Chapter 3
Knowing ON-line
— a Controlled Observation Study

In the preceding chapter, above and beyond the geometric aspects, the semantic factors of spatial prepositions were extended to “extrageometric variables” (Coventry, Prat-Sala & Richards, 2001: 377). It was pointed out that these sources of information may be integrated “on-line” (ibid: 395) in the process of understanding. In addition, it was proposed that commonly discussed semantic factors such as functionality and geometry are accounted in a processual way by considering the interplay of situation and context(s) and change of attention.

From the developmental view, there is also a legitimate claim made in Wilcox and Palermo (1974: 263) that it is necessary to incorporate “contextual factors” in the studies of infants’ semantic development when approaching the question of how infants acquire the meaning of spatial relational terms: “It seems logical to assume that the way in which the young child interprets a word in a given situation is a complex function of the context and a number of linguistic and non-linguistic strategies” (ibid: 253). What these linguistic and non-linguistic strategies are and how they are used, is at issue in this chapter. The approach is based on the background presented in the last chapter. It focusses on how infants make use of “situated information [situierte Information]” (Strohner, 1995a: 56), which implies both, linguistic and non-linguistic facts.

The following study seeks to capture the situated information controlling two variables in children’s understanding of spatial prepositions: the instructions and the situation. The idea of varying the situation in experiments arose from criticisms of studies about children's relational knowledge, which were raised by Wilcox and Palermo (1974) as well as by Grieve, Hoogenraad and Murray (1977). These researchers made the objection that without a separation between what children know about objects from their linguistic knowledge, we cannot make reliable conclusions about the development of relational knowledge. The varying of instructions should examine linguistic knowledge and test how much information infants receive through the preposition itself. In previous approaches, it was generally assumed – following Clark’s (1973) study – that the early understanding of IN- and ON-prepositions was supported by non-linguistic information originating from the environment, and that infants thus demonstrated less linguistic competence. The following study attempts

to capture also the intracontextual processes (see qualitative results in section 3.7). The design of the study, however, cannot be understood before explaining the language studied and the stimuli used.

3.1 Spatial relations in Polish

The choice of Polish as the language studied was connected to Slobin's (1973: 188) linguistic complexity hypothesis, which offers a possible explanation for the order of acquisition of prepositions observed in children across different languages. According to Slobin (1973), Polish is a complex language, because reference to spatial relations requires not only the use of a preposition but, depending on the object's gender, also a case inflection — see example (1) for masculine and (2) for a feminine noun.

(1) POD→ most
[UNDER bridge]

(2) POD→ kul-ę
[UNDER sphere-AKK]

Slobin (1973: 188; see also section 1.4) reports that in languages with a system like the one in Polish, children produce the appropriate inflection before they start to use the corresponding preposition. He explains this peculiarity in terms of operating principles for the construction of language (Slobin, 1985: 1159), one of which predisposes the child to pay attention to the end of a linguistic unit. In accordance with this idea, when given in instructions, children should be particularly sensitive to the case inflection of the nouns as this gives them the information about the appropriate relation. This hypothesis will be tested in the experiment.

Another linguistic complexity in Polish is that there are two prepositions for the English equivalent ON: a dynamic and a static[1] one.

dynamic: in this case, the preposition stands for a spatial movement and is in the accusative or genitive case (depending on the gender). In the following it will be marked with "→" to distinguish it from the static form.

static: in this case, the preposition stands for a certain location or a state and is in the locative or instrumental case.

In the case of the English IN-relation, there are also two different morphemes in Polish: DO, for the dynamic, and W, for the static form. In the following studies (including the pilot study), however, only the dynamic form of the preposition was used, because the static form involves more complexity in the syntax of the instructions — see example (3).

1 This terminology is adapted from Klein (1991).

(3)	Zrób tak,	żeby		konik	był	na		mo-ście!
	[Do this way	that	(the)	horse	would be	on	(the)	bridge-LOK]
(4)	Daj	konika		na	most!			
	[Give (Put) (the)	horse		on→	(the) bridge]			

Within Cienki's (1989) classification, the chosen dynamic form of a preposition complies with the Adlative and expresses a spatial behavior, in which "the motion involved leads to a decrease in the distance of the spE [spatial Entity] from the L'r [Localizer]" (ibid: 3). However, the term Localizer implies the relationship of a spatial entity to an animate entity, which was not appropriate for the objects used in this study, since these were all inanimate. For this reason, the more neutral terminology of landmark and trajector adapted from Langacker (1991: 6, 1998:5) is preferred. These notions were previously introduced in section 2.2.

3.2 Pilot study

It was explained above that in Polish spatial relations are marked in terms of prepositions. The first step in the empirical studies then was to test whether the phenomenon of a predictable order of acquisition of prepositions applies for Polish as well. For this purpose, a pilot study was conducted, in which one child (23 months old) was observed over a period of five days in play sessions (twenty minutes daily). During these sessions, different instructions were given to this boy and his reactions recorded. In sum, the boy received 19 instructions with the preposition NA→ [ON], nine instructions with the preposition DO [INTO] and 19 instructions with the preposition POD→ [UNDER]. The prepositions DO was used in only 9 instructions, because of the limited set of objects. A further reason was that the boy showed a confidence concerning the performance to such a case of instruction. Overall, the expected order in the understanding of spatial prepositions observed in other languages such as English (Clark, 1973), German (Thiel, 1985) and Hebrew (Halpern, Corrigan & Aviezer,1983) was confirmed. The ratio of correct responses to instructions in the 23-month-old child is presented in Figure 6.

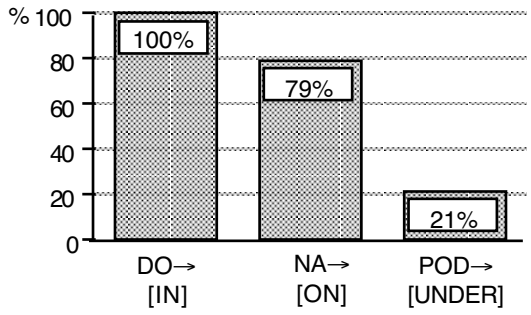

Figure 6: Correct responses for Polish locatives in the pilot study

The results suggest that for the boy studied, the relation of UNDER was hardest to comprehend. In 47% of the 19 different cases, in which an instruction with the preposition UNDER was uttered, this relation was understood as an ON-relation. In 21% of the cases, the child responded with another relation (like IN or IN FRONT OF), and in a further 21% of the cases, the instruction was not understood at all, i.e. the child showed no relational performance.

3.3 Method

3.3.1 Instructions

The experiment was based on two types of instructions. The instructions always began with Daj... [Give...]. This formulation is less typical but has the advantage of being semantically neutral with regard to directionality. Other verbs like Postaw... [Put...] imply a state in which one object is supported by another (e.g. lying on a table) and can thus influence performance. The two types of instructions were designed to examine whether infants explicitly react to prepositions and receive specific information through them: one type consisted of a syntactically correct request relating two objects to each other in terms of a particular spatial relation (5a); the other also consisted of a request, but in this case it was syntactically incorrect (5b) and the preposition was omitted[2]:

(5) a. Daj konika NA→ most
[Give horse-AKK ON bridge]
'Put the horse on the bridge'

(6) b. Daj konika_ most
[Give horse-AKK _bridge]
'Put the horse _ the bridge'

One could argue, referring to Slobin's (1973: 191) organizational principles, that the infants know which preposition is omitted because of the inflection. One needs to keep in mind, however, that it is also syntactically correct to substitute other prepositions within this structure (6c–g). The inflection therefore is not a reliable indicator of the missing prepositions.

c. Daj konika POD→ most
[Give horse-AKK UNDER bridge]

d. Daj konika NAD→ most
[Give horse-AKK OVER bridge]

2 I am grateful to Dan I. Slobin for the idea of instructions without prepositions.

e.	Daj	konika	ZA→	most
	[Give	horse-AKK	BEHIND	bridge]
f.	Daj	konika	PRZED→	most
	[Give	horse-AKK	IN FRONT OF	bridge]
g.	*Daj	konika	W→	most
	[Give	horse-AKK	INTO	bridge]

In consequence, there must be more than a syntactic indicator leading infants to the correct understanding. Given these multiple possible solutions for completing an instruction semantically (6c-f), it was particularly interesting to observe the infants' behavior when they reacted to the instruction without a preposition. Especially in the **HiK**-situation (see below), close attention was paid to the infants' responses to an instruction with an explicit preposition in order to see whether they would specify the location for placing the trajector object accordingly.

For the spatial relation in instructions for the experiment, the NA→[ON] relation was chosen. There were two main reasons for this decision. On the one hand, as shown in the pilot study above for Polish and in many other studies for other languages (e.g. Clark, 1973; Thiel, 1985), the NA-preposition emerges early in the hierarchy of acquisition. On the other hand, the objects chosen for this support-relation usually also allow another relation that of UNDER. If one compares such support-objects to containers, one finds that objects allowing the containment-relation suggest predominantly the IN-relation (e.g. IN a cup). Furthermore, experiences during the pilot study with objects allowing containment showed that children were attracted and fascinated by the action of putting or closing things in a container (e.g. a closet) in itself and it was thus difficult to draw their attention to any other action. For this reason, it is not advisable to use container-objects, if one intends to explore prepositions other than IN.

3.3.2 Situations

In addition to the different instructions, infants were confronted with two different stimuli settings. A well-known setting designed to trigger their intercontextual knowledge and a situation that was artificial in order to probe the extent of their linguistic knowledge. As was argued in 3.2, each action of an individual is constrained by a socio-cultural intercontext, and one of the principal issues at hand is to discover how exactly infants' understanding is additionally composed of situative information and intracontextual mechanisms.

Well-known Situation

In the well-known situation, objects and toys were used that the infants would recognize from their every-day interactions. When responding to an instruction in this situation, infants were expected to use intercontextual cues i.e. to rely on their background knowledge about objects and events. This experimental setup was based on research findings indicating that infants know a great deal about space and objects before they have labels to describe them (Bowerman & Choi, 2001: 478; H. Clark, 1973: 28). In keeping with such research, it can therefore be presumed that infants already have some expectations about spatial alignments with objects. Toy-objects such as a table, for example, or a bridge most easily imply the relation ON and, even when performing instructions that are syntactically incomplete, infants will choose this relation (in spite of the fact that there are other options to complete this instruction). The trials in the well-known situation consisted of three sets (see Table 2).

Table 2: The well-known objects and instructions in the study

	OBJECTS		INSTRUCTIONS
Set 1		pot (TR), table (LM)	Daj dzbanek stół [Put the pot the table] Daj dzbanek na stół [Put the pot on the table]
Set 2		cup (TR), plate (LM)	Daj filiżankę talerzyk [Put the cup the plate] Daj filiżankę na talerzyk [Put the cup on the plate]
Set 3		horse (TR), bridge (LM)	Daj konika most [Put the horse the bridge] Daj konika na most [Put the horse on the bridge]

HiK-Situation

For the following experiment, the challenge was to construct a new situation with abstract objects. The idea used originates from Wilcox and Palermo's (1974) objection to the objects Clark (1973) used in her study. From a methodological point of view, the authors made the criticism that Clark's choice of objects was biased. The objects suggested mainly one spatial relation, which influenced children's behavior and thus supported the rules theoretically

claimed by Clark (1973; see section 2.2).

> It appears to us that Clark's results may have been a contextually determined artifact of the particular objects she used. [...] Thus, it appears that the contextual support for the linguistic statements presented to the children by Clark was such that the children had no alternative to the specific nonlinguistic strategies which the children in that study selected when they did not know how to respond to the statements including 'on' and 'under' (Wilcox & Palermo, 1974: 247).

The authors did a survey among parents confirming that the majority of toys used suggested the IN-relation. Wilcox and Palermo (1974) concluded that studies about infants' understanding of spatial relations have to consider the nature of the objects used and that infants should have the choice of many relational possibilities to carry out with objects presented to them. Freeman, Lloyd and Sinha (1980; see also section 2.4) took this idea of the nature of objects on board and studied to what extent the objects themselves and their canonical orientation influence infants' behavior and thus constitute a great part of their relational knowledge. They found evidence for a "canonicality effect" (Freeman, Lloyd & Sinha: 1980: 259), i.e. that if, for example, cups are used in their customary orientation, infants' performance is better than if they are inverted.

A similar critical point is taken into account by Grieve, Hoogenraad and Murray (1977) and considered in Paprotté (1979). In both approaches, objects were systematically varied. An additional methodological improvement concerns the nature of objects used in the studies: while Grieve, Hoogenraad and Murray (1977: 247), explicitly claiming the use of "'neutral' objects", utilized small and large boxes, Paprotté (1979) used styrofoam-objects, a container, a plate and a rod. Paprotté (1979) found out that "Für die Styroporgegenstände sind sowohl fehlerhafte wie korrekte Reaktionen insgesamt niedriger als für Alltagsgegenstände [For the styrofoam-objects both the incorrect and correct reactions are overall lower than for the everyday objects]" (ibid: 208).

Although they also criticized the objects used in Clark's (1973) study, in both approaches (Paprotté and Grieve et al.) other important rules established by Clark (see section 2.2) were disregarded. In accordance with these, it is argued that abstract objects may also influence children's behavior when they include a surface or the possibility of containment and therefore negate the observations about their relational knowledge or understanding. As a result, two main difficulties with the idea of using neutral objects are seen:

1. Objects like boxes are not neutral enough. Especially in the study by Grieve, Hoogenraad and Murray (1977) and also by Paprotté (1979) they include a surface or the possibility of containment and can therefore suggest a relation (ON or IN) to the infants.
2. Additionally, Grieve, Hoogenraad and Murray (1977) realized that it may be motorically more difficult for infants to follow an instruction in which a smaller box should be placed UNDER a larger box, because the appropriate response entails lifting the larger box, holding it in the air and simultaneously putting the smaller box UNDER the larger one.

Before continuing the research into infants' relational knowledge, it is therefore important to synthesize the ideas presented above and take into account the difficulties involved in designing a setup of objects, which adheres to the following conditions:

a. the child has never seen the setup before,

b. the objects must not suggest a certain relation,

c. the objects must allow the child to perform many relations in the same way, i.e. the preformation of an UNDER-relation should not be more difficult or require more complicated motoric action than is the case for an ON-relation,

d. the objects should provide as little context as possible,

e. the objects allow for control of the situative information.

The **HiK**[3]-construction was an attempt to satisfy these criteria (see Figure 7).

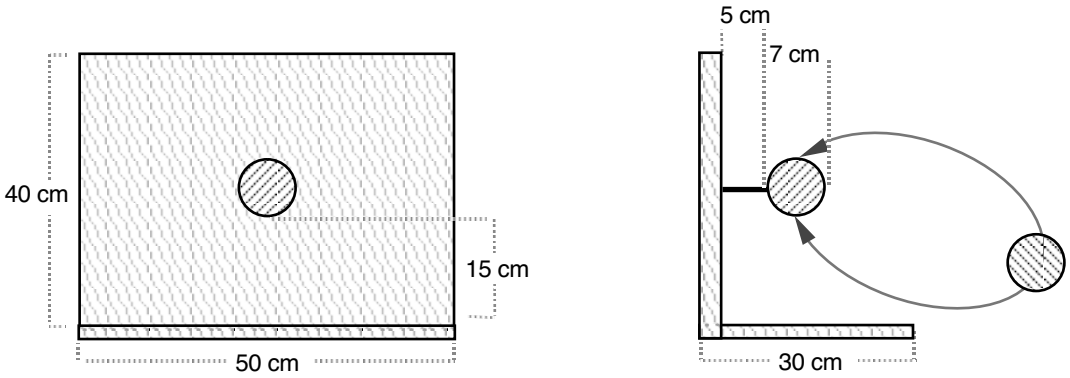

Figure 7: The **HiK**-construction

The construction acts as a 'not yet specified' or artificial situation, since the children have never seen it before. In the experiment, the **HiK**-construction was put on the table in front of each child. The confrontation with this construction creates an unfamiliar situation in contrast to the well-known situation where common toys were used (see Figure 8). The **HiK**-construction consists of two main focus objects. Two balls were chosen because they have neither a horizontal surface nor are they potential containers. They imply only the well-known activity of rolling. The first ball, which is installed in the wooden construction and covered with Velcro®, was introduced to the child as kula [sphere]. The second one is mobile, also covered with Velcro® and was introduced as pi*l*ka [ball].

3 The name **HiK** stands for "Heidelberger interessante Konstruktion", and refers to the fact that the idea for this wooden construction was born in Heidelberg. I am grateful to Werner Brüggenthies for the implementation of the construction plans.

Figure 8: The **HiK**-situation

A number of relations are possible with the aid of these two balls: the ball can be attached to the sphere in an ON-, UNDER-, BEHIND-, additionally German AN- [ON, AT], Polish NA-, DO-, ZA-, POD-relation. In each of these relations, the motoric action is similarly complicated, as it does not require any additional action such as for example lifting to achieve the desired relation. This feature neutralizes the argument that UNDER is more difficult than IN and ON. As explained above, if a child wants to hide a trajector-object UNDER a landmark-object, it is usually necessary to act upon and change the location of the landmark. In the **HiK**-construction, in contrast, to carry out the UNDER-relation is motorically as simple as other relations.

Another important aspect that was incorporated in the construction concerns the control of situative information. This control was possible due to the fact that the sphere is one of three interchangeable parts. Together with the perspex-rod, the sphere could be replaced with a cube or a shelf (see Figure 9).

Figure 9: **HiK**'s interchangeable parts: cube and shelf

Each of these was supposed to suggest a certain relation based on the observations made by Clark (1973). A cube was chosen, because it implies a surface, while a shelf implies a hollow space. By varying these parts, a control of the nature of objects in a situation is possible (see Figure 10).

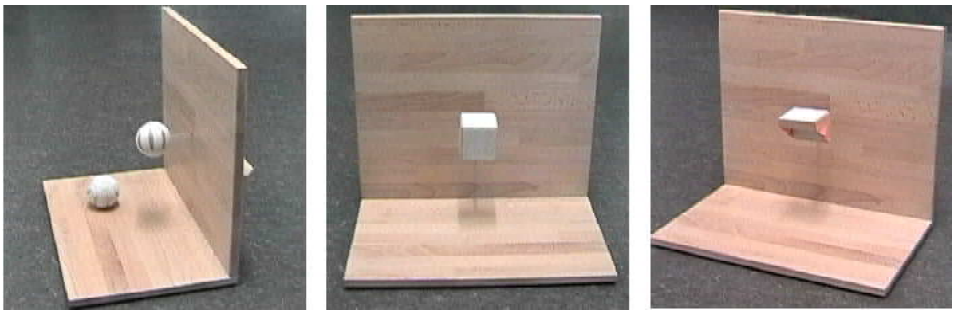

Figure 10: Different interchangeable parts used in the **HiK**-construction

In the experiment described here, the child was instructed to put the ball the sphere (7) and to put the ball on the sphere (8).

(7) a. Daj piłkę kulę!
[Give ball-AKK _ sphere-AKK]
'Put the ball _ the sphere'

(8) b. Daj piłkę na kulę!
[Give ball-AKK on sphere-AKK]
'Put the ball on the sphere'

Concerning the semantics of spatial prepositions, the aim of this construction was to observe an abstraction of children's linguistic knowledge, as is suggested in many approaches to the semantics of prepositions. Herskovits (1985: 343) remarks that the "prepositional category as a whole is organized around a focal relation, the ideal meaning". From this perspective, a child has acquired the meaning of a preposition, as soon as she or he is able to overcategorize the "whole set of uses of the preposition [...] (corresponding roughly to different senses)" (ibid: 343) to an ideal meaning:

> The idea of an ideal meaning is that (a) it is manifested in all uses of the preposition, although shifted or distorted in various ways, and (b) it does not apply to the referents of the noun-phrases, but to geometric description associated with these referents (Herskovits, 1985: 355).

To be able to solve the **HiK**-task correctly, it was hypothesized that the infants would have to make use of their ability to abstract the geometric features of a NA-relation and to apply them (with respect to the ideal meaning) to the new abstract objects presented.

3.3.3 Design and predictions

The study examines the correlation of two variables: in two situations (the artificial **HiK**-situation and the well-known situation), two types of instructions (without and with a

preposition) were given (see Table 3).

Table 3: Design of the experiment

		SITUATION	
		well-known	abstract **HiK**
INSTRUCTION	INS_{wp}: without preposition	NCR_1	NCR_3
	INS_{NA}: with preposition NA→	NCR_2	NCR_4

NCR: Number of correct responses according to the instruction

These two situations correspond to two hypotheses. For the well-known situation, the first hypothesis can be formulated as follows: if the infants master both tasks (instruction with and without preposition) with the same success, it suggests that, in a well-known situation, infants understand instructions without prepositions equally well as with prepositions ($NCR_1 = NCR_2$), because their knowledge about objects is crucial. Particular focus will be on the child's first response to an instruction without preposition: if she or he carries out the expected relation correctly it cannot be due to the preposition and must therefore be due to background knowledge about the objects involved and the given situation.

For the artificial situation, the second hypothesis is formulated as follows: if the preposition supplies important information, then the infants will pay more attention to it in an abstract situation. This means that the instructions with prepositions will lead to better performance than instructions without prepositions ($NCR_3 < NCR_4$). In this case, the focus will be on the child's second response, i.e. to an instruction with the preposition NA→ — can she or he correctly indicate the spatial relation based on the preposition?

With regard to the hypothesis for the **HiK**-situation, the objection can be made that the Polish NA-preposition is potentially ambiguous. The instruction NA kul*ę* [ON the sphere], for example, could be also understood as anywhere on the surface of the sphere rather than a specific location on top of it. In comparison, the same instruction in German AUF die Kugel [ON the sphere] contrasts with AN die Kugel [ON the sphere] and thus the preposition AUF provides a more specific location. To counter this objection, a pilot study with five (two female and three male) Polish-speaking adults was conducted. The adults were given the same instruction as the children. 100% of the adults put the ball on the top of the sphere as hypothesized for this study. Thus, although the preposition is potentially ambiguous, the responses of Polish native speakers suggest persuasively that the meaning of the preposition in this situation (as evidenced by the location of the ball) is as clear as in German.

Participants

Twenty-four Polish speaking infants with a mean age of 23 months participated in this study. Thirteen females and eleven male participants were confronted with the task. The youngest participant was 20 months, the oldest 26 months old. One child was excluded from the scoring because of concentration difficulties. All the children were monolingual native speakers of Polish and lived in a small town or one of its surrounding villages in the South of Poland. The parents came from different occupational backgrounds but most were non-academic. With the aid of a pharmacist and three pediatricians, suitable children were sought. Their parents were asked for participation. If they had agreed, the experimenter contacted them later by phone or personally if they had no phone at home. The first experiment was carried out in three different places: in two doctors' practices and a parish room. Each subject was interviewed separately. The care-givers were asked to make no comments during the experimental trials, but to encourage the infants whenever they turned to them for help.

Procedure

The order of the sets (**HiK**, then sets 1, 2, 3 from the well-known situation) was designed to correspond to the likely progressive interest of the children. For many infants the **HiK**-situation was too abstract, and it was doubtful whether they would have wanted to continue to play with it, after they had seen the more familiar sets 1-3. Consequently, every child was seated in front of the **HiK** first. To attract her or his attention, questions like "What is it?" were asked. Then the names for the objects (sphere and ball) were introduced. Finally, instructions were given that were neutral in their formulation.

Scoring

Table 4 shows infants' performance after scoring, i.e. how many infants performed the NA→ relation as suggested by the objects with regard to different sets. The row 'other relations' in the table displays how many infants performed different relations than those expected (e.g. POD [UNDER] instead of NA). Interestingly, three children responded with a different NA relation in set 2 following an instruction with a preposition. More specifically, one child performed the converse relation (i.e. the plate on the cup), the other two put the cup on the table (on which the objects were presented, not on the toy-table).

The row 'used different toy' shows how many children performed the NA→ relation with different toys provided by the set (e.g. they put the horse ON the table instead of ON the bridge) — such responses were excluded from the final scoring. The term 'anticipation' refers to a situation in which a child performed the NA→ relation before the instruction could be expressed (i.e. as soon as both objects were presented). This reaction is also omitted for the final scoring as well as a number of invalid trials shown in the row "invalid" (in some cases

children did not want to respond).

Table 4: Infants' performance in a well-known situation (before scoring)

			WELL-KNOWN SITUATION		
			set 1	set 2	set 3
			pot / table	cup / plate	horse / bridge
INSTRUCTION	INS_{wp}	performed NA→	14	13	14
		other relations	0	1	0
		used different toy	6	3	3
		invalid	4	7	7
	$INS_{NA→}$	performed NA→	13	9	16
		anticipation	2	5	2
		other relations	0	3	0
		used different toy	3	4	3
		invalid	6	3	3

With regard to the **HiK**-situation, Table 5 displays how many infants performed a contact between the ball and the sphere following the instruction without a preposition. In the case of an instruction with a preposition, infants were expected to specify the location of the ball on the sphere. If they could not work out the location from the instruction, they mostly repeated the previously performed relation — the number of infants who behaved this way can be seen under the category 'other relation'. The row 'another action' refers to responses in which infants did not make a contact between the ball and the sphere but instead carried out another action entirely like throwing the ball away or trying to take the sphere down.

Table 5: Infants' performance in a **HiK**-situation (before scoring)

			ABSTRACT SITUATION
			HiK
INSTRUCTION	INS_{wp}	performed contact	14
		another action	5
	$INS_{NA→}$	performed NA→	4
		another action	4
		other relations	11

In the final scoring, different task forms (with and without a preposition) were compared. Every infant's performance in the well-known situation containing an instruction with a preposition, for example in set 1, was related to her or his performance resulting from an instruction without a preposition from another set, for example set 2. Altogether six comparisons were added up to establish the total result. The performance in the well-known situation, however, was not compared to the **HiK**-situation because each type of situation is linked to a different hypothesis. The infants' performance as a result of the instructions was coded as a solved or non-solved task: if a child performed a relation NA→ between the LM and TR-object due to an instruction (with and without preposition), this task was coded as a solved task. If a child performed a different relation than NA→ between the LM and TR-object in a well-known situation, this response was coded as a non-solved task. In the case where a child performed the relation with a different object than those provided by the set or the relational reaction came before the instruction could be uttered, this response was excluded from scoring.

In the artificial situation, a task was coded as solved if the child produced a contact between the ball and the sphere for instructions without any preposition. In the case of an instruction with a preposition, a task was only coded as solved if the child located the ball in the correct NA→ position on the sphere (merely producing a contact was not sufficient). Any other reaction, for example putting the ball on the bottom of the **HiK**-construction or on its vertical wall, was coded as non-solved.

3.4 Quantitative results

The first result mentioned here is a personal observation and concerns the infants' responses to the instructions without a preposition. Strangely enough, they were not surprised when the incomplete instruction was uttered. Rather they seemed to react as if it were a complete instruction, and did not show any uncertainties in their behavior. The results of the experiment in the first situation are presented in Table 6.

Table 6: Results in the well-known situation

		$INSTRUCTION_{wp}$ (NCR_1)	
		solved	non-solved
$INSTRUCTION_{NA→}$ (NCR_2)	solved	48	1
	non-solved	1	0

According to the McNemar-test for dependent samples, the tasks are equally difficult when the number of persons who solved the first task (INS_{wp}) and did not solve the second task

($INS_{NA\rightarrow}$) is equal to the number of persons who did not solve the first but solved the second task. In the table above, the number is 1 in both cases. These results indicate that the tasks were equally difficult and the hypothesis $NCR_1 = NCR_2$ can be confirmed, i.e. that in a well-known situation, infants understand instructions without prepositions equally well as instructions with prepositions.

For the abstract **HiK-**Situation, the results are depicted in Table 7. Because the sum of the relevant fields for the McNemar-test for dependent samples is 14 and therefore smaller than 60, a Binomial-test was applied to this data. Assuming a significance level of 0.02 the results of the Binomial-test indicate that the tasks were not equally difficult. Moreover, the results of a one-way Binomial-test specify an inversion of the prediction assumed in the second hypothesis, which was made for the abstract situation (i.e. if the prepositions supply important information, then the infants will pay more attention to them and the task $INS_{NA\rightarrow}$ will be easier for them to perform). The trend predicted for this hypothesis was $NCR_3 < NCR_4$ (i.e. that abstract situation with prepositions will be solved more successfully). However, by a significance level of 0.0015, the data suggest the opposite $NCR_3 > NCR_4$ (i.e. that abstract situation without prepositions are in fact solved more successfully) as is displayed in Table 7.

Table 7: Results in the abstract **HiK**-situation*

		$INSTRUCTION_{wp}$ (NCR_3)	
		solved	non-solved
$INSTRUCTION_{NA\rightarrow}$ (NCR_4)	solved	2	2
	non-solved	12	4

* In contrast to Rohlfing (2001) these results show a stronger trend against the assumed hypothesis.

In the artificial situation, it seemed to be easier for the infants to react to an instruction without a preposition. This could be due to the fact that this type of instruction implied only a contact between the sphere and the ball. In contrast, the type of instruction implying a concrete location of the ball on the sphere was difficult for the infants to carry out. Thus, the second hypothesis that infants will pay more attention to prepositions to understand locative instructions in an abstract situation could not be borne out. On the contrary, the results suggest just the opposite: in the **HiK**-situation the preposition does not seem to supply any additional information concerning the location of the ball on the sphere; only the activity of attaching matters to the infants.

3.5 Methodological issues central to the interpretation of comprehension studies

Before starting the discussion of the results presented above, a few general critical considerations should be recognized with regard to the methodology used in this study. French and Nelson (1985: 83) have already noted that it is very difficult to draw any reliable conclusions from the use of performance failure as a measure as was used in the study presented here.

> If a child fails to demonstrate that she comprehends a particular term, it may be that she cannot comprehend the term (the invited conclusion) but it is also possible that she does understand the term but has failed to meet other task demands necessary for successful task performance. (French & Nelson, 1985: 83)

Secondary abilities such as responding to a desire uttered by an adult person, motor skills, etc. indeed play a crucial role in the correct response of a child. French and Nelson (1985: 84) object that it is not adequate to investigate "knowing about" language (in this case, knowing about a preposition), because it is preceded by "knowing" language. It occurs obvious that the authors separate infants' communicative abilities (knowing language) from linguistic reasoning abilities (knowing about language).

In the discussion here, however, infants' understanding of language is viewed as a process including both non-linguistic abilities and linguistic knowledge. It is therefore legitimate to interpret cases in which children failed to demonstrate comprehension as non-solved. It should be emphasized here that the theoretical argument underlying the results is based on a situative understanding of semantics. In this view, secondary abilities and non-linguistic strategies belong to the word meaning and it is assumed that the modular understanding of language develops later in form of a lexical competence. As will be discussed in the next chapter in detail, the argument is that the meaning of spatial prepositions that infants have at this age is not incomplete but different from the meaning adults have. It relies more on additional metalinguistic abilities. Nevertheless, these abilities are not only used by infants as suggested by Paprotté (1979: 211) but also by adults (Coventry, Prat-Sala & Richards, 2001).

3.6 Discussion of quantitative results

For the following discussion, it is helpful to return to the term lexical knowledge (cf. 1.2). The notion is applied task-dependently here and concerns the main question of how much information a child receives through a certain preposition. Thus, the term refers to the child's cognitive ability to abstract the meaning (the structure of the relation) of an ON-preposition and transfer it to every conceivable situation even if she or he has not seen this situation in her or his every day interactions. Similarly, Parisi and Antinucci (1970: 197) use the term lexical competence, which is defined as "the knowledge every speaker has of the meaning of the words in his language". The view proposed by the authors will be supplemented here

with a pragmatic component as "[t]his knowledge is primarily manifested in the ordinary production and understanding of sentences" (ibid) in every conceivable situation. Lexical knowledge is distinguished from conceptual knowledge, because there is evidence that conceptual knowledge about relations develops much earlier than lexical knowledge (see section 1.3). Concerning the semantics of spatial relational terms discussed in chapter 2, lexical competence should integrate all of the suggested aspects, namely the geometry, functionality and attentional change in order to guarantee the appropriate use of the meaning in production and understanding in every conceivable situation. This is also the view on understanding proposed in two-level semantics (see section 1.5.2). However, the results from the study present a different picture of infants' lexical competence.

The outcome from the well-known situation shows that in understanding instructions, the NA→ preposition does not play a privileged role. In solving the tasks, the situational cues were crucial, as assumed by the hypothesis related to this: when responding to the instructions without prepositions, infants carried out the NA→ (ON)-relation in the manner suggested by the nature of the LM-object. Only in two cases, during the cup / plate-set did the infants show other reactions. These 'mistakes' were interesting in their own right, and this will be considered in the qualitative results (see section 3.7).

The results from the well-known situation show that infants understand instructions containing the spatial relation NA→ (ON) very well. However, the results from the abstract situation suggest that their understanding does not correlate exclusively with their lexical knowledge about this preposition. The refutation of the second hypothesis on the basis of the outcome from the abstract situation suggests that in a new situation with artificial objects, the preposition in an instruction does not supply any additional information. Moreover, in this procedure, in which children were expected to respond to the preposition directly and to specify the location accordingly, the task seemed to be more difficult. Most of the children were not able to relate the preposition to geometric aspects of its meaning — which was required in order to respond appropriately to the instruction in the **HiK**-situation. These findings contrast with results from studies with adults who tend to respond in accordance with geometry-based semantic features when the functional aspects are not obvious in objects (cf. Coventry, Prat-Sala & Richards, 2001: 395-396). It, thus, cannot be assumed that infants acquire the meaning of a spatial preposition by first establishing a core meaning that consists of a geometric relation — as suggested by the Pomos approach formulated in the semantic task (cf. section 1.5.2). Infants in the study presented above did not demonstrate the use of such a core meaning in the **HiK**-situation. The findings confirm Tomasello's view suggesting that at "younger ages children simply do not possess the abstract syntactic competence characteristic of older children and adults" (2000b: 247). Instead, linguistic instructions are understood context-dependently. Understanding an instruction – against this background – arises from the integration of contextual and situational clues and includes knowledge strategies based on infants' knowledge about objects and events. The results from the study presented here suggest rather persuasively that infants pay much greater

attention to functional features in understanding instructions containing spatial prepositions. Nevertheless, a longer familiarization period with the construction used here could help to find out more about infants' behavior in the **HiK**-situation and about the relative weight of geometric features.

3.7 Qualitative Results

In the last section, it was shown that what infants know about objects dominates their understanding of spatial prepositions. Coventry, Prat-Sala and Richards (2001: 393) identify two different types of "object knowledge" in adult understanding (cf. also S. Johnson,1998: 211-212 for a developmental view on object knowledge). The first type concerns the functions that objects usually have, the second type characterizes how objects function in context. Using the terms introduced in 2.4, the first type refers to the intercontextual object knowledge, the second type to understanding, which is created situatively, i.e. in a given situation.

The focus of this section is on object knowledge in infants[4]. Questions to be considered include what representations the knowledge consists of and how this knowledge contributes to the solution of the tasks in understanding spatial prepositions (cf. sections 2.4 and 2.5). Possible answers have already been attempted in, for example, Clark (1973) who postulated two rules for object knowledge (see section 2.1) or Freeman, Lloyd, Sinha (1980) and Sinha (1982) who pointed out the effect of canonicality in understanding spatial prepositions (see section 2.4). Concerning the nature of such object knowledge, Clark (1973: 168) introduces the notion of non-linguistic strategies, which stands for knowledge oriented towards perceptual features. Similarly, Paprotté (1979: 211) argues for pragmatic-perceptual strategies ["pragmatisch-perzeptuelle Strategie"]. Both authors emphasize that strategies are believed to dominate infants' understanding of instructions with spatial prepositions (Clark, 1973: 162; Paprotté, 1979: 204). It is assumed that such strategies make infants more sensitive to the information provided by the situation than to the meaning of linguistic information. The function of the strategies – as they are presented in Clark (1973) and Paprotté (1979) – seems to be a compensatory one: since infants have not yet acquired full adult linguistic competence, they use these compensatory strategies when they are not sure about the instructions (Paprotté, 1979: 211). Paprotté suggests that with growing language control, such pragmatic-perceptual strategies are abandoned in favor of semantic-syntactic strategies (ibid). However, as already sketched in 1.3, it is not clear from a developmental perspective, how infants manage the transition from pragmatic-perceptual or the "motoric schema of reaction [motorisches Reaktions-schema]" (Paprotté, 1979: 207) to

4 With regard to the development of infants, the term object knowledge is not used here in the Piagetian sense, which involves the claim that children must learn that objects are independent of their own actions (Nelson, 1996: 94).

abstract linguistic strategies grounded in the conceptual system.

Despite the lack of clarity from a developmental point of view, the attempts at answers by Clark and Paprotté form the starting point for this section. An interesting account of why infants understand prepositions like IN and ON primarily, is expected in the analysis of non-linguistic information and the learning processes it is involved in. This analysis will be undertaken using various examples from the study presented above within the framework of Cognitive Grammar already introduced in section 2.5.

3.7.1 Trajector-Landmark asymmetry

Following the theoretical conclusions in Clark (1973) and Paprotté (1979), the conception of object knowledge can be reduced to two rules (Clark, 1973) discussed above in section 2.1. However, in the experiment just described, a differentiated behavior could be observed. In the following discussion, strategies entailing more than just the two rules are presented.

Considering the experimental task within the framework of Cognitive Grammar, the infants studied performed a relation between two objects: the trajector and the landmark. The relation between the objects implies the motion of a trajector to a landmark (see Figure 11), but the direction and the kind of the motion depends on the profile of the participants in this relation.

Figure 11: Trajector - Landmark alignment

Including the change of attention within semantic aspects is in line with Mandler's (1988) proposal to account for children's understanding of space by means of the spatial primitives of landmarks, which "play important and distorting roles in the formation of cognitive maps at all ages" (Mandler, 1988: 430). This was already mentioned in the context of the aspect of topology (see section 2.1.1). The respective importance of the roles of the different participants was already mentioned in section 2.5 following Carstensen's (2001) semantic explanation of spatial relations. From a developmental perspective, Mandler (2000a: 8; 2001), Gasser, Colunga and Smith (1999) and also Nelson (1996: 110) place emphasis on the assigning of various participants of a relation to specific roles in order to keep distinct situations conceptually separate and receive "minimally adequate semantic descriptions" (Langacker, 1998: 10) while focussing a participant.

How important the roles of trajector and landmark are for infants in discerning a relation, will be exemplified with a case from the experiment presented above. One child had been excluded from the scoring because of the intervention of her mother, who was trying to take control of the communication and instruct the child on her own (see Table 8). The child seemed to have concentration difficulties, and the mother wanted to help her to follow the particular

instruction. In keeping with this, however, the mother's instructions were uttered in a different way, probably tuned to the concentration difficulties the girl had. Attracting the girl's attention, the mother first focussed on the trajector. Then, as the girl managed the first part of the instruction, the location, in other words the landmark, was specified. As the questions (4) and (7) in the transcription show, the trajector–landmark alignment evidently forms a basis for understanding relations, and the focus of attention plays a crucial role in performing the experimental task correctly.

Table 8: Focussing trajector and landmark — an excerpt of a transcription

	MOTHER	CHILD
1		puts a toy horse on a plate
2	Daj go na schody! Daj! Put it [= the horse] on the stairs [= on bridge]	
		looks around
3	Oliwka, na schody! Oliwka [= first name], on the stairs!	
4	Gdzie masz konika? Where do you have the horse?	
		grabs the horse and holds it up
5	To daj go na schody, no?! So, put it on the stairs, will you?!	
6	Daj go na schody Put it on the stairs	
7	Gdzie sa schody? Where are the stairs?	
		grabs the bridge and holds it up
8	No, tu! Yes, here	
9	To połóz tam konika Then, put the horse there	
		puts the horse on the bridge

Within the framework of Cognitive Grammar, therefore, in the experimental task, a non-linguistic strategy (that is, a behavior motivated through object knowledge) is assumed to motivate the roles of the objects (trajector or landmark) and the motion. Altogether four strategies based on the asymmetry between landmark and trajector could be observed.

3.7.2 Non-linguistic strategies within the framework of Cognitive Grammar

Trajector is profiled

In the experiment presented in this chapter, it was clear that participants typically focussed on one object exclusively, even though two were presented to them. In this sense, they attend to the relations possible with a single object. Such relations are derived from activities performed with the objects, for example drink for the cup or the juice (see Figure 12). In other words, they link an object to a certain activity (see e.g. Thiel, 1985: 198).

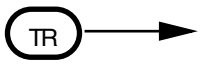

Figure 12: The trajector and its dominion

Even in this simple linkage, infants' relational knowledge about objects is already manifesting itself. Infants are demonstrating what Freeman, Lloyd and Sinha (1980: 243) have termed the canonical orientation of an object (see section 2.4), i.e. they know how to place a table upright, how to hold a pen, etc. This canonicality constitutes the basis of infants' knowledge about objects and sets up conditions for recognizing the object / artefact and handling it 'correctly'. Apparently, this type of non-linguistic knowledge about objects in infants already displays culture-specific aspects. In our cultural group, a basket, for example, resides in its canonical orientation when it serves as a container for transporting something with the opening upright — and not with the opening upside down for catching something (Sinha & de López, 2000). How an object is handled is grounded in "canonical rules" (Sinha, 1983: 276), which are preserved by the cultural group and provided by humans', social interest and value. Sinha (1988: 204) concludes that knowledge of the material world is "fundamentally social"; cups, for example, do not occur naturally, but must be produced. To be a drinking vessel, a cup must be a container and possess a certain structure (Sinha, 1983: 276). Canonical rules influence this structure and assign to a cup in its canonical position its function as a container. Similarly, Nelson (1996: 95) points out that what the child is learning or constructing is not laws of object relations, but rules of social interaction with objects.

The principle of canonicality is grounded in children's experiences with objects and events and builds up a child's expectations about these objects and events. In this sense, canonicality belongs to the intracontext of a child, i.e. its individual experiences with the world and the individual meaning she or he assigns to them. The strategy of acting in accordance with canonicality, in turn, develops by perceiving situations which are influenced by the intercontext. More concretely, a child identifies the role of an object within a socially created situation (i.e. how the objects are used) and then builds up an expectation for the next time that she or he is confronted with it in a certain situation.

In the study presented above, when presented with a cup, Marcel (23 months old) imitated the activity of drinking or serving immediately with the accompanying culturally appropriate

knowledge of how to grasp the object. Similarly, in the **HiK**-situation, eleven out of nineteen children associated the mobile ball with the activity of to roll or to throw away. That is, they were seated in front of the **HiK**-construction, but as soon as the mobile ball was introduced, they grasped it and rolled or threw it away. In this case, no landmark is needed for the associated activity, because the child's attention is on the trajector. The trajector is also the reference point. Accordingly, its dominion (Langacker, 1998: 7) or "background knowledge" (Sinha, 1983: 269) is activated.

It seems obvious that in accordance with this strategy functionality as a semantic aspect plays a crucial role for creating a dominion for the participant. The child observes this participant object in a situation and is attentive to its "functional or dynamic relations" (Nelson, 197: 276). The activity associated with the participant restricts how to orientate it. The abstract schema of this strategy can be compared with the pattern in sentences (9) and (10) because of the way the trajector is profiled.

(9) The pen writes.

(10) The ball rolls.

In these cases, the structure with intransitive verbs consists of the trajector only and profiles a canonical aspect of the objects: in (9), it is necessary to know how to hold the pen for the activity of writing. To understand (10) it is necessary to know what motion a ball can make. In comparing the strategy the infants used to handle the presented objects with the pattern of the sentences (9) and (10), a similarity can be found in the way the dominion is needed for both understanding these sentences and handling the object. The dominion is associated through profiling the trajector.

Landmark is profiled

The next strategy to be discussed is also reported in Clark (1973; cf. section 2.1). She argues that infants' relational behavior is guided by the physical properties of objects. If the object presented includes a surface, further objects will be assigned to the trajector role and placed ON the initial landmark. If the object presented is a container, the infants will put the other object IN this landmark. This behavior dominates language understanding to such an extent that infants will typically place a pot ON a table, even if they have been requested to put the pot UNDER the table. In this case, a non-linguistic strategy suggests a certain relation on the basis of physical properties of the landmark (see Figure 13).

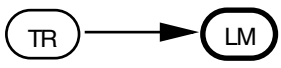

Figure 13: The landmark is profiled

Again, the canonical orientation of an object as observed by Freeman, Lloyd and Sinha (1980) and Sinha (1982) is a part of the object's perceptual properties, because of the culture-dependent functionality arising from it. "Culture is an inherent part of function" (Thorseng, 1997: 4), i.e. it is important to know how to place a table in order for it to support something. In a new but similar situation, when infants see an unknown object (e.g. a bridge), they try to associate it with an object they already know well (e.g. a table) and merge it with its appropriate canonical orientation. In the experiment presented above, only one child had problems using the bridge in its upright position and instead used it upside-down like a crib.

Behavior in accordance with this strategy could be observed in Julia (25 months old) when playing with the objects after the experimental session. For a short time, her attention was focussed exclusively on the table and on putting objects on it; it did not matter what she had in her hand, it was the surface of the table that was crucial. She pointed with her finger to the surface and put a horse on it. In this situation, the landmark seems to activate background knowledge, the dominion for further conceptions of the situation: the table (or its physical properties) triggers a certain dominion. This dominion suggests the relation ON, and motivates corresponding behavior with the trajector. In this case, the landmark and its physical properties are the focus of the child's attention and establish a dominion for relationships and the infants' further conceptual considerations.

In the **HiK**-situation, it was difficult to observe behavior in accordance with this strategy, because the **HiK** was specifically constructed so as not to provoke a certain relation with its physical properties. For this reason, the construction intentionally avoids the shape of a surface or a container. Nevertheless, at least three of the nineteen infants (16%) used the bottom of the wooden construction to put the ball on it (see Figure 14).

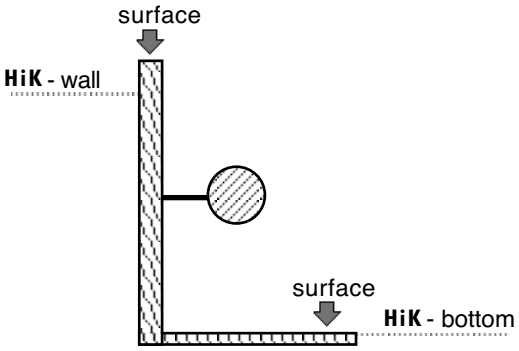

Figure 14: Surfaces in the **HiK**-construction

One of them, Mateusz (26 months old), put the mobile ball on the top of the **HiK**-wall, as this has a small surface as well. This suggests that infants pay attention to physical properties of the landmark and have a predisposition for discovering well-known properties like surface and containment even in an artificial situation. These findings support Paprotté's (1979: 211)

observations: “Unbekannte Objekte werden daraufhin überprüft, ob sie perzeptuelle Merkmale aufweisen, die denen der Alltagsgegenstände entsprechen” [Unknown objects are examined to see whether they have perceptual features correlating to the features of everyday-objects].

In keeping with this strategy, the landmark with its specific geometry functions like a profiled target creating a dominion for a certain behavior. The crucial difference here – in comparison to the previous strategy of profiling the trajector – is that the geometry of the landmark rather than the trajector functions as a semantic factor for creating a dominion. Once again, the functionality is strongly bound to the geometry of the object: an object with a surface supports something. If the surface is not horizontal, the object will fall or roll down.

The Landmark or the Trajector is profiled

The next strategy can be viewed as a generalization of the previous two strategies and can be traced back to Thiel (1985: 192), who argues for the relational character of objects [“relationaler Charakter eines Objektes”]. Making use of this strategy, infants link a certain activity to a type of object in a particular orientation. This relational character is highly subjective because of the child’s individual experiences, i.e. which activities the child has observed with a certain object. If a child observes that objects are put on a plate, the plate will play the landmark role motivating the ON-relation (as a result, other objects are put on it). The objects that are put on the plate (like food or cups) take on the trajector role, but the child knows that this role is only possible with an appropriate orientation of the object (see Figure 15). An object’s character consists of the sum of the object’s roles and creates expectations about the roles the object will play in future situations. If a child observes a plate in the exclusive role of a support (e.g. for food), she or he will know the plate only in this trajector role. In a later situation, upon seeing a plate, the child ‘calls up’ precisely this role and tries to relate other objects to it appropriately (e.g. the child will put a toy-horse ON the plate).

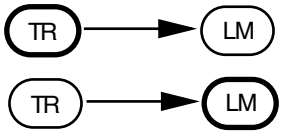

Figure 15: The trajector or landmark is profiled

After the experimental session, Szymon (25 months old) was playing with a plate. For him the object obviously had a landmark role functioning as a support since Szymon put a lot of objects (sheet of paper, horse, pen) on this plate. In addition, a cup clearly functioned in a landmark role for Szymon, as evidenced by the fact that Szymon put some things in the cup in an unconventional way, for example, a horse or a bridge in the cup, even though they were definitely too big to fit in the cup. It was obvious that the landmark-object (the cup) was profiled in constructing these relations.

In the **HiK**-situation, the landmark was linked to the activity attach, because the balls were covered with Velcro®. After the infants had played with it and discerned the possibility of attaching, three of the participants tried to attach other objects like a horse or a cup to the passive sphere. In this case, the landmark (the passive sphere) was profiled and expected to cause the function of attaching. However, in the **HiK**-situation, the trajector can be profiled as well. Jonasz (23 months old) examined other objects like a chair or the **HiK**-wall for the property of attachment and tested whether the mobile ball could be attached to these as well. In his case, the function of attachment was associated with the trajector (the mobile ball).

One can argue that there is no justification for making a difference between the character of objects (cf. Thiel,1985) and the strategy of using the inherent physical properties of the landmark as described initially by Clark (1973). The character of objects can, indeed, be considered as merely an extension of Clark‘s strategy. Nevertheless, as has been shown it is not only perceptual properties like ‘surface’ or ‘containment’ that can profile the landmark-object and lead to a certain behavior in infants but also other functional properties such as, for example, attachment in the **HiK**-situation. It has also been shown that it is possible for a trajector to take on a certain relational character and be profiled. The crucial difference between Clark‘s and the strategy proposed here, then, is that Clark‘s strategy allows only for the landmark to be profiled and then based only on physical properties such as surface and containment. The strategy presented in this section, on the other hand, makes it possible for the trajector to be profiled (cf. Thiel, 1985) and for this to not necessarily be based on physical properties but alternatively (or additionally) on functional properties such as attachment.

Typicality of a situation

In 3.4, it was already mentioned that in only two cases with the cup / plate-set did the infants show other reactions in understanding than the expected relation. It is interesting to analyze these so-called mistakes.

Marcel (23 months old), for example, after receiving the instruction to put the cup plate! put the plate ON the cup. His reaction was a surprising one, because the plate was expected to suggest an ON-relation in accordance with its relational character. Paprotté (1979: 207) also reports on children’s certainty in placing a cup on the plate, even though his instruction was “Teller auf Tasse [cup on plate]”. At first glance, it seems that the child was not able to assign the roles to the objects as suggested in the instruction. However, after consultation with Marcel’s mother, it turned out that she is accustomed to making tea in such a way that she first puts the tea in a cup and then covers it with a plate to keep it warm while it brews. Thus, in trying to solve the task, the boy imitated a situation that was well-known to him. In this example, the movement of one object towards another as required by the relation was motivated by the typicality of the situation as a non-linguistic strategy. Again, this strategy accords with a particular experience of the child. The child perceived the situation task-

dependently as he assigned a certain relation to the appearance of both objects (see Figure 16). It is less plausible to assume that the roles are already marked in this case. Rather, the appropriate constellation involves both objects simultaneously.

Figure 16: Typicality of a situation: relation between objects is profiled

In the training study – which will be described in the next chapter – there are also indications that the roles have to be established with experience. The experimenter demonstrated the relation UNDER with a roof and a dog: the dog was placed under the roof. Imitating, the UNDER-relation first time, Artur (23 months old) put the dog in front of himself and covered it up with the roof. The constellation was imitated well, even though he ascribed other roles to the involved objects (the dog as a landmark and the roof as trajector).

The functional semantic factor underlying the relational character of objects (cf. Thiel, 1985) and the canonical orientation (Freeman, Lloyd & Sinha, 1980; Sinha, 1982) follows from such a task oriented situation. Nelson (1996: 93-94) terms this beginning point "event knowledge", whereby the event is characterized as consisting of an "organized sequence of actions through time and space that has a perceived goal or end point".

> To have knowledge of an event is to have organized knowledge of the sequence of actions, that is, to represent the temporal order in which the components of the event take place, and of the causal relation among actions within an event (Nelson, 1996: 96).

If the child observes a specific kind of tea-making and gets used to it (typicality of a situation), she or he will associate the plate with the activity of covering, and the character of the plate is in this case is a trajector.

3.8 Discussion of qualitative results

Three points are worth noting in the summary of infants' non-linguistic strategies as analyzed here in terms of Cognitive Grammar.

The first of these is that the strategies presented above seem to have in common that canonicality forms the basis of infants' object knowledge. In terms of attentional change, Sinha (personal communication, 1.11.2001) proposes that canonicality stands for conventional profiling of objects. These conventions, in turn, are derived from cultural values and determine how an object / artefact should be handled. For this reason, the belief that the object knowledge presented above in form of strategies can be developed by the child independent of culture or language must be rejected. However, the reason for this is not that the language system is prominent in the categorization of spatial relations. "Clearly, children do not wait for language to instruct them how to represent and interpret spatial relationships in concrete situations" (Bowerman & Choi, 2001: 478). Rather, the results from the

experiment presented above indicate that the role linguistic information plays in understanding spatial relations is less significant. The language-specific and culture-dependent variables are already transported non-verbally and help in the later understanding of linguistic input. To put it another way, when a child perceives an object, the culture-dependent variable is already playing its role, because the object is presented in a particular way within a particular social group. Nelson (1996: 96) emphasizes, “event knowledge is social knowledge and social knowledge is event knowledge”.

This fact leads to the second point worth noting. Even though the four strategies seem to differ in the focus of attention, they also seem to interact with each other: profiling the trajector is based on the canonical orientation of a given object, which is also crucial in the relational character of objects. The relational character is, in turn, an extension of Clark’s perceptual properties-strategy. The typicality of a situation, however, forms the centre or basis of background knowledge, since all of the strategies discussed above can be derived from it. The experience of a relation in a certain situation seems to provide information that is crucial for a child in building up her or his knowledge about the interaction of objects. In later, similar situations, the child associates a known action with these objects and takes into account their canonical orientation. The child extends her or his knowledge about an object by observing its roles in different activities in different situations. Information from these various observations helps the child to establish a character for an object — a kind of concept (see Figure 17).

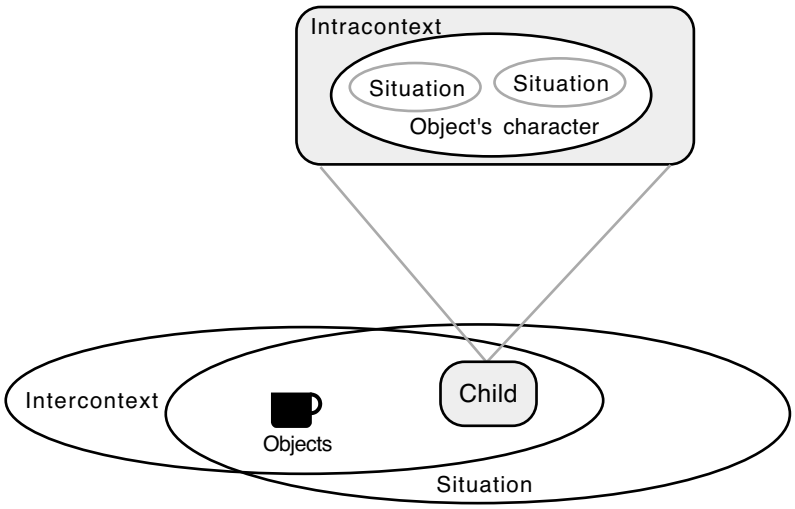

Figure 17: The interaction of inter- and intracontext

On this basis, the child knows which relations are possible with this particular object (cf. Nelson, 1974: 279). In other words, the character of an object consists of the sum of its roles: if a plate functions only as a support, the child will know the plate only in this role. In a later

situation, upon seeing a plate, the child will activate this role and try to relate the other objects to it appropriately. This intracontextual knowledge dominates the child's further actions in later situations and serves an important function: the child knows what a plate is for. In keeping with this, when a situation is designed to motivate a certain expected relation – as in the well-known situation in the experiment presented above – it is possible for infants to understand an instruction without a preposition. In this case, the understanding is supported by situational cues. More specifically, based on the character that the child has created for an object (i.e. the state of knowledge about an object, the dominion), a certain role is allocated to the object, which decides about the relation.

The internal interaction of strategies leads to the idea that the strategies are linked to each other and form a bundle. This idea ties in well with the suggestion made by Paprotté (1979: 212) who views the meaning of a preposition as a bundle ["Bündel[s]" or "Strategie-bündel[s]"] of relevant pragmatic factors.[5] The bundle represents possible responses on the basis of a different focuses of attention, i.e. profiling the trajector and / or landmark and activating background knowledge associated with them. However, as the example of the child Marcel (described in section 3.9.2) demonstrated, he knew about two different relational possibilities with a plate depending on particular aspects of the situation, for example, the co-occurring object. For this reason, the notion of background knowledge or dominion should be rethought, as it is not limited to a canonical orientation or the two rules formulated in Clark (1973) that are based on perceptual features.

Finally, against the background of the analysis conducted in this section, the results presented in 3.4 can be interpreted more globally. The four strategies presented have been identified as relevant pragmatic factors, which support the understanding of the preposition ON. In the analysis of how strategies contribute to the meaning of prepositions, it was shown that the meanings used by infants at the age studied are based on functional (Vandeloise, 1994), attentive (Carstensen, 2000; 2001) and geometric factors. The relevance of geometric factors was indicated in the analysis of the rules proposed in Clark (1973). However, the geometry used at the age studied is strongly bound to the function of objects, i.e. that a surface is connected with the function of support. Children's conception of geometry at this age can scarcely be abstracted or transferred to artificial objects such in the **HiK**-situation. What is possible in adults – that geometric properties alone can be used to evaluate the appropriateness of spatial terms where there is no information about the function of objects involved (cf. Coventry, Prat-Sala & Richards, 2001: 395-396) – is highly limited in infants' problem solving.

Objects like tables, bridges, plates are used to support something. The canonical relation linked to them is ON, because different trajector-objects are put on them. In their everyday

5 " [...] Bedeutung der Präpositionen als Funktion eines Bündels relevanter pragmatischer Faktoren [...]" (Paprotté, 1979: 212).

life, infants perceive the most basic function of objects foremost and initially disregard which further relations may also be possible with them. The ON-relation is presumably more constrained by the environment as physical constraints like gravity are entailed. S. Johnson (1998: 235-236) points out that gravity is a fundamental environmental constraint on object behavior, because it constrains highly reliably the ways in which objects behave. In this sense, the geometry of an ON-relation can be discerned easily by infants by testing whether an object is supported by another or not.

3.9 Conclusions

As the quantitative results from the last chapter and the analysis in this chapter show, children's understanding of spatial relations seems to rely on object knowledge that presents itself in a bundle of strategies. These strategies form the basis for the process of understanding spatial relational terms and the appropriate use of objects. These findings contradict the semantic tasks formulated from the viewpoint of Pomos and Cognitive Determinism, as infants do not necessarily develop a core meaning or a meaning consisting of necessary and sufficient conditions for understanding instructions.

The precise nature of infants' understanding supported by their object knowledge in the form of strategies was already questioned at the beginning of this chapter. Against the background of the quantitative results, the following alternatives seem plausible. When infants understand instructions containing spatial prepositions, their understanding stemming from conceptual knowledge is incomplete, as it is dominated by situational cues about actual objects involved rather than knowledge of the meaning of the preposition used. Alternatively, infants' semantic knowledge could be seen as already complete because their knowledge about objects or intercontextual influences belongs to the meaning of spatial prepositions.

Gentner (1982: 301), for example, pleads for the incomplete understanding theory suggesting that infants have an early preverbal knowledge about objects only, because they are more given ontologically whereas relations are more arbitrarily imposed by the structure and conventions of language. Also Gasser, Colunga and Smith (1999) assume a greater relative difficulty in acquiring words to talk about relations as opposed to words to talk about objects.

The second alternative conclusion is supported by studies, in which it is emphasized that even adults regularly make use of their 'non-linguistic', in other words intercontextual knowledge, in everyday communication (Feist & Gentner, 1998; Garrod, Ferrier, Campbell, 1999; Feist, 2000; Coventry, Prat-Sala & Richards, 2001). It is therefore well-founded to focus on pragmatic factors, which seem to be an essential part of communication (cf. Strohner, 1995b: 50) and to investigate to what extent their influence changes within development.

If we admit that context-dependent factors such as attentional change (or to use Langacker's (1998) term: profiling) belong to the semantics of spatial prepositions, then the analysis of infants' non-linguistic strategies within the framework of Cognitive Grammar shows that the acquisition of the characteristics of grammatical relations begins much earlier than has been assumed in previous research. In explanation, the reasoning processes in the form of non-linguistic strategies used by infants suggest a structure of profiling participants and activating dominions similar to the pattern displayed for clause structure with subject and object presented in Langacker's (1987; 1998) Cognitive Grammar. It is therefore argued that infants have the ability to perceive the trajector-landmark asymmetry and direct attention to some entity for the purpose of then establishing mental contact with another in the sense of Langacker (1998: 7) well before they can express it in language. This ability to pay attention to the roles of objects within a scene seems to be crucial for the later development of syntactic constructions. In this sense, it appears that infants acquire some grammatical relations preverbally. This argument is supported by Carstensen (2001), who gives prominence to the feature of attention as a basis for the semantics of spatial prepositions (2001: 144). The importance of attentional selection was also clear in each of the strategies described above. The overall argument is further supported by Carey (2001) who concludes from her findings that the later development of specific language is based on more general abilities that infants have already acquired. The ability to perceive the trajector–landmark asymmetry may be one such ability. This ability is probably closely connected to underlying mechanisms for analyzing events into the roles that objects play. The suggestion that not only the content of a concept but also the processing mechanisms used to develop it belong to children's early spatial meanings, is already made in Sinha et al. (1999: 97). The authors imply, moreover, that the mechanisms underlying semantic development are not necessarily of a language-specific nature (ibid). An interesting avenue of future research is the question of whether the ability to perceive the trajector-landmark asymmetry forms part of processes such as the perceptual analysis postulated in Mandler (e.g. 2000: 69). Mandler emphasizes that when participating in or looking at events, infants characterize conceptually the roles of objects involved (Mandler, 2001; 2000a: 8), in terms of what they do and what is done to them.

Another question posed at the beginning of this discussion (cf. 1.3 and 3.7) concerned the nature of preverbal knowledge. It was discussed whether preverbal knowledge is senso-motoric (that is perceptual) or conceptual. The results presented in this chapter have confirmed the importance of the role that non-linguistic strategies play in understanding spatial relations at the age studied. This fact could be interpreted as supporting the theories established by, for example, Parisi and Antinucci (1970), Clark (1973), or Paprotté (1979). These researchers claimed explicitly that at this stage, infants' linguistic knowledge is incomplete and they therefore still have to learn and perfect their ability in this area to achieve adult-like performance in linguistic competence. However, as has been shown in the analysis of strategies presented here, the theory that the knowledge, which is applied through non-

linguistic strategies, is solely a part of the perceptual system is no longer tenable. The application of these strategies requires at least some level of recall which in turn "requires that information be encoded into the declarative (explicit) knowledge system" (Mandler & McDonough, 1997: 142). Using such strategies, infants' display their knowledge of objects, which, in turn, comprises several supporting skills, "some perceptual, some cognitive, and others rather more difficult to categorize" (S. Johnson, 1998: 212). Furthermore, it depends on a child's intracontext (which is influenced by the intercontext) as to which strategy is employed in which situation (see Marcel's reaction presented 3.9.2). Which strategy children will use in a certain situation cannot be predetermined as claimed in Clark (1973). This is an argument against the purely sensorimotor nature of the strategies.

If the assumption elaborated above is correct and the strategies discussed here are a part of conceptual knowledge, the question remains whether this knowledge at the age studied should be considered incomplete. Zlatev (1997: 195) believes that linguistic ability can be described as sophisticated when "the differentiation between utterance and situation [...] takes place as the utterance becomes extended over a large range of contexts". This is also the view of proponents of the two-level semantics theory. A descriptive term for the maturation process, – often regarded as the emergence of symbolic meaning – Zlatev (ibid) refutes the term decontextualization, because he is convinced that a meaning is not "context-free". Instead, he proposes the term transcontextualization. The process of transcontextualization as a synthesis suggested already in Nelson (1974: 276) is based on collecting experiences and knowledge about the roles of objects. Precisely this collection process was demonstrated in the strategies presented above. It was argued that a child extends her or his knowledge about an object by observing its roles in different situations. Information from these various observations helps the child to establish a character for an object. Since it seems difficult to determine how many different roles are needed in order to be able to develop a decontextualized meaning, the path that the argumentation about transcontextualization takes reaches an impasse. It, thus, seems implausible to view non-linguistic strategies as "sensorimotor language" (Zlatev, 1997: 185) and to assume a switch between this stage of language and that of "symbolic language" (Zlatev, 1997: 185). Rather, the results from the first study in this chapter and second study that will be described in chapter 5 indicate that infants already have the ability to transfer and abstract their knowledge but do not make use of it in everyday communication. This is the reason why a dynamic and continuous process of conceptual development seems much more plausible. This conception corresponds to the view presented in Mandler and McDonough (1998) who suggest that infants have already begun to form concepts at the age of seven months and that they base them on "conceptual differences in addition to perceptual ones" (Mandler & McDonough, 1998: 1274).

Not only has the nature of the strategies been discussed in this section, it has also been shown that non-linguistic strategies that are based on intercontextual knowledge are a relevant factor in understanding linguistic information at this age. Nevertheless, their

influence probably minimizes with time depending on the communicative task required in a particular situation. Overall, the role of object knowledge as manifested in the use of strategies can be summarized as follows. It has been argued that there is no sudden switch between the use of strategies and the use of purely linguistic information in understanding language. Through the analysis of the influence of strategies, it has been shown that the role of intercontext is omnipresent in the understanding of spatial prepositions. Terminologically speaking, there is no reason to assume that the strategies presented above are non-linguistic, because the results from the experiment presented above suggest that they are a part of linguistic understanding. The same has been reported from studies about adult communication (e.g. Coventry, Prat-Sala and Richards, 2001). The term prelinguistic does not account for the work of strategies either, because it implies the absence of language ability and can, thus, hardly be applied to the infants at the age studied, since they have already begun to talk. For these reasons, the strategies will be referred to as co-linguistic in the remainder of the discussion.

3.10 Summary of chapter 3

An experimental study conducted with Polish-speaking infants formed the central focus of this chapter. The design of the study aimed to test whether context-dependent semantic factors – best characterized in the interplay of situation and contexts (see section 2.4) – influence infants' understanding of instructions with spatial prepositions. The quantitative results confirmed this hypothesis. When a situation is designed to motivate a certain expected relation – as in the well-known condition of the experiment presented above – it is possible for infants to understand an instruction without a preposition. In this case, the understanding is supported by situational cues. Infants seem to rely primarily on their experience of what an object does or how it is used. In the qualitative analysis of infants' reactions, it is noticeable that infants study the perceptual features of objects, even the artificial objects in the **HiK**-situation, and try to relate them to objects they know well from their everyday interactions. These findings endorse the claim that infants do not perform solely on the basis of a linguistic instruction or on the basis of the preposition conveying a certain semantical core meaning. Rather, infants' understanding is strongly influenced by their co-linguistic strategies. Through the analysis of these strategies, it has been shown that the role of intercontext is omnipresent in the understanding of spatial prepositions. Intracontextually, the mechanism of profiling a participant is crucial for understanding spatial prepositions. This allows the child to create a dominion and thus make use of non-linguistic experiences. It was argued that infants have the ability to perceive the trajector-landmark asymmetry and direct attention to some entity for the purpose of then establishing mental contact with another (Langacker, 1998: 7) well before they can express it in language. The ability to pay attention to the roles of objects within a scene seems to be crucial for the later development of syntactic constructions. In this sense, it appears that infants acquire some grammatical relations preverbally.