence types for each age group separately. It is worth noting that the calculation for age group 4;6 is based on a low amount of data (55 incorrect repetitions spread over 12 conditions).

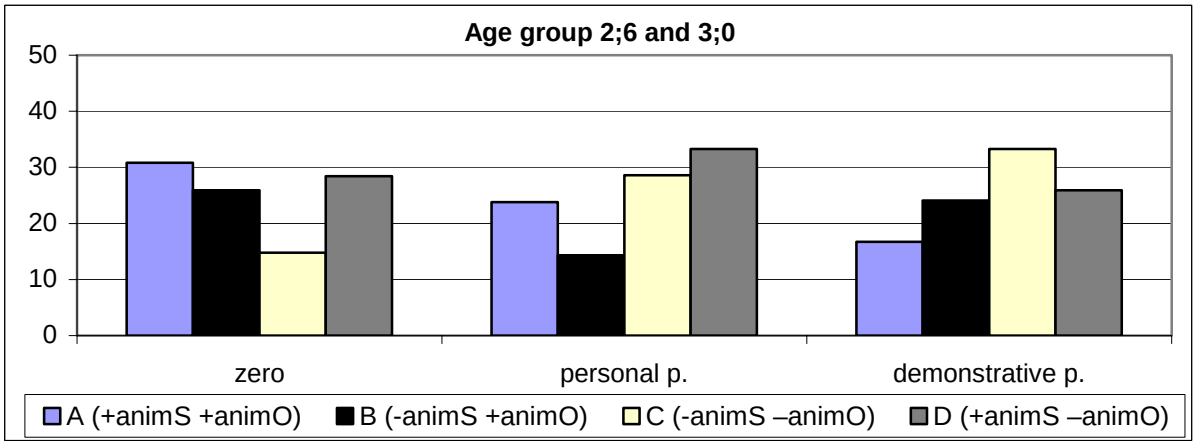


Figure 7. Distribution of incorrect repetitions of zero, personal, and demonstrative pronouns over sentence types at age 2;6-3;0

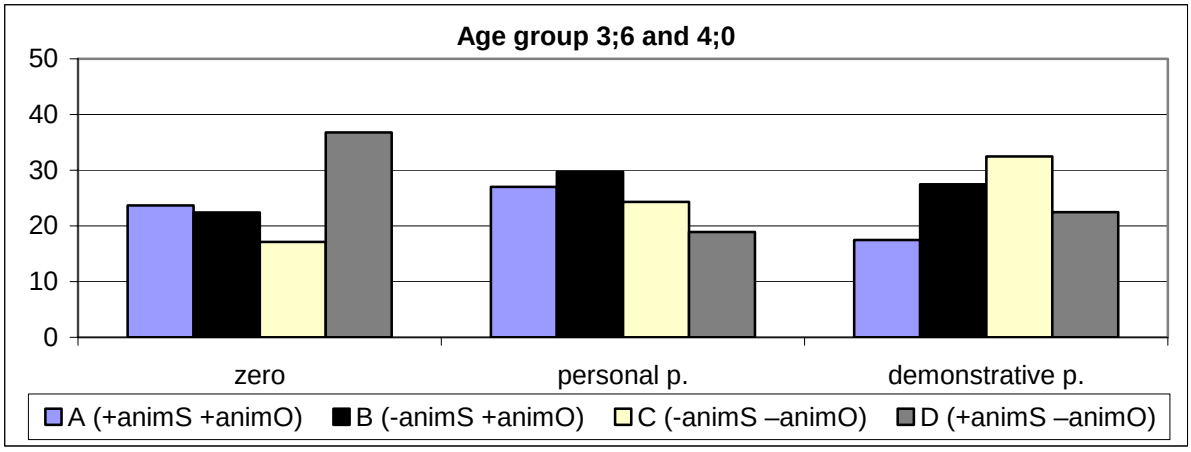


Figure 8. Distribution of incorrect repetitions of zero, personal, and demonstrative pronouns over sentence types at age 3;6-4;0

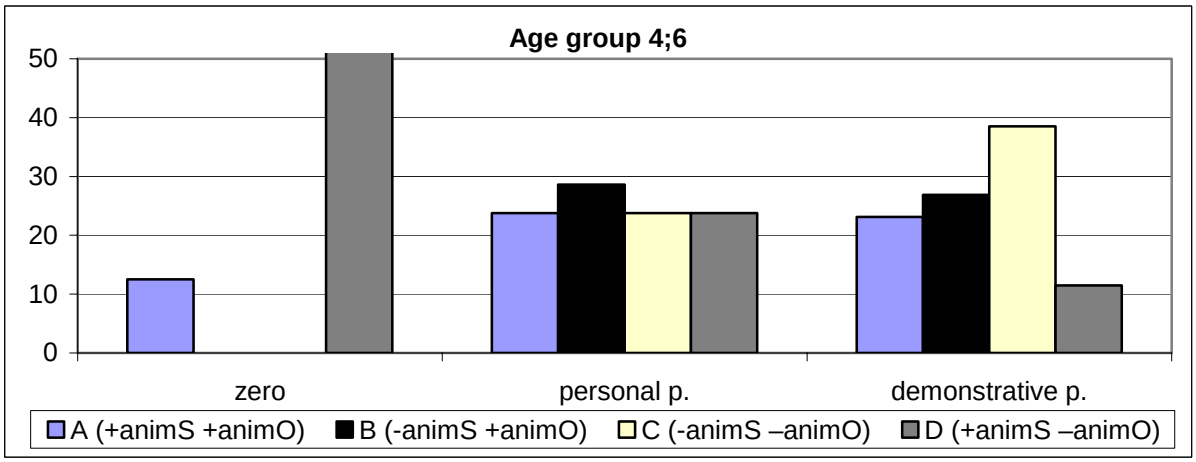


Figure 9. Distribution of incorrect repetitions of zero, personal, and demonstrative pronouns over sentence types at age 4;6

Table 8 summarizes the emerging tendencies and their development over age.

Table 8. Frequency of incorrect repetitions over age groups and sentence types

	zero		personal		demonstrative	
	most frequent	**least** frequent	**most** frequent	**least** frequent	**most** frequent	**least** frequent
2;6-3;0	A		D	B		A
3;6-4;0	D	C	B	D	C	
4;6		+B	(B)	∅		D

Incorrect zero and demonstrative pronouns are used in direct opposition. With the youngest children, their distribution tends to be exclusively based on the animacy cue (A vs. C and vice versa). At age 3;6-4;0, animacy becomes correlated with subject role in the preferred production of the zero pronoun (D in the second row). And vice versa, at age 4;6, animacy becomes correlated with sub-

ject role in the avoidance of the demonstrative pronoun (D in the last row). Exclusive correlation of incorrect pronoun production with animacy (A vs. C) lasts longer with the demonstrative than with the zero pronoun.

In direct opposition, incorrect production of the personal pronoun seems to be related to syntactic role from age 3;6 on.[5] There is no indication of a mere animacy contrast in any of the age groups whereas such tendency occurred in the analysis of the total of personal pronoun productions (cf. A vs. C at age 3;6 and 4;6 in table 6). At age 3;6-4;0, in/animacy and object role appear to be decisive. Incorrect personal pronouns tend to be preferably produced when an animate object occurs in the presence of an inanimate subject (B) and avoided when an inanimate object occurs in the presence of an animate subject (D). The relevance of the in/animacy opposition is underlined by the closer similarities of the frequencies in A and B (animate objects) vs. in C and D (inanimate objects) (cf. figure 8). The opposition is not long-lasting, it nearly disappeared at age 4;6.

Finally, in order to track down a possibly new step in development, the distribution of incorrect productions of the 5;6-year-olds (figure 10) and the adults (figure 11) shall be presented, although the number of incorrect repetitions is low (especially with the adults). Note that the zero pronoun values at age 5;6 result from a total of four and the demonstrative pronoun values in the adult group from a total of nine incorrect productions.

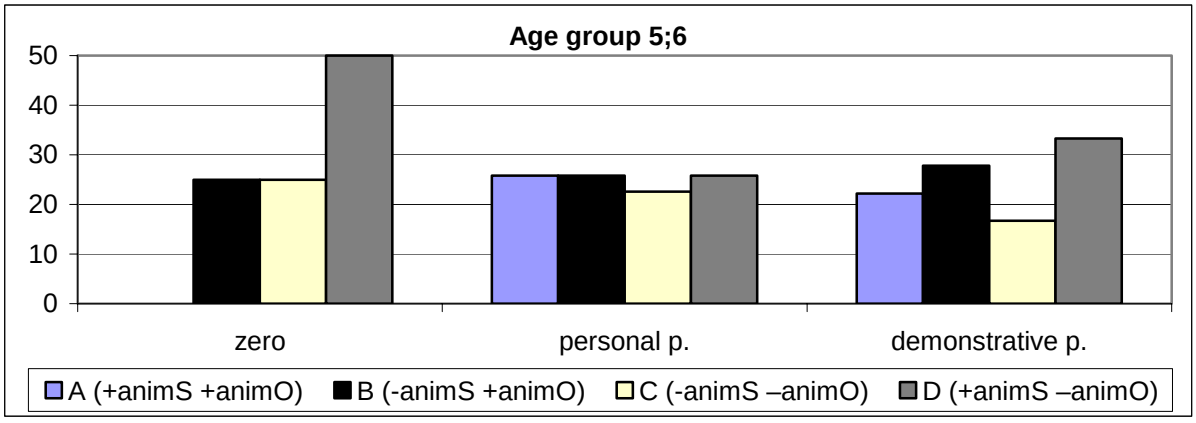


Figure 10. Distribution of incorrect repetitions of zero, personal, and demonstrative pronouns over sentence types at age 5;6

[5] Due to the late onset of productive use of the personal pronoun, incorrect personal pronouns are infrequent at age 2;6-3;0. Thus, the opposition in question in table 8 is not completely reliable.

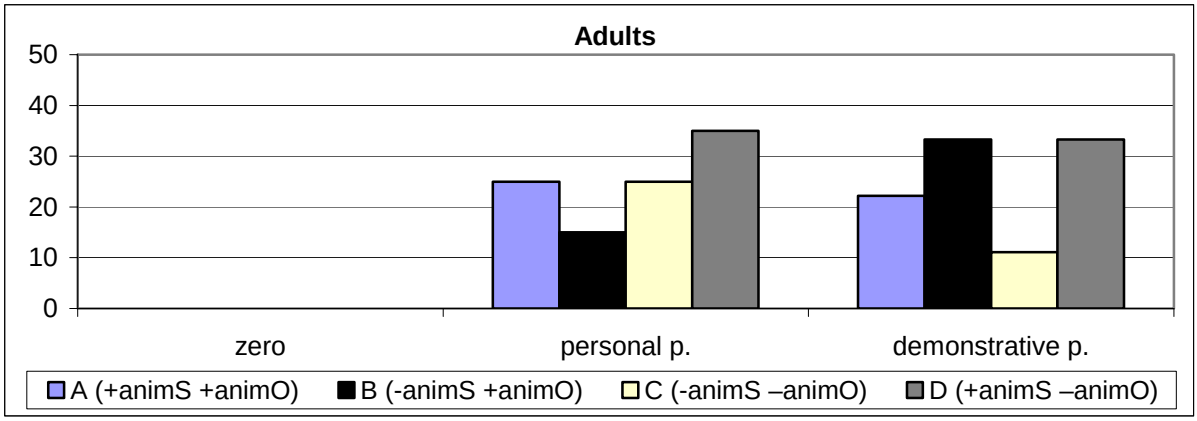


Figure 11. Distribution of incorrect repetitions of zero, personal, and demonstrative pronouns over sentence types in the adult group

The two figures reveal that incorrect productions tend to show a completely different distribution than up to age 4;6. The zero pronoun (nearly) disappeared from incorrect production; personal pronouns constitute the absolute majority (cf. figure 5). The point to hint at is that in both groups sentence type D, which represents the canonical sentence structure (animate subject – inanimate object), attracts the most incorrect productions with all pronoun types; i.e., even with demonstrative pronouns. This might indicate, that both antecedents the animate subject and the inanimate object are good topic candidates for the continuation of the story.

4 Discussion of the results on pronoun production

The analysis of the general repetition scores of the presented pronouns (section 3.1) revealed changes in the general preference ranking of the three pronoun types. The main change takes place between the zero pronoun, which is most preferred up to age 4;0 but infrequent afterwards, and the personal pronoun which is infrequent up to age 3;6 but most frequent at age 5;6 and with the adults (cf. figure 1). These changes can be used to identify three stages in the production preferences of zero, personal, and demonstrative pronouns:

Table 9. Preferences in the production of zero, personal, and demonstrative pronouns

stage	**age range**	**preference hierarchy**				
stage 1	2;6 – 3;0	zero	>	demonstrative	>	personal pronoun
stage 2	3;6 - 4;0	zero	>	demonstrative/personal pronoun		
stage 3	4;6 – 5;6	personal	>	demonstrative	>	zero pronoun

The initial preference for the zero pronoun is to be interpreted as subject drop, which is a well-known phenomenon in spontaneous productions up to about age 2;6 in German. Overt subjects become regularly produced when children gain

command of finite verb forms (e.g., Weissenborn 1990, 1992). The extension of zero pronoun production up to age 4;0 in the experiment is presumably caused by two facts: a) that this ungrammatical structure is offered by the experimenter and b) that all involved participants, the experimenter, the puppet, and the child, share attention of the situations and their protagonists supporting elliptic structures, especially when the child is uncertain whether the presented pronoun type is appropriate or not. The personal pronoun is more affected by subject drop than the demonstrative pronoun before age 4;0. The data allow for the hypothesis that the personal pronoun is not a fully productive anaphor up to age 3;11. It has to be checked at which age and in which contexts the personal pronoun becomes productive in spontaneous productions.

Considering the three pronoun types presented in the experiment, children tend to oppose subject omission (zero pronoun) and demonstrative pronoun and to ignore the personal pronoun in stage 1. Stage 2 seems to cover a phase of reorganisation of pronoun use, presumably caused by the increasing use of the personal pronoun and the necessity to reorganise the oppositions between the single pronoun types. Stage 3 presents the target stage, with the personal pronoun as most frequent (and presumably least restricted), the demonstrative pronoun as less frequent (and presumably more restricted), and the ungrammatical zero pronoun as least frequent (i.e., avoided).

The developmental steps in pronoun use are remarkable in that the pronoun type which is most unspecified in its anaphoric use in adult language, the personal pronoun, becomes productive after the pronoun type which is more restricted in adult language, the demonstrative pronoun (Bosch & Umbach this volume). This is the opposite order as found in a range of other acquisition domains where it is the less restricted or default form of the adult language which becomes productive prior to more restricted forms in child language (e.g., the infinitive of the verb, the nominative of the noun, the indefinite in opposition to the definite article). A first hypothesis on how this could be explained is that the demonstrative pronoun is more general and thus more available to the child than the personal pronoun due to the syncretism of deictic and anaphoric features in this form and the importance of deictic reference in early child language. As mentioned above, the conducted experiment includes shared attention of situations and protagonists among all participants; very likely, this constellation additionally contributes to an initial preference for demonstrative (i.e., verbal pointing) over personal pronouns.

The analyses of all pronoun productions (section 3.2) and of the incorrect productions (section 3.3) revealed that the distribution of the three pronoun types over the four sentence types is not arbitrary, but shows relevant tendencies with respect to the antecedent properties in/animacy and syntactic role. In the case of the zero pronoun, the results on the distribution of incorrect productions

equal the findings on all zero pronoun productions: up to age 3;0, zero pronoun production exclusively correlates with animacy, afterwards subject role becomes a further cue resulting in a preference for sentences with animate subjects. With the demonstrative pronoun, incorrect productions exhibit a pronounced tendency to correlate with inanimacy up to age 4;0, whereas the analysis of all demonstrative pronoun productions suggests an early correlation with both inanimacy and subject role. When the personal pronoun becomes regularly produced (age 3;6), it correlates with both animacy and object role in both types of analyses, however, animacy appears as a slightly stronger cue considering all productions.

In the youngest age group, demonstrative pronouns are the most frequent incorrect type in sentence type C, although zero pronouns are generally most preferred at this age and prevail in incorrect production in all of the other sentence types. Both preference (demonstrative pronouns) and avoidance (zero pronoun) in C is stronger and lasts longer with incorrect repetitions than regarding all pronoun repetitions.

Altogether, these results lead to the assumption that, at the onset of pronoun production, animacy is a more decisive cue than is grammatical role. By generalizing the findings of the last sections, three stages of pronoun production in dependence of antecedent in/animacy and syntactic role come into view:

Table 10. Developmental stages in the correlation of pronoun production with the antecedent properties in/animacy and syntactic role

stage 1	2;6 - 3;0	**ZERO PRONOUN** +animate ⟷ **DEMONSTRATIVE PRONOUN** –animate
stage 2	3;6 – 4;6	+animate S ⟷ –animate S +animate O **PERSONAL PRONOUN**
stage 3	5;6	adult-like behaviour: no preferences elicited by the experiment

These developmental stages roughly correspond with the three stages inferred from the general pronoun type preference (cf. table 9). Moreover, they provide evidence for the *hypothesis on developmental steps* (section 1, (3)): Children up to about age 3;0 exhibit a bipolar opposition in anaphoric pronoun use. The demonstrative pronoun is opposed to pronoun omission (zero pronoun). In difference to the hypothesis, the personal pronoun is not unified with one of the other two types, but is simply less frequent in production. In accordance with the hypothesis, the opposition of pronoun omission and demonstrative pronoun is simply based on the animacy feature, i.e., on only one of the two investigated ante-

cedent features: pronoun omission is preferred when the antecedent(s) is/are animate and the demonstrative pronoun is preferred when the antecedent(s) is/are inanimate (A vs. C). Further, as it was assumed, the system of pronominal anaphora becomes more complex in stage 2 in both respects the number of opposed pronoun types and the features involved in the determination of their anaphoric capacity. Very likely, productive use of the third pronoun type, the personal pronoun, leads to a specification of the features opposing the anaphoric capacities. In stage 2, syntactic role is used in addition to in/animacy. The opposition of pronoun omission and demonstrative pronoun becomes specified as animate subject vs. inanimate subject. The personal pronoun is set in opposition to the other two pronoun types: a syntactic role opposition with the zero pronoun, (animate) subject vs. (animate) object related, and a more complex or stronger opposition of animate object vs. inanimate subject with the demonstrative pronoun.

According to the reversed-mapping hypothesis (section 1), the anaphoric preferences of the three pronoun types reveal the relation of antecedent features to antecedent salience. The formally least complex zero pronoun correlates with animate subjects, whereas the more complex personal pronoun correlates with object role and the even more complex demonstrative pronoun with inanimacy. The results provide evidence for positive answers to the questions on the salience hierarchy of these features (see (2) in section 1): animacy > inanimacy and subject > object. Further, there is an interaction of both features with respect to salience hierarchy: animate subjects > animate objects > inanimate subjects > inanimate objects.

The 5;6-year-olds and the adults did not show relevant differences in the repetition of the three pronoun types. Because of the low amount of incorrect repetitions especially with the adults, it is impossible to decide whether the 5-year-olds utilize the same oppositions in the anaphoric capacities of the three pronoun types as the adults do. Nevertheless, the distribution of incorrect repetitions deviates from that of the younger children. Recall that sentence type D attracts the most incorrect repetitions with all three pronoun types. As has been concluded above, the features [+animate] and [+subject] accumulate to the highest antecedent salience in the given experiment. In sentence type D, the salience of the animate subject is strengthened to a maximum by the fact that the object exhibits the opposite and, thus, least salient feature combination. Hypothetically, the 5;6-year-olds and the adults oppose the pronominal types in order to continue either the subject (zero and personal pronoun) or the object (demonstrative pronoun) antecedent, i.e., to continue the discourse topic or to change it (Bosch & Umbach this volume). In line with this assumption, it can be assumed that these groups prefer to continue the topic (subject) in sentence type C (very low amount of demonstrative pronouns) and to change the topic to the object antece-

dent in sentence type B (high amount of demonstrative pronouns despite overall preference for personal pronouns), cf. figures 10 and 11, but recall the low amount of incorrect repetitions. We will see whether these hypothetic correlations are confirmed by the results of the comprehension task.

5 Results on pronoun comprehension

5.1 General remarks

Recall that pronoun comprehension was tested by asking the children a clarification question after the repetition task. The situation presented in the antecedent sentence is ambiguous with respect to pronoun reference (*der affe umarmt den hund* 'the monkey is hugging the dog' – *er lacht laut* 'he is loughing loudly'). The clarification question (*who*-question) aims at identifying the referent of the pronoun in the child's representation of the situation. Each antecedent sentence provides one subject and one object antecedent in SVO order. The subject antecedent is at the same time the first and the object antecedent the last mentioned antecedent. The results of the experiment show that children do not use a simple position cue, neither in production nor in comprehension. However, correlations with other features can not be excluded. In a follow-up experiment (not analysed yet) word order is varied in order to investigate this factor. In the following, we will speak of subject vs. object choice having in mind that this, for the time being, is synonymous with first vs. last mention.

Section 5.2 presents an overall analysis of antecedent choice irrespective of correlations with pronoun type or antecedent features. Antecedent choice in relation to the pronoun type produced in the repetition task is analysed in section 5.3. Section 5.4 considers relations of antecedent choice and sentence type (i.e., antecedent features). Finally, potential correlations of all three components antecedent choice, sentence type, and pronoun type are examined in section 5.5.

5.2 Overall analysis of antecedent choice

Figure 12 presents the total rate of subject-object choice in each age group.

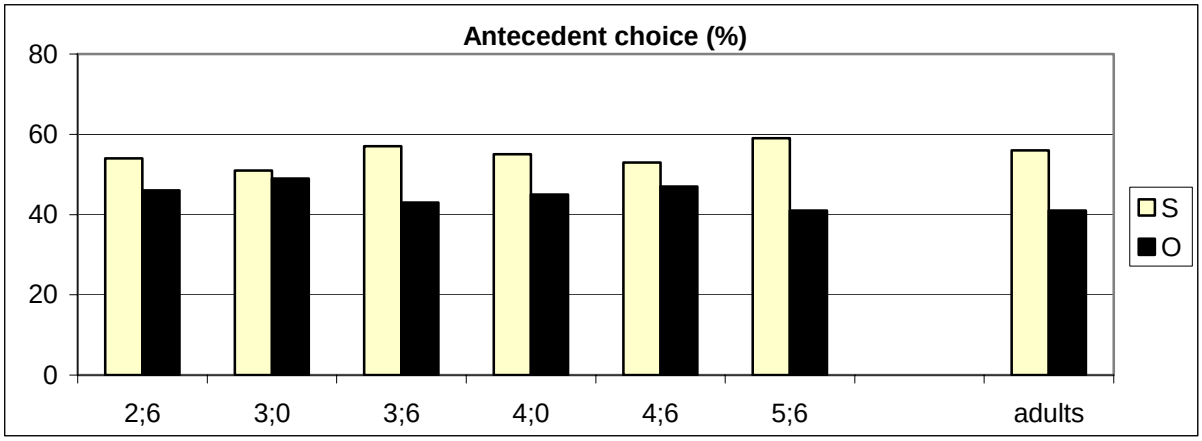


Figure 12. Total rate of subject-object choice per age group

There is no overall tendency to prefer the subject over the object antecedent. Even at age 5;6 and with the adults, the tendency to chose the subject antecedent remains at chance level.

5.3 Antecedent choice in relation to the produced pronoun[6]

According to the *hypothesis on anaphoric capacities* (section 1, (1)), the different pronoun types should indicate differences in anaphoric reference, i.e., in the internal representation of the pronoun referent. Figures 13 to 15 present antecedent choice in relation to the pronoun type produced in the repetition task.

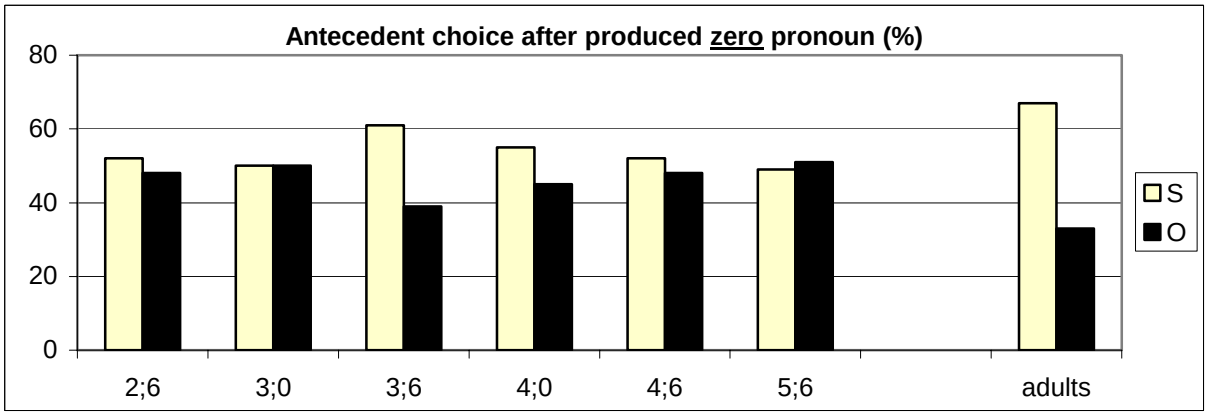


Figure 13. Subject-object choice in relation to zero pronoun per age group

[6] Note that there is a difference in the data-base for the calculation of the overall antecedent choice based on all answers to the clarification question (section 5.2) and the antecedent choice in relation to the produced pronoun based on only those answers that follow the production of one of the three pronoun types (section 5.3). Therefore, the bars in figure 12 do not present the average value of the correspondent bars in figures 13 to 15.

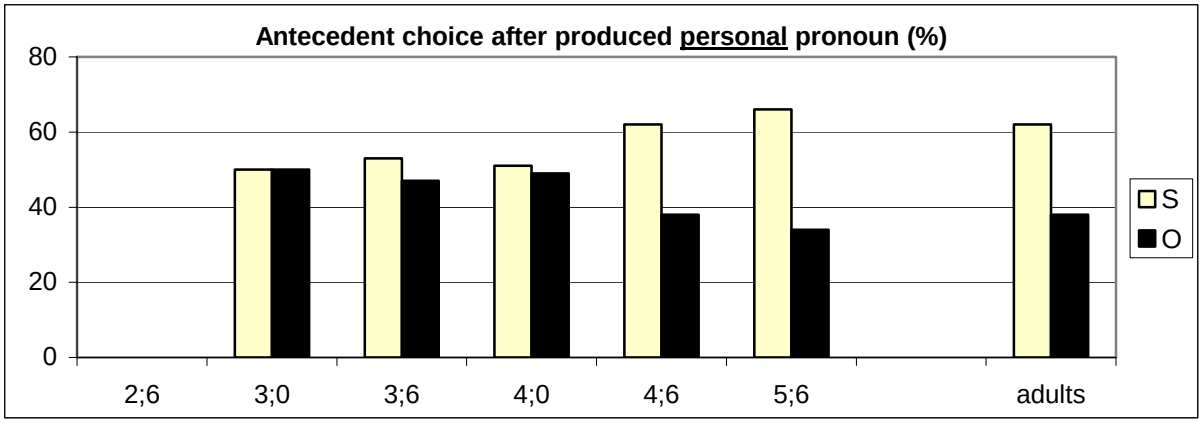


Figure 14. Subject-object choice in relation to personal pronoun per age group[7]

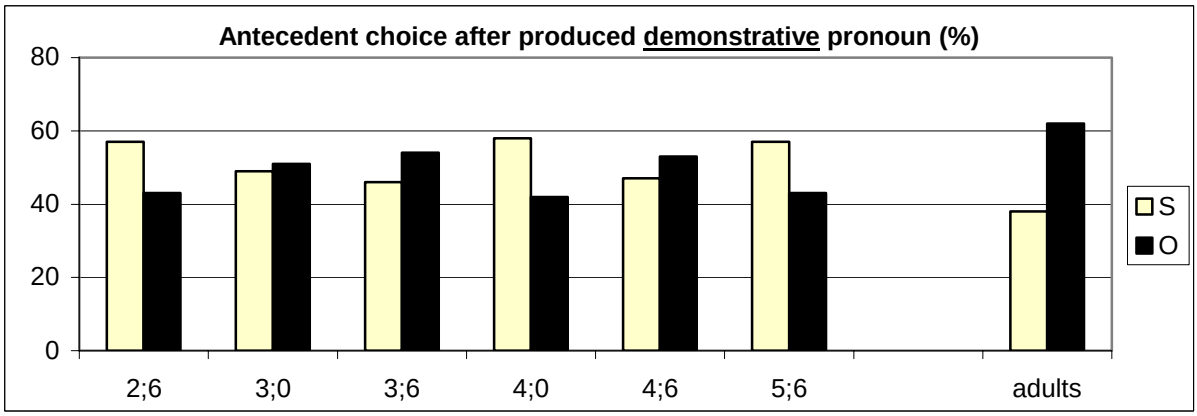


Figure 15. Subject-object choice in relation to demonstrative pronoun per age group

Whereas the adults show an opposition of subject choice with zero and personal pronoun vs. object choice with demonstrative pronoun, no such opposition occurs in the children's data. Moreover, no overall tendency to prefer the object with either pronoun type is observed in the children. Up to age 4;0, performance is at chance level with all three pronoun types. With the older children (age 4;6 and 5;6), a tendency to prefer the subject antecedent occurs when the personal pronoun has been produced. Only in case of this pronoun, the older children perform in accordance with the adults. In case of the demonstrative pronoun, rather they tend to do the opposite, i.e., prefer the subject over the object antecedent. Even with the zero pronoun, children do not show adult-like behaviour but perform at chance level in all investigated age groups (except, for age 3;6; however, there is no developmental continuity with neighbouring age groups).

The expectation of an overall dependence of antecedent choice (comprehension task) on pronoun choice (production task) is confirmed for the adults but not for the children. In the next section, we will examine whether antecedent

[7] There is no calculation of personal pronouns for the youngest age group (2;6) because of the low amount of data for this form.

choice is (more) constrained by the antecedent features syntactic role and in/animacy.

5.4 Antecedent choice in relation to sentence type

Figure 16 demonstrates that there are indeed differences in antecedent choice across the four sentence categories. In the following we will primarily focus on subject choice. Object choice is inherently included in that the opposite of what is said on subject choice is true for object choice. Note that object choice can be inferred from figure 16 by the difference of each bar to 100%.

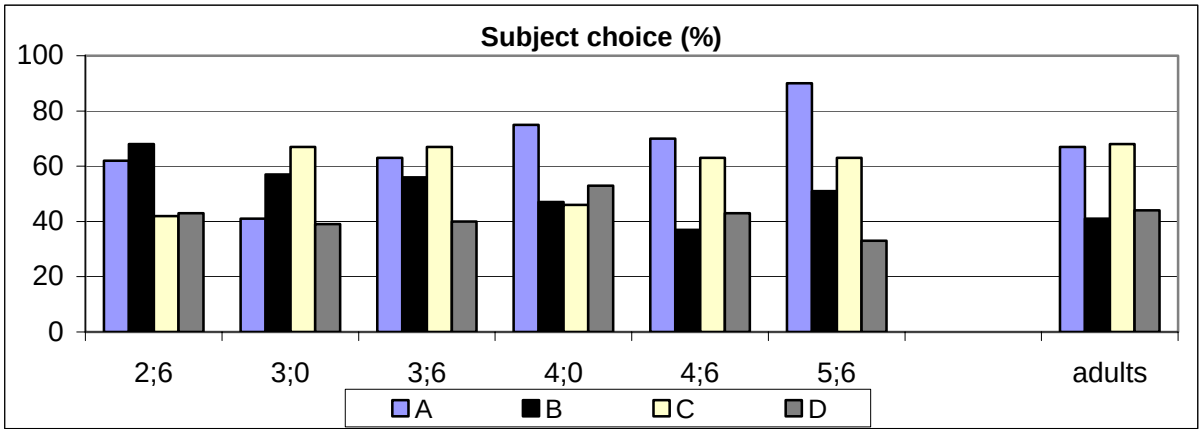


Figure 16. Subject choice per sentence type and age group

Comparing the youngest children with the adults and the oldest children, there appears a complete change in the preferences for subject choice. The youngest children tend to prefer the subject antecedent if the antecedent sentence contains an animate object (A/B), but they tend to prefer the object antecedent if there is an inanimate object (C/D). In other words, animate objects are the least appropriate antecedents for the youngest children. In contrast, the adults and the oldest children tend to prefer the subject if both antecedents bear the same animacy feature, i.e., if both are animate (A) or inanimate (C). If the two antecedents differ in animacy (B/D), there appears a tendency towards object choice. Figure 16 depicts this pattern of developmental change. After the initial stage at age 2;6, a remarkable increase of subject choice is observed in sentence type C at age 3;0 and 3;6. At age 4;0 and 4;6, subject choice decreases in sentence type B and increases in sentence type A. Finally, at age 5;6, but already observable at age 4;6, both processes combine to the opposition of subject preference in A/C vs. subject avoidance in B/D. Table 11 summarizes the described stages.

Table 11. Stages of reorganization of subject choice in relation to antecedent features

stage	**age range**	**developmental processes**
stage 1	2;6	frequent subject choice in A/B; infrequent subject choice in C/D
stage 2	3;0 – 3;6	increase of subject choice in C
stage 3	4;0 (- 4;6)	decrease of subject choice in B, increase of subject choice in A
stage 4	4;6 – 5;6	frequent subject choice in A/C; infrequent subject choice in B/D

In sentence type D, subject choice is comparably at a low level in all age groups. This is remarkable considering the findings that zero is the most preferred incorrect pronoun type in D from 3;6 to 5;6 (figures 8 - 10) and that D attracts the most incorrect repetitions with all pronoun types in the 5;6-year-olds and the adults (figures 10 and 11).

5.5 Antecedent choice in relation to sentence type and pronoun type

Finally, it has been checked whether antecedent choice varies in the single sentence types in dependence of the produced pronoun type. Table 12 presents the summary of the observable results. 'SBJ' indicates that there is a tendency to prefer the subject with each of the three pronoun types (more than 62,5%). Expressions including an arrow indicate that there is a tendency to prefer (more than 62,5%) subject (S) or object (O) with the pronoun type listed in front of the arrow. 'Chance' indicates that subject-object choice lies between 37,5% - 62,5% with each pronoun type. 'Zp' means zero pronoun, 'pp' personal pronoun and 'dp' demonstrative pronoun. Performance with pronoun types lacking in a cell lies at chance level.

Table 12. Preferences in antecedent choice per sentence type and produced pronoun

	2;6 excl. pp	**3;0**	**3;6**	**4;0**	**4;6**	**5;6**	**adults**
A	SBJ	zp → O	zp/pp → S	SBJ	SBJ	SBJ	zp/pp → S dp →O
B	SBJ	chance	zp → S dp → O	zp → S pp → O	zp/dp → O	chance	dp → O
C	zp → O	SBJ	zp → S	pp → O	pp → S	pp → S	zp/pp → S
D	chance	pp/dp → O	pp → O	pp/dp → S zp → O	zp/pp → S dp → O	zp → O	chance

Let us start with a closer look at the adults. It turns out that there is an interaction of sentence type (antecedent features) and produced pronoun type differen-

tiating the results of section 5.3 and 5.4. The preference for subject with zero and personal pronoun opposed to object with demonstrative pronoun (figures 13 – 15) is most pronounced in sentence type A. In sentence type C, the same opposition occurs, but it is weaker due to chance performance with demonstrative pronoun. In sentence types B and D, however, performance is at chance level except for the demonstrative pronoun in B (object preference). It turns out that the opposition of A/C vs. B/D (section 5.4) is based on variation of antecedent choice with zero and personal pronoun. The preference for object choice with demonstrative pronoun (figure 15) is restricted to antecedent sentences containing an animate object (A/B), whereas performance is at chance level if there is an inanimate object (C/D).

Table 13: Anaphora resolution in the adults depicted by the rate of subject choice (%)

repeated pronoun	A animate S animate O	B inanimate S animate O	C inanimate S inanimate O	D animate S inanimate O
zero	76	55	80	50
personal	76	38	88	42
demonstrative	35	22	48	45

Table 13 reveals that the difference in antecedent choice with zero and personal pronoun (figures 13 and 14) is restricted to sentence type B, in which object choice is more likely with the personal than with the zero pronoun. The hypothesis that the comparably high rate of irregular repetitions in sentence type D is caused by oppositions of subject vs. object preferences with the three pronoun types (end of section 4) is not confirmed. Of all sentence types, antecedent choice is only with D at chance level for all pronoun types. Does this indicate that, with canonical sentence structure, both types of discourse continuation (topic continuation or topic change) are equally likely and disambiguation is a function of context?

With respect to the data of the children, table 12 highlights that there are instances of different antecedent preferences of the pronoun types within sentence types. However, at a first glance it is hard to detect oppositions fitting in a developmental pattern over age. Considering the distribution of antecedent preferences per pronoun type in more detail, there appears two stages in the development of pronoun comprehension with respect to sentence types B, C, and D. In sentence type A, i.e., if both potential antecedents are animate, the subject is the preferred antecedent irrespective of the produced pronoun type in all age groups. This indicates the strong impact of antecedent features on antecedent choice up to age 5;6. Considering the other sentence types, stage 1 reaches up to

age 4;0 and stage 2 covers age 4;6 and 5;6. At stage 1, children exhibit a tendency towards subject reference with zero, object reference with personal,[8] and at first subject reference followed by chance performance with demonstrative pronoun in sentence types B and C (inanimate subject). With the canonical sentence type D, there seems to exist an overall tendency towards object reference indicated by the lack of subject preferences (except age 4;0) and the four instances of object preference which include all three pronoun types. Comparing sentence types A and D, it seems that, in stage 1, the in/animacy of the object leads to opposite tendencies in antecedent choice. In the presence of an animate object (A), the animate subject is the preferred antecedent, i.e., given positive neutralization of the animacy feature, the (animate) subject wins over the (animate) object. In contrast, in the presence of an inanimate object (D), the animate subject is not the preferred antecedent anymore, but object choice becomes equal or more likely. At stage 2, antecedent choice in sentence types B and C (inanimate subject) develops differently. In sentence type C (inanimate object), performance is at chance level with zero and demonstrative pronoun, whereas the personal pronoun tends to be correlated with subject reference. In sentence type B (animate object), zero and demonstrative pronoun tend to correlate with object reference, whereas performance is at chance level with the personal pronoun. In sentence type D, varying preferences with zero pronoun appear, whereas the personal and demonstrative pronoun seem to develop the functional opposition of subject vs. object preference. In sum, at stage 2, there emerges an opposition between the personal pronoun used for subject reference and the demonstrative pronoun with which subject preference tends to be at least avoided (cf. tables 15 and 16 below).

One further outcome of the present analysis is a more detailed insight into the differences in the results of the adults and the two oldest age groups of the children found in section 5.3. The difference in the result for the zero pronoun (figure 13) origins from different preferences in sentence types B and C, i.e., in the presence of inanimate subjects. The lack of an overall object preference with demonstrative pronoun in the children in contrast to clear object preference in the adults (figure 15) is caused by the strength of subject preference in sentence type A. In all other sentence types children do show the tendency towards object preference.

6 Discussion of the results on pronoun comprehension

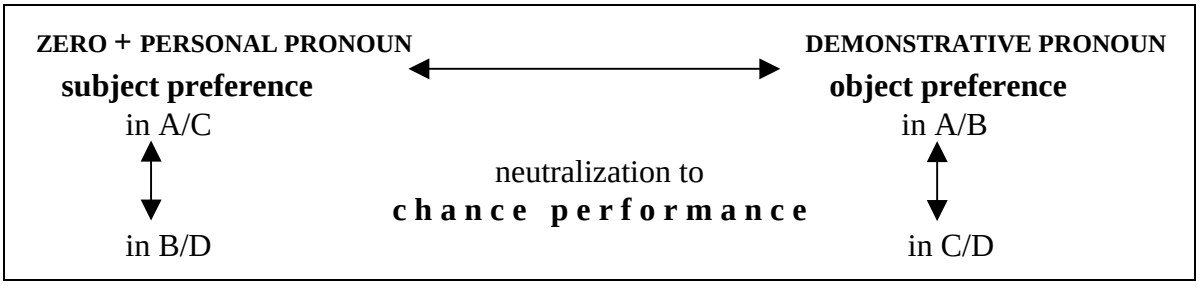
The first result is that the target pattern of pronoun resolution - as found in the adults in this experiment – was observed in children only from age 4;6 on and

[8] Recall that personal pronouns are productively produced from age 3;6, at the earliest.

only with respect to the personal pronoun. With zero and demonstrative pronoun, children and adults display distinct behaviour. The second result is that, even in the adults, anaphoric specification of the pronoun types does not hold irrespective of the distribution of the in/animacy feature among the two protagonists. This means that the anaphoric function of a pronominal type is not absolutely fixed; rather each type covers a certain anaphoric domain in which anaphoric reference can vary in dependence of the given feature constellation. The third result is that the hypotheses proposed in section 1 are confirmed in general, but some specifications and modifications are required. Finally, differences between production and comprehension were observed in the results on salience ranking of the investigated antecedent features. In the following, these results will be discussed in more detail.

The adults oppose the anaphoric capacities of zero and personal with demonstrative pronoun. The resolution preferences can be neutralized by the distribution of animacy feature. Subject preference with zero and personal pronouns is neutralized by distinctivity of the animacy feature (B/D). Object preference with demonstrative pronoun is neutralized by occurrence of inanimate objects (C/D). The adult pattern of pronoun resolution can be schematized as follows:

Table 14. Oppositions in antecedent choice in the target stage (adults)



These results can be further strengthened by noticing that figures 13 and 14 indicate a stronger subject preference with the zero pronoun than with the personal pronoun. Leaving aside for the moment the question why the observed preferences can be neutralized in certain sentence types (see below), the overall pattern of preferences confirms the reversed-mapping hypothesis. Most importantly, the ungrammatical zero pronoun is treated by the adults in line with this hypothesis. This provides evidence for the existence and strength of a 'reversed-mapping principle' determining the reference domain even for 'new' types of anaphora.

In the children's data, pronoun type is completely ignored in sentence type A. This underlines the stronger impact of antecedent features on children's resolution behaviour up to the end of the investigated period. Pronoun-type-

related oppositions remain weak and unstable up to age 5;6. However, on the base of the results for sentence types B, C, and D, the two stages in the emergence of anaphoric preferences described in section 5.5 allow for hypothesizing the functional oppositions presented in tables 15 and 16.

Table 15. Oppositions in antecedent choice emerging up to age 4;0 (stage 1)

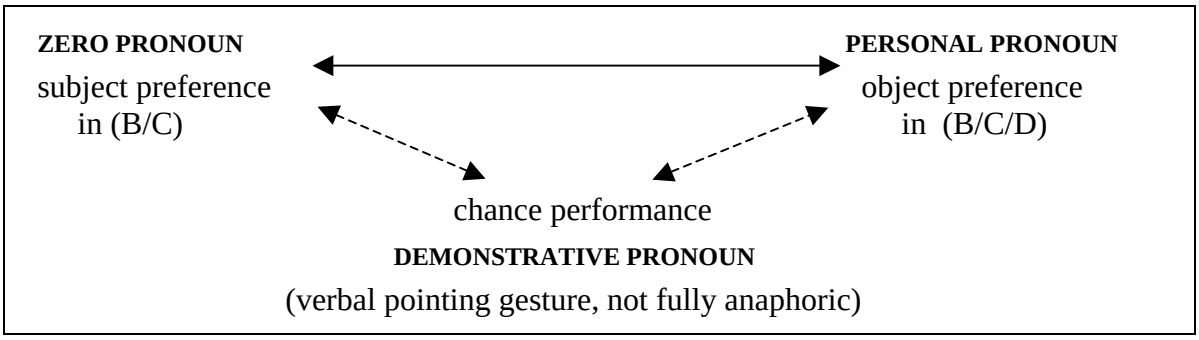
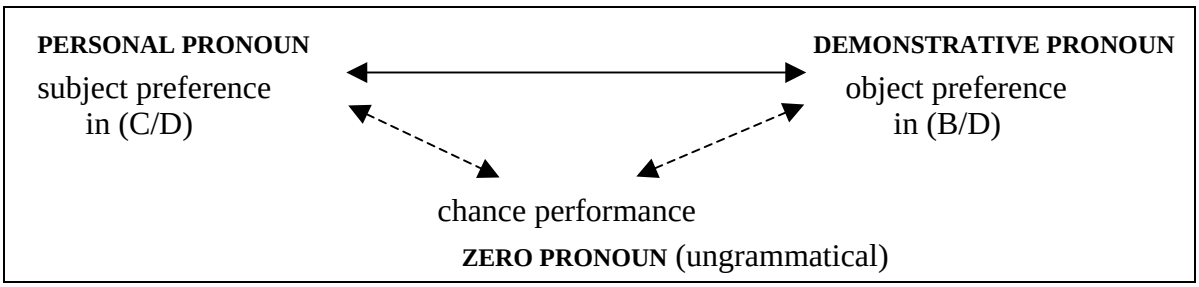


Table 16. Oppositions in antecedent choice emerging at age 4;6 and 5;6 (stage 2)



It can be argued that the difference between the three stages (including the target stage) is mainly caused by different functional specification of the demonstrative pronoun. Recall, it has been argued in section 4 that the deictic capacities of the demonstrative pronoun cause earlier emergence of productive use with the demonstrative than with the personal pronoun. The demonstrative pronoun can be used as a (verbal) pointing gesture. In Bittner (2007), however, it has been shown that German-learning children younger than 2;6 are aware of the anaphoric character of the demonstrative pronoun in spontaneous language production (dialogs). It is predominantly used if the referent in question is prementioned in the linguistic context. In contrast, a full DP is used if the referent is newly introduced or reactivated after a longer time in linguistic context. Anaphoric and deictic use converge in the function of symbolizing that the referent in question is in the 'shared focus of attention'. Even in the experiment reported here, the younger children seem to treat the demonstrative pronoun exclusively in this 'shared-focus-of-attention'-function. With this function it can refer/point to the subject, as well as to the object antecedent. No further specifications of its anaphoric capacity is acquired in stage 1. Provided that these considerations are correct, the anaphoric (core) system in stage 1 consists of zero and personal pro-

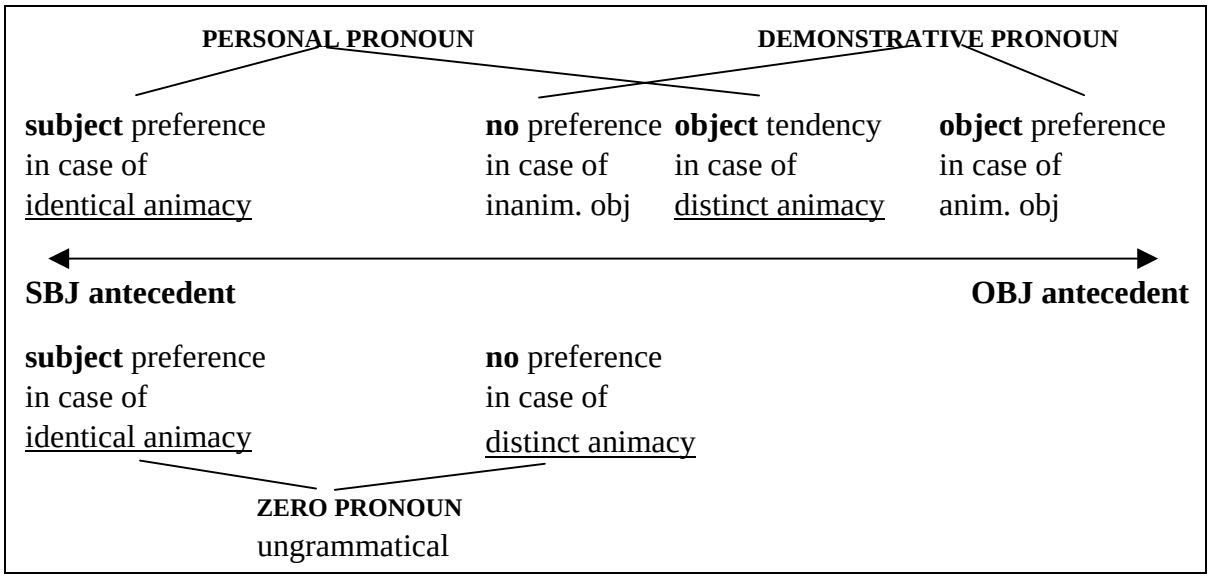
noun which tend to be opposed as predicted by the reversed-mapping hypothesis (table 15).

Following this line of explanation, the changes in the anaphoric oppositions from stage 1 to stage 2 are caused by incorporation of the demonstrative pronoun in the anaphoric (core) system. At stage 2, children seem to have specified the anaphoric function of the demonstrative pronoun in accordance with the reversed-mapping hypothesis. Being the most complex anaphor it refers to less salient antecedents (animate objects). This developmental step is accompanied by another one. Children seem to become aware of the ungrammaticality of the zero pronoun, i.e., of subject omission. Figures 1 and 5 highlight the rapid decrease of zero pronoun production from age 4;0 to 4;6. The resulting uncertainty on how to cope with the zero pronoun in the experiment comes to light by variation and chance performance in anaphora resolution. Moreover, this development leads to the loss of an anaphoric mean specified for reference to high salient antecedents. The change from stage 1 to stage 2 caused by the two developmental steps can be viewed as a move against the clockwise direction (cf. figures 15 and 16): The zero pronoun loses the status of a (grammatical) anaphoric means and moves towards chance performance. At the same time, the demonstrative pronoun gains the anaphoric capacity to refer to object antecedents and moves towards the position taken by the personal pronoun so far. In accordance with the reversed-mapping hypothesis (or due to it) and supported by the disappearance of the zero pronoun as appropriate means for subject reference, the personal pronoun moves from object towards subject preference. Needless to say that the emerging anaphoric opposition of personal and demonstrative pronoun is in accordance with the reversed-mapping hypothesis.

It can be stated that children enter the path to the target stage at about age 4;6. However, the anaphoric oppositions displayed by the children deviate from those of the adults in quantity and quality even at age 5;6. The difference in quantity appears in the number of pronouns incorporated in the system of anaphoric oppositions. Whereas the adults relate all three of the tested pronoun types, children relate only two of them. This means only two of them are assigned with explicit anaphoric specifications and underlie the ‘reversed-mapping-principle’. The difference in quality (entailing a difference in quantity) appears in the stronger specification of the anaphoric capacities including the appearance of chance performance and resulting in the specification of certain domains of anaphoric reference for each pronoun type. Table 17 aims at schematising these domains and specifications of anaphoric capacities in the adults. The main criterion of salience determination is syntactic role, the animacy feature causes internal specifications and determines the anaphoric domain of each pronoun type. Note that the presence of the ungrammatical zero pronoun in the experiment might influence the ‘normal’ target oppositions between personal

and demonstrative pronoun. Note further that the experimental conditions include only a small part of the criteria relevant for salience determination and anaphoric reference even for personal and demonstrative pronouns. In this view, the results present principled ways of interaction of salience determining criteria in the target language rather than the complete adult system.

Table 17. Specification of the anaphoric capacities of the three pronoun types in the adults



The findings for the adults are interesting with respect to the current discussion on the anaphoric capacity of the personal pronoun in German (cf. Bosch & Umbach this volume, Bouma & Hopp this volume). Bouma & Hopp provided experimental evidence for the assumption that the personal pronoun refers to the subject antecedent which is in line with e.g. classical Centering Theory (a.o. Grost et al. 1995). Bosch & Umbach, however, discuss results from a corpus study showing that the personal pronoun can refer to other antecedents as well. Additionally, they present experimental data indicating that reading time is not significantly delayed if the personal pronoun follows stimuli including an object bias or even unbiased stimuli, whereas reading time is significantly delayed if a demonstrative pronoun follows stimuli containing a subject bias. These results suggest that the anaphoric capacity of the personal pronoun is less restricted (by grammatical role) than that of the demonstrative pronoun.[9] This fits in very well with our findings for the older children and the adults (tables 12, 13, and 17). Furthermore, recall that, in the adults and the oldest children, the correlation of personal pronoun with subject reference did not occur in the conditions with distinct animacy of antecedents (B and D), but it did occur in the conditions with

[9] In fact, Bosch & Umbach argue that grammatical role is not decisive at all. Instead, the anaphoric capacity of the personal and the demonstrative pronoun is seen as related to information structure, especially the discourse-topic status of the potential referent.

identity of the animacy features (A and C; figure 16 and table 12). The examples of the stimuli presented in Bouma & Hopp and even of the experiment reported in Bosch & Umbach contain exclusively antecedents with identical animacy features. Seemingly, the animacy pattern of the potential antecedents influence the resolution of the personal pronoun. An overall and exclusive correlation of the personal pronoun with subject role has to be rejected on the base of the findings of Bosch & Umbach and of our experiment.

The findings for the personal pronoun, but even for the demonstrative and the zero pronoun, suggest the interaction of different features in the determination of anaphoric relations. With all three pronoun types, subject (zero and personal pronoun) or object choice (demonstrative pronoun) becomes more or less likely in dependence of the distribution of the animacy feature. Although the interaction of grammatical role and in/animacy is not as systematic in the children as in the adults, it is yet present (table 12). Moreover, animacy has a stronger overall impact on the children's resolution strategies than on that of the adults. This is evident, most impressively, by the dominating role of the animacy pattern in sentence type A. When both antecedents are animate, subject preference occurs with all pronoun types. This is not just a result of the neutralization of the animacy criterion; instead, it also matters whether both participants are animate or inanimate. Inanimacy of both antecedents (C) makes subject choice less likely at stage 1. At stage 2, it remains preferred with the personal pronoun, but becomes less likely with the other two pronoun types. Only at the target stage is the resolution pattern nearly the same in sentence types A and C (weaker object preference with demonstrative pronouns in C is caused by inanimacy of the object). In case of distinct animacy features (B and D), object choice becomes more likely in general and, especially, with the demonstrative pronoun. This holds irrespective of the distribution of in/animacy over subject and object. The results for sentence type D provide the strongest evidence that the personal pronoun is not restricted to subject reference in German: The most maximal contrast in antecedent salience, animate subject vs. inanimate object, does not lead to subject preference, neither in the adults nor in the children. However, we do not have a consistent explanation for the lack of subject preference in this condition.[10] It is worth noting that sentence type D caused unexpected or at least special results in both the production and the comprehension part of the experiment. One can speculate whether the maximal salience contrast and the closer familiarity of personal and demonstrative pronoun in German cause some specific resolution conditions.

[10] It can ruled out that this is an artefact of the stimuli construction by comparison with the results on Russian and Bulgarian (Gagarina this volume, Kuehnast this volume). In these languages, the subject is the preferred referent of zero and personal pronoun.

Finally, we will consider the results with respect to the questions and hypotheses formulated in section 1 and in relation to the results on pronoun production. By summarizing the results on pronoun production (section 4), we proposed the following salience ranking of the discussed antecedent features for the children at age 3;6 to 4;6 (tables 8 and 10):[11] animate subject > animate object > inanimate subject > inanimate object. As already shown, this finding is confirmed with respect to syntactic role by the resolution patterns: subject > object. However, with respect to animacy, which is the more dominant feature from the production perspective, this ranking does not occur. Neither animate antecedents predominantly attract less complex anaphors nor inanimate antecedents more complex anaphors. Taking into account that the pronouns always occurred in subject and as such in topic position in the experiment, it follows that there is no overall tendency to consider animate antecedents to be the better topics of a subsequent utterance in children and adults. However, this is not true in general. It has been found that the object preference with demonstrative pronoun is strong with animate objects but neutralized with inanimate objects in the adults. Taking into account that, according to e.g. Bosch & Umbach (this volume), demonstrative pronouns symbolize a change of the discourse topic, our results suggest that topic change is more expected with animate antecedents by the adults. Children, however, do not show the same preference for animate objects. Considering the subject preference with (zero and) personal pronoun, no such internal specification occurs. Inanimate subjects are as good candidates to continue the discourse topic as are animate subjects. In sum, in pronoun resolution, syntactic role appeared to be a stronger salience criterion than in/animacy. The reversed-mapping hypothesis, thus, is confirmed with respect to the correlation of syntactic role and pronoun type. Animacy occurs as an additional mapping factor in the domain of the demonstrative pronoun: Animacy wins over inanimacy in the expected way, i.e., animate objects are the more preferred antecedents of the demonstrative pronoun. Special confirmation for the reversed-mapping hypothesis results from the fact that the adults tend to integrate the ungrammatical zero pronoun in the anaphoric system in the expected way. This also holds even for the children at stage 1 who also prefer subject reference with this form (table 14). Furthermore, children at that stage oppose zero and personal pronoun in accordance with the reversed-mapping hypothesis.

Part (a) of the hypothesis on developmental steps (section 1) has to be refined in that also the older children exhibit a bipolar opposition of two pronoun types. Only the adults integrate all three pronoun types in the anaphoric system in that each pronoun type – despite of overlaps – occupies a different part of the

[11] Recall that the oldest children and the adults repeated the presented pronoun mostly correct. Thus, no salience ranking could be inferred for these groups.

scale from subject to object preference (table 16). Further, the ungrammatical zero pronoun does not cause complete alignment of zero/personal or personal/demonstrative pronoun. All three pronoun types are treated distinctively in all stages. This suggest that children operate on the base of the one-form-one-meaning principle trying to find out a specific functional content for each grammatical sign. The developmental steps confirm that a maximal bipolar opposition – embodied in this experiment by subject vs. object preference of distinct pronoun types – is at the onset of the development of anaphoric contrasts. Due to weak and changing preferences in antecedent choice during stage 1, it is hardly to decide whether part (b) of the hypothesis on developmental steps is confirmed in the sense of a true interaction of syntactic role and in/animacy at this stage. Syntactic role is clearly the main criterion for antecedent choice. In/animacy seems to function as a minor but separate criterion influencing the impact of the syntactic role criterion as described above. However, no internal specification of subject or object preference on the base of in/animacy can be detected. At stage 2, the differences in the preferences of the personal pronoun emerge: Subject preference with identical vs. chance performance with distinct animacy features of the antecedents. But it is only at the target stage, that the in/animacy-dependent internal specification of object preference with the demonstrative pronoun occurs. In sum, there are only weak evidences for part (b) of the hypothesis on developmental steps but at the same time no counterevidence turned up.

The questions on salience ranking (see (2) (a-c) of section 1) are positively answered on the base of the production data in section 4. On the base of the comprehension data, answers to questions (2b) and (2c) would be slightly different or more preliminary, at least with respect to the children. The differences in the results concerning the question on interaction of the two investigated criteria lead to the hypothesis that interaction has not to be understood as convergence of all relevant criteria to one unified salience hierarchy. Instead, each feature creates its own salience hierarchy, the interaction – and the relevance – of which varies across the different types of anaphoric means. These findings correlate with the suggestion of Kaiser (2005) that there is no unified notion of salience in anaphora resolution. In our case, the syntactic role hierarchy appears to be relevant with all pronoun types and from the very beginning. In contrast, the animacy hierarchy appears to be of different relevance for the single pronoun types and true interaction with syntactic role emerges late.

7 Conclusion

The reported experiment tested a complex pattern of factors (potentially) relevant in the production and comprehension of intersentential pronouns. The re-

sults allow first insights into developmental steps in the acquisition of anaphoric specification of pronominal reference. It is worth noting that although a huge group of subjects has been tested, the data base is small with respect to each of the 12 conditions investigated in the experiment. The results are therefore preliminary and have to be controlled and deepened by further investigations.

The main goal was to examine whether syntactic role and in/animacy of potential antecedents influence the production and comprehension of zero, personal, and demonstrative pronouns in 2;6 to 5;11-year-old children and adults. Further, it should be investigated whether the patterns of pronoun production and comprehension support the 'reversed-mapping hypothesis' proposed in several theories on anaphora resolution. The main results are as follows:

(A) Children tend to distinguish the anaphoric capacities of the three pronoun types from the very onset of production.

(B) The personal pronoun becomes productive later than the demonstrative pronoun, which can be explained by the impact of deictic capacities of the demonstrative pronoun and the children's frequent use of deictic reference; the zero pronoun, which is ungrammatical in German, is treated by the younger children as subject drop, the older children become aware of the ungrammaticality of this form and tend to avoid it.

(C) Using the scale of formal complexity of the three pronoun types, zero > personal > demonstrative, to infer possible salience hierarchies of the investigated antecedent features, the following hierarchies turned up: (a) in the production task: animate > inanimate; subject > object; both combining to animate subject > animate object > inanimate subject > inanimate object, (b) in the comprehension task: subject > object is the primary scale, interacting for demonstrative pronouns with animate > inanimate as the secondary scale; for the other two pronoun types, the animacy pattern represented by both potential antecedents is decisive.

(D) The correlations of pronoun type and antecedent features provide evidence for the reversed-mapping hypothesis: Children and adults tend to oppose the three pronoun types in production and comprehension such that less complex anaphors correlate with high salient antecedents and vice versa; strong support for the existence of a reversed-mapping principle results from the correlation of the ungrammatical zero pronoun with (animate) subject in the children up to age 4;0 and the adults.

(E) The system of anaphoric oppositions develops over age from simple maximal contrasts of two pronoun types (zero vs. personal up to age 4;0 and personal vs. demonstrative up to age 5;6) to the complex anaphoric distinctions in the target stage; in production, the distinctions are exclusively based on the animacy feature in the younger children, syntactic role becomes relevant as a further criterion only at about age 3;6; in comprehension, syntactic role is most decisive but the animacy feature or even the animacy pattern influences the strength of the correlation of pronoun type and syntactic role.

(F) The data suggest a reorganisation of the initial anaphoric oppositions from age 3;6 to 4;5. In pronoun comprehension, children do not attain the adult pattern of anaphoric oppositions before their sixth birthday. With respect to production, the experiment does not allow any statement on the properties of the target stage and on when children reach that stage because the oldest children and the adults performed mainly correctly in the repetition task.

(G) There is no evidence for use of merely positional, i.e., first-last-mention cues, with any of the three pronoun types at any age bracket. The subject and object preferences, interpretable as positional preferences, vary under the influence of the in/animacy feature.

(H) There is strong evidence from the adults' and the older children's data that the personal pronoun is not exclusively resolved to subjects. Subject preference turned up only in case of the neutralization of the animacy feature (identity in in/animacy of both antecedents), otherwise object reference becomes equally likely. The anaphoric properties of the personal pronoun turned out to be less specified than those of the demonstrative pronoun which does not show tendencies towards subject reference in the adults' data.

(I) The anaphoric capacity of a single pronoun type is not determined by (a) absolute and stable features; instead, different features are active and interact in different contexts; this leads to variation in the anaphoric reference of one and the same pronoun type; there appears a certain anaphoric domain in which a pronoun type can be used. Further, and consequently, anaphoric capacity is not even determined by (b) a unified salience hierarchy; instead each feature creates its individual salience hierarchy and the actual anaphoric reference results from the interaction of relevant hierarchies.

To finalize, there is a range of open questions to be addressed in future research. In addition to the necessity to strengthen the presented results by further data and the use of other experimental methods, the relevance of other criteria such as topicality, information status, positional cues, semantic and syntactic parallelism and their interaction with syntactic role and in/animacy has to be investigated. Questions resulting from the analysis of the present data concern the unexpected and yet unexplained findings for sentence type D in nearly all analyses. Are they an experimental artefact or are they caused by the feature constellation presenting the maximal salience contrast of the investigated antecedent features? Another question arises from the results of Bosch & Umbach (this volume): What is the impact of topic continuation and topic change on our results? Even in the adults, production of the demonstrative pronoun does not regularly lead to object choice, which would indicate comprehension of a topic change in the presented stimuli. Finally, differences between results of the production and the comprehension part of the experiment appeared which cannot be explained on the base of the conducted experiment.

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