The Semantic Organisation of 'Cut' and 'Break' in Dutch

a developmental study

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Marian Erkelens

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MA Thesis for the study of 'Taalwetenschap', Vrije Universiteit Amsterdam

Marian Erkelens
Roelof Hartplein 2F
1071 TT Amsterdam
(020) 670 15 96
Student number 1091727

First supervisor: Prof. Dr. M. Bowerman
Second supervisor: Dr. A. Majid
Second reader: Prof. Dr. G. E. Booij

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Foreword

After four years of studying linguistics it was a pleasure for me to be able to make my theoretical knowledge practical by doing an experimental study all by myself. I did not hesitate before accepting the opportunity my supervisor, Melissa Bowerman, gave me to join in the 'cut and break' project at the Max Planck Institute in Nijmegen. The current study is a first step towards a developmental approach to the 'cutting and breaking' domain. Hopefully this study can contribute something to the larger project at the Max Planck Institute.

Although some foreknowledge about theoretical linguistics is an advantage, any English-speaking adult should be able to understand the study I performed by reading this thesis. Chapters 1 and 2 are the most theoretical ones, outlining the background of the issues relevant to the study. Chapters 4 and 5 are the most technical, describing the method and results of the experiment. In the unhoped-for case that the reader is interested only in the research questions and conclusions, the reading of chapters 3 and 6 will do.

The result of my efforts, the present thesis would not have been anything like the present without the help and support of my supervisors at the Max Planck Institute, Melissa Bowerman and Asifa Majid: to both of them I owe much gratitude for the time and the effort they invested with respect to both the progress and the contents of this study.

I thank the direction, personnel and children at NSO 'De Zeppelin' and KDV 'De Hoogvlieger' for their permission for and cooperation with my experiment.

For mental support I would like to thank my boy friend Wolter, and for mental-financial support my parents. A lot of my friends, housemates and relatives have helped me over the last year; partly by participating in the adult experimental group, partly by listening to my stories: thank you all, but special thanks to my brother Leon for reading and commenting on my draft versions, and to Nieske and Alle, who were willing to have lunch with me at the University when I needed it the most, this really speeded up the writing process.

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Marian Erkelens

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1 Introduction

One of the amazing things in life is how young children learn something complex like language. The acquisition of word meaning is the most visible development for us to follow. Who does not enjoy children of about one and a half years of age who start to express their wishes: *mummy, ball, there, sit*?

At first sight, acquiring word meanings (the semantics of words) is a simple matter of mapping word forms to meanings existing in the world. Children see their mother, want her attention and find out they have to say *mummy* to get it. They map the word *mummy* to a meaning like 'the woman who gives me things'. As simple as it looks, many researchers in the cognitive sciences have racked their brains over this process. There is more to it than there seems. The broad question of how children learn to map word forms to meanings is the main topic of this thesis. But one domain of semantic notions (i.e. 'cutting' and 'breaking') will be in particular focus. In this domain the acquisition of verbs plays an important role. Both the scope of meanings and the scope of linguistic expressions are in this way narrowed down to a study that can be handled.

Stating that word learning is a complex task is easy. But why is word learning complex? Why is it not just, as appears from the speech of small children around us, the description of the things you see around you in the words of your language? To answer this question the reader should know more about some important sources that play a role in the acquisition of language.

The first source is indeed the knowledge we have of the world around us. In communication we talk about the world we live in, for this is what we all can see, feel and think about. Because language expresses knowledge of the world, this knowledge plays a role in learning how to communicate. After all, we have to make a connection between this knowledge and language. We refer to this knowledge of the world with the term 'cognition'. Our cognition is an important basic source for learning language. A second source is language itself. When we talk about our cognition we use language, and in order to use language we have to organise our cognition according to mutually understandable notions. Such bits of structured cognition that we can talk about are often called 'concepts'. Concepts, thus, are organised bits of in our heads reflecting notions in the world. These notions can either be induced by the language or based on experience. To be able to talk about our concepts, we have to know which concepts are expressed in our language by which words. The mapping of these non-linguistic concepts to linguistic forms is not a straightforward process, as we will see now.

If all non-linguistic concepts had a linguistic counterpart in the form of a word, the mapping would be one-to-one. But this is not the case, since our language does not have words for all the things we have in mind. And different languages also differ in the way they map words to non-linguistic concepts. So non-

linguistic concepts have to be organised anew for the purpose of language. For a particular language a certain collection of meaning elements can be lexicalised, that is, expressed in a word form. Such a collection of meaning elements expressed by a word in language is what we will call a semantic category. Not all languages have the same semantic categories, for they group the meaning elements in different ways. Young children have to find out which particular concepts are described by which words in their native language. Here, the complexity of the word learning task becomes apparent.

To avoid the risk of getting stuck in theorising, this thesis has a specific topic: the learning of Dutch words for concepts in the so-called semantic domain of 'cutting' and 'breaking'. Later on this domain will be further specified. For now it will be sufficient to know that the linguistic part of this domain is particularly concerned with verbs like the English *cut* and *break*.

At this point the issues to be dealt with have been introduced. The next chapter will discuss the theoretical background of the issues in this chapter, elaborating the sources of word learning mentioned above: cognition and language. The specific domain of 'cut and break' will of course get more attention, too. After this theoretical basis we will move on to the study I conducted for this thesis: an experiment on how Dutch children and adults talk about 'cutting and breaking' events.

2 Theoretical background

As mentioned in the introduction, many researchers have puzzled over how children acquire words. In this chapter some of their research will be discussed in order to give a more thorough idea of the complexity of the matter. Secondly, more details of the semantic domain 'cut and break' will be given.

2.1 Cognition and language

The scope of this theoretical review is restricted to research conducted since the 1970s. Around the 1970s it was recognised that cognition is one of the important sources of word acquisition. In the last decade or so, increasing emphasis has been placed on the role of language in shaping word meanings. In this section I will first give an overview of the relevant theories about the role of cognition. Then I will turn to recent ideas about the role of language that are especially relevant for this study.

2.1.1 The role of cognition

The scientific climate of the 1970s has been described as the Cognitive Revolution. In several scientific disciplines, researchers put increasing emphasis on cognition. An important name associated with the Cognitive Revolution is that of Chomsky (1959, 1965). According to Chomsky, a big part of language is innate. That is, the competence to learn a language is a universal one. Children all over the world are born with this same competence. Based on this language competence, children form an abstract rule system for language. All languages in the world conform to the structure that is stored in this underlying capacity children have to learn language.

To find out what this underlying capacity for language learning actually consists of, researchers went looking for universals of language acquisition. They did so by comparing children learning many different languages (see R. Brown, 1973, and Slobin, 1973, for overviews). This comparison led to an interesting finding: children speaking very different languages turned out to express the same set of very general, non-linguistic concepts: notions like agency, action, location, possession and the existence, recurrence, non-existence and disappearance of objects (Bowerman, 1973; Braine, 1976; R. Brown, 1973; Slobin, 1970; 1973). How to explain this universal tendency? Could there be a universal conceptual basis for these semantic categories?

The work of Piaget (e.g. 1954) was used to help explain this remarkable universality of meanings. Piaget had investigated the early conceptual development of children in the first two years of life and beyond. In this research he found that children concentrated on the same kinds of concepts as researchers were now identifying in the linguistic analyses described above. What other explanation could there be but that children rely heavily on their early conceptual notions? They talk about the meanings that

are most available to them. So conceptual development was seen as basic to linguistic development. Research on cognition and language came together and provided new insights into matters of development.

Additional empirical evidence in this period came from the incorrect early uses of words by children. Bowerman (1978) and Clark (1973) reported children's use of words for a broader range of meanings than in adult use. That is, children often apply words to referents that an adult regards as lying outside the semantic category labelled by that word. This process is called "overextension". Examples of overextension are the use of a word like 'ball' for all round things, 'ice' for all frozen substances, and 'money' for all coin-shaped things (Bowerman, 1978; Clark, 1973). These overextensions suggested that children do have non-linguistic conceptual notions they want to express. Since they do not yet have the words for all these conceptual notions, they use the words they have and apply them to their non-linguistic concepts. Children often overextend not only the categories of simple object words, but also those of verbs. Several overextensions of verbs of separation like the English *open* were reported by Bowerman (1978) and by Clark (1993). Children used *open* for actions like:

- Trying to separate two Frisbees
- Unscrewing a plastic stake from a block
- Taking pieces out of a jigsaw puzzle
- Taking a chair away from the table
- Pulling up a tee-shirt to display the stomach
- Pulling a strip of masking tape so it dangles from the roll
- Unfolding a napkin
- Turning on the TV

Based on these uses of *open*, Bowerman (1978) proposed that the concept children label with this verb revolves around notions of 'separation' and 'revealing what is hidden'. Children arrange these underlying semantic notions in a different way than adults do and so overextend the use of *open*. These overextensions supported the claim that children want to express the non-linguistic notions they have in mind.

Summarising up to this point, in the 1970s a lot of empirical evidence pointed to a convergence of early conceptual and semantic development. Practically every researcher acknowledged the important role of cognition in development. For language development this meant that non-linguistic concepts were seen as preceding the linguistic forms. The process of first language development, according to this view, consisted of mapping linguistic forms onto the concepts that have arisen from non-linguistic development (see Bowerman, 2000 for discussion). This we will call the 'cognitive view': that learning words is finding out which words in your language map to which pre-established, non-linguistic concepts.

2.1.2 The role of language

If we pursue the cognitive view we encounter a problem concerning the mapping between non-linguistic concepts and semantic categories. Although languages can vary in the way they group conceptual notions into semantic categories, these semantic categories still remain representations of non-linguistic conceptual notions, according to the cognitivists. If you take the viewpoint that non-linguistic concepts basic to word acquisition arise in the course of conceptual development, semantic categories cannot have totally different structures than those universal concepts have. Language itself can not provide input for the structuring of conceptual categories, for these categories supposedly appear independently of language in the course of cognitive development. It is exactly on this critical point that recent research has shown some interesting cross-linguistic phenomena.

In many conceptual domains, languages structure meanings in different ways. Supposing, as cognitivists do, that non-linguistic conceptual notions underlie these domains, then cross-linguistic variance is a problem. The universal conceptual domains that are assumed are often crosscut by the meaning categories that different languages display. Take, for example, the conceptual domain of spatial relations. This domain has in the past served as good evidence for the claim that language maps to children's non-linguistic concepts. Spatial relations are typically conceptual notions children are aware of before they produce words to express these relations (see Bowerman, 1996 for overview). And when they start talking about these relations, they acquire the linguistic expressions for spatial relations in the same order as the spatial concepts have been found to emerge in non-linguistic cognition (Johnston & Slobin, 1979; see Bowerman 2000 for discussion). As discussed earlier in this chapter, the way children overextend a spatial word like *open* also points to this convergence of conceptual and linguistic development. But the semantic categories languages have for words expressing spatial relations are not universal at all, as has turned out in recent empirical research. This can be illustrated easily with the different categorisation for spatial notions to do with contact and support in English and Dutch (Bowerman, 2000). Actions like 'putting a cup on a table', 'putting a towel on a hook' and 'putting a ring on a finger' all belong to the semantic category of *on* in English. But if we take a look at Dutch, which is a language very closely related to English, we see that all these notions belong to different semantic categories. The preposition *op* 'on1' is used for putting a cup on a table, the preposition *aan* 'on2' for putting a towel on a hook and the preposition *om* 'around' for putting a ring on a finger. What we see here in the case of *op* 'on1' and *aan* 'on2' is the crosscutting of the conceptual category of English 'on', by the conceptual categories of Dutch *op* and *aan*. Although speakers of both languages have more or less the same basic conceptual understanding of what is going on in these spatial relationships, they have certain language-specific information that guides their word use. Numerous other examples of cross-linguistic differences in spatial semantic classification have been reported in studies over the last ten years or so (see Bowerman & Choi, 2001 on Korean and English; de Léon, 2001 and P. Brown, 2001 on the Mayan languages Tzotzil and Tzeltal). These studies suggest that the formation of semantic categories may be influenced by the

linguistic input. That is, it looks as if the semantic categories may not be direct mappings to non-linguistic conceptual categories, but are in a sense constructed through the guidance of the language being learned.

How can we test the hypothesis that language serves as a guide in the construction of semantic categories? How can we determine whether children not only have universal conceptual notions, but also language-specific notions? One way to test this is to study very young children for their sensitivity to language-specific conceptual notions. If children appear to be sensitive to language-specific conceptual notions even before speech production, the claim that they rely only on universal conceptual notions in early language acquisition appears untenable.

Such a study on very young children has been conducted in the domain of spatial notions. Choi, McDonough, Bowerman and Mandler (1999) have examined comprehension of language-specific categories in Korean and English speaking children between 18 and 23 months old. The specific notions they studied are expressed by the semantic categories *(put) in* for English and *kkita* 'interlock, fit tightly' for Korean. These two categories overlap each other, just like the earlier mentioned categories of English *on* and Dutch *in, om, aan*. As a matter of fact, the English category *(put) in* is crosscut by several Korean categories; Korean does not have a category such as English *(put) in* at all (for a more detailed discussion of the differences between Korean and English, see Bowerman and Choi, 2001). The extremely interesting finding of this study was that, even before producing the words, children were sensitive to the differences that are specific for their own language. These very young children already knew which notions are relevant for the semantic categories of their language and which notions are not. The English children knew that "containment" is relevant for *in*, but "tight fit" is not, while Korean children knew that the reverse is true for *kkita.* That is, sensitivity for language-specific spatial categories was present in comprehension even before language production began. These findings challenge the thinking that children have universal conceptual notions they use as a basis to fit the semantic categories of their language.

As well as providing evidence for differences in the spatial domain, Bowerman and Choi (2001: 502) also reinterpreted overextension patterns. In their paper they demonstrated that remarkable differences between English and Korean showed up in the overextension patterns: whereas English-speaking children overextended the use of the verb *open* to a lot of different referents, as illustrated earlier, Korean children hardly overextended the verb that is the closest translation to *open*. This pattern was accounted for by comparing the categorisation of 'opening' actions in English and Korean. The languages display very different organisation: Korean has many different verb categories crosscutting the domain of *open* in English, and these are also used for other actions that have nothing to do with opening in English. The Korean verb *ttutta* 'tear away from base', for example, is used to describe the action of

opening an envelope, but at the same time for an action like taking off wallpaper. Bowerman and Choi explained the overextension patterns by stating that in English, the scope of the verb is already so broad that children had trouble determining its boundaries. In Korean, in contrast, the scopes of the verbs are narrower: e.g., in *pellita* 'separate two parts symmetrically' (e.g., open shutters) or *pyelchita* 'spread out flat thing' (e.g., open book) the properties of the action are very detailed and concrete, so children apparently formed these semantic categories more easily. Again, this is more evidence that children construct their semantic categories in a language-specific way.

In this section we have seen that in addition to the role of cognition in language development, language itself plays an important role, too. A number of empirical studies over the last decade have shown that the mapping of conceptual categories to semantic categories takes place under the influence of the language you learn. Even the purely non-linguistic basis of conceptual categories themselves is called into question. Linguistic input that helps to organise the semantic categories might play an important role in conceptual development. Young children are sensitive to language-specific differences, so their concepts might be in a way constructed under guidance of their language.[1] To make the theory posed here more concrete, it is now time to take a closer look at a specific semantic domain, that of 'cutting' and 'breaking' events.

2.2 'Cutting' and 'breaking' events

The conceptual notions belonging to the domain of 'cutting' and 'breaking' are mainly actions, so verbs are especially relevant. First we will have a closer look at the phenomenon of verb learning, as opposed to noun learning. General verb learning issues will prove to be interesting, especially in studies of the 'cutting' and 'breaking' domain. After some general points about verbs we will turn to what "the domain of 'cutting' and 'breaking'" means exactly and what this domain consists of.

2.2.1 Verbs

According to Schaefer (1984), in an article we will come back to later, the meanings of verbs are even more interesting than those of nouns. In formulating this claim he draws on Fillmore (1968), who stated that verbs govern all possible semantic relationships that nouns can express in the same sentence. In a certain sense, verbs are the main building blocks of the sentence not only in structure, but also in meaning. Given such claims, it seems justified to emphasise verbs in this study.

Verbs have a different function in a sentence from nouns. Where nouns often refer to objects, things you want to talk about, verbs express the core event of the sentence. But does this difference in expression between nouns and verbs arise from a different semantic organisation? Gentner (1982) stated

[1] Whether or not these language-induced concepts also play a role in non-linguistic cognition (the Whorfian hypothesis) is not an issue here. The claim made here is about the development of semantic categories only.

that nouns and verbs do have a different semantic organisation. In her study she compared children learning English, Mandarin Chinese, Japanese, Kaluli, German and Turkish. She found that in all these languages children produced nouns earlier than verbs. Comparing the languages, she concluded that the difference was not due to linguistic factors like frequency of occurrence, word order or transparency of the word form in the adult language. If no linguistic factors can explain the difference in acquisition order, there must be an underlying conceptual difference between nouns and verbs. The exact nature of this difference is hard to establish, but Gentner did present some possible ideas about the differences. She hypothesised that nouns have a more transparent relation with the conceptual world. They refer more directly to the things given to us by the world. She stated that verbs have a less transparent relation to the perceptual world. These differences, according to Gentner, lead to differences in acquisition: object concepts, which are given to us by the world, can be learned by a single mapping, but predicate concepts form a system that must be discovered by the child. This hypothesis explained the slower acquisition of verbs in comparison to nouns. That is, the difference is due to a difference in semantic organisation. This difference in semantic organisation is supported by the findings of Huttenlocher and Lui (1979). In several recall tasks, these researchers found differences in the way verbs and nouns are processed, e.g. in a free recall test with a list of nouns and a list of verbs, the participants could reproduce nouns better than verbs. Huttenlocher and Lui claimed that these differences originate from different semantic organisation. Concrete nouns fall into closely related and hierarchically organised domains, they said, while verbs form a more matrix-like organisation.

The conceptual organisation of verbs is a complex problem to study. If verbs do not map simply to observable notions in our world, children have to discover the system of predicate concepts, before they can map forms to it. Observation of how Dutch children organise their conceptual categories for the domain of ‘cutting and breaking’ verbs is the goal of this study.

2.2.2 The ‘cutting and breaking’ domain

Up to now I have been mentioning ‘cut and break’ verbs as if these two verbs were the only interesting ones in the domain of study. What actually is meant are the verb classes that revolve around verbs such as the English *cut* and *break*. These two verb classes are similar in that they describe actions involving the separation or coming apart of objects. But they are also different in both meaning and structure; that is, both semantically and syntactically (Guerssel, Hale, Laughren, Levin and White Eagle, 1985; Levin, 1993; Pinker, 1989). ‘Cut’-type verbs are verbs like *cut*, *slash*, *chop* and *grind*. Those verbs all share some elements of meaning and have a comparable argument structure. ‘Break’-type verbs are verbs like *break*, *shatter*, *crumble*, *split* and *crack*. This class of verbs also shares some kind of meaning and argument structure.

The collection of events involving a 'cut'-type or 'break'-type action we will call the domain of 'cutting and breaking', or 'cut and break' for short. In the present study, films of such events were used to elicit linguistic descriptions. In showing such events to subjects, we presented a visual stimulus that presumably tapped into their conceptual organisation of this domain.

Now that we have a better view of what the domain of 'cutting and breaking' encompasses, we can turn to the questions from the previous sections and apply them to this particular domain. What can we observe in this domain about the universality of concepts, or about linguistic influences on the construction of conceptual categories?

2.2.2.1 Universality

As stated earlier, 'cut'-type and 'break'-type verbs form two distinct classes that differ from each other in meaning and argument structure. Comparison of the English verbs *break*, *cut*, *hit* and *touch* in a study by Levin (1993) led to the same conclusions. In an attempt to establish what the shared aspects of meaning are, she identified *cut* and *break* both as change of state verbs (the 'result' is important), while *hit* and *touch* are verbs that refer to the action itself. To distinguish *cut* and *break* she stated that *break* is a pure change of state verb, whereas *cut* describes a change of state by means of contact through motion. These differences in meaning are reflected in the way they behave syntactically, e.g. 'cut'-type verbs can appear in the conative construction while 'break'-type can not: *he cut at the bread*; * *he broke at the bread*.

These differences between the two types of verbs may be true for English but are they universal? Guerssel et al. (1985) carried out a cross-linguistic study to investigate different languages on their lexical organisation of these two classes of verbs. They compared the underlying structures of the verb classes in English, Berber, Warlpiri and Winnebago. It would take us too far afield to get into the details of this study, but their findings clearly pointed to an underlying universal representation of the two different verb classes along the lines of English *cut* and *break*. All four languages had some verbs with meanings comparable to *cut* and *break*, and within these two classes the verbs behaved similarly to each other and differently to verbs in the other class, both syntactically and semantically. These findings suggest that the difference between the two classes of verbs is indeed universal.

2.2.2.2 Contradictionary findings

In reaction to the Guerssel et al. (1985) study, Pye (1994) compared the treatment of 'break'-like verbs in additional languages. He discovered considerable cross-linguistic variation in the semantic features determining the boundaries of verb classes in different languages. Not a clear universal notion but a variety of different factors seemed to determine verb use for a 'breaking action'. In Mandarin, for example, the object is an important factor in the choice of a verb. Long objects require a different verb than short objects: the verb *dwàn* is used for the breaking of long objects like sticks and ropes, but the verb *può* is used for the breaking of plates and clothes. In K'iche' Maya different verbs are used for the four different

kinds of events of breaking hard things, soft things, long/flexible things and hollow things. Other factors that played a role in the different languages were things like the force, manner of separation and degree of resistance. The fact that different factors played different roles across languages led Pye to reject the idea of a universally valid set of semantic features for 'break'-type verbs. The meaning of 'break' is not determined by an underlying conceptual notion, but rather by the full range of uses. What learners have to do to acquire meaning, in this view, is to construct concepts of 'breaking' by observing all possible uses of the words and work out the governing semantic categories.

The acquisition of 'cutting and breaking' verbs is the subject of a study conducted by Schaefer (1984). Because this study is comparable in a certain way to the study I carried out, I will discuss it in some detail. The procedure used by Schaefer was to elicit the semantic categorisation of children and adults in a classification task. Participants were asked to go through a group of visual stimuli in the form of 33 coloured photographs several times. Each time, the participants had to decide, for each stimulus, whether or not the stimulus showed an action denoted by a given verb. This procedure was done for the five English verbs *cut*, *tear*, *open*, *peel* and *break*. The visual stimuli were all actions that fall more or less in the domain of 'cut and break'; Schaefer called them verbs of separation. He tested 10 nursery school children (ages between 4;4 [4 years and 4 months] and 5;2), 10 first graders (ages between 6;5 and 7;6) and 10 adults (ages between 19 and 30), all of whom spoke English as their first language. The visual stimuli were selected on the basis of pre-selected non-linguistic cues that could influence the manner of classification: the object acted on, the manner of the action and the instrument used.

The classification strategies of the adults and the children differed in many ways. Schaefer observed some main answering patterns. All these patterns showed differences in the way children and adults classified the stimuli. Whereas most of the adults assigned most of the stimuli to just one of the five verb categories, children tended to group them under more than one verb.

It is obvious that children differed from adults, but what were the underlying processes that led to these differences? Schaefer hypothesised that children weighted the relevant features determining the classification of the stimuli differently than adults. In particular, they may have weighted the feature 'instrument' disproportionately for some verb categories. For example, they often grouped all stimuli involving a knife under *cut*, irrespective of the action and the object; similarly, they often grouped all stimuli involving the instrument 'hand' under the verb categories *tear* or *open*. Children seemed to learn the correct weighting of the different features that establish a verb category only gradually. This supported the idea that semantic categories are constructed during the learning process. Category formation for English verbs of 'cutting and breaking', according to Schaefer, consists of determining the proper weight to give to the semantic features that comprise a category.

Another study of the development of ‘cutting’ and ‘breaking’ verbs was carried out later by Pye, together with Loeb and Pao (Pye, Loeb and Pao, 1996). These researchers studied children between 3 and 5 years old who were learning English, Chinese, or K’iche’ Maya. They found that children did not rely on universal concepts to acquire word meaning, but seemed instead to construct their own meaning paradigms. This idea of constructing the semantic categories relevant for your language emphasises the role of language input, as discussed in section 2.1.2. For the domain of ‘cut and break’ we see the same tendency as in the domain of space: an initial theoretical emphasis on universal concepts as basic to word acquisition, followed by empirical evidence which points to more diversity among languages. This has lead to the view that children are confronted with the task of determining how the semantic categories of their language are organised.

2.2.3 Summary

Now that we have a better idea of what the domain of ‘cutting and breaking’ events is, we see that this domain provides interesting insights into the arrangement of conceptual knowledge. On the basis of empirical studies different claims have been made about the exact organisation of verbs. Some researchers, like Guerssel et al., have claimed universal concepts for ‘cut’-type and ‘break’-type verbs. But others, like Pye and Schaefer have pointed to language-specific influences on category formation. The present study examines the organisation of the semantic categories of ‘cutting and breaking’ verbs in Dutch. The main question was how children categorise ‘cutting and breaking’ events compared to adults.

3 Setting the stage

Before turning to the description of the experiment I conducted, the background of the experiment and the Dutch domain of 'cut and break' will be clarified. In this chapter the full scenery of the experiment is put in place. The questions that are central to this study are an important part of this setting. After reading this chapter the reader should have enough information to see the present study in its full context.

3.1 Background

The big questions about how exactly word acquisition takes place can be studied by observing language data from children. By taking the semantic domain of 'cut and break', we have identified a part of language that is suitable for study, as exemplified in chapter 2. To explore this domain thoroughly it is necessary to compare how different languages organise this domain. This exploration would give answers to questions like: How do languages vary in the organisation of the verbs applicable to this domain? Is it true that a kind of universal distinction exists between 'cut'-type verbs and 'break'-type verbs?

A cross-linguistic investigation focused on these types of questions has been initiated at the Max Planck Institute for Psycholinguistics in Nijmegen (hereafter: MPI). At this institute one particular research group, focusing on language and cognition, is studying how different languages lexicalise 'cut and break' events. Over 20 languages have been studied so far and the cross-linguistic comparison of these data is in progress (Bohnemeyer, Kelly and Abdel Rahman, 2002). Some very interesting questions arise concerning language development in this domain. The way children acquire language can give insight into questions about the formation of semantic categories, as pointed out in the previous chapter. Therefore, plans are in progress at the MPI to examine the development of the 'cut and break' domain in some of these languages, too.

My own primary interest in linguistics is first language acquisition: how do young children learn their mother tongue? The developmental perspective of the investigation of 'cut and break' events is thus my favourite part to study. After reading the study done by Schaefer (1984, discussed earlier) I am convinced that the study of language acquisition in a cross-linguistic perspective can clarify a great deal about the organisation of semantic categories in language. This is how I came to the present study.

3.2 Research questions

To get an overall picture of the acquisition of 'cut and break' verbs, my study of Dutch ultimately has to be supplemented by comparable studies in other languages. Nevertheless there were some questions this study could deal with. First, the following question can be asked by comparing children and adults:

1. Do children and adults differ in the way they organise their semantic categories of 'cutting and breaking' events?

A second question of importance in this comparison was based on the ideas of Schaefer (1984):

2. Do certain meaning-related features (like the instrument or the manner of action) play a salient role in the categorisation?

A final question, which is in fact a fairly big question, was inspired by the recent developments in theorising about the role of language in the acquisition of word meanings:

3. Is the way children learn the categories in a domain influenced by the adult-like way of organising the domain semantically?

In order to say anything meaningful about these questions in the domain of 'cut and break' in Dutch I first needed to take a closer look at the lexicalisation of this domain.

3.3 Dutch 'cut and break' verbs

Inferences about the Dutch 'cut and break' domain could be made by analysing speech data elicited earlier in the 'cut and break' project at the MPI. For this project, a stimulus set was developed by Bohnemeyer, Bowerman and Brown (2001) consisting of 64 video clips depicting events of 'cutting and breaking'. Seven Dutch adults were asked to describe these stimuli for the purpose of the bigger cross-linguistic investigation. The data of four of these adults were available for me to analyse. I made an overview of the verbs used by every consultant, and tallied their frequency. These data revealed three rough groups of 'cut and break' verbs for Dutch.

The verbs in the first group were used frequently and their meaning seems to be clearly connected to the 'cut and break' domain: *stuk/kapot slaan* 'to slam broken', *scheuren* 'to tear', *breken* 'to break', *hakken* 'to chip', *snijden* 'to cut', *kapot trekken* 'to draw open/broken', *kapot maken* 'to make open/broken' *knippen* 'to cut', *zagen* 'to saw' and *pellen* 'to peel'.

The second group consists of verbs that all four participants used for certain stimuli, but that, in my native speaker's opinion, do not really belong to the 'cut and break' domain for Dutch. These verbs are *halen* 'to get', *schuiven* 'to shove', *openen* 'to open', *open/vanaf doen* 'to do open/off', *open trekken* 'to tear open' and *open maken* 'to make open'. The verbs *halen* and *schuiven* were used in describing certain actions (e.g., removing a chair from a table, putting a cup in a pile of cups) that are not clearly events of 'cutting and breaking'. The connection of the verb *open* to the 'cut and break' domain is also not very

clear, but in the stimulus set there are several scenes which depict opening events, such as “open a door” or “open eyes”. The reason that those events were included in the stimuli was to provide boundary cases for the domain of “cut and break”, but these cases do not belong to ‘cutting and breaking’ in Dutch. These verbs were left out of the analysis, although they might be relevant in a cross-linguistic perspective.

The last group is a motley collection of low-frequency verbs, each used by only one or two participants to describe certain stimuli presented to them. This group consists of the verbs *kappen* ‘to fell’, *klieven* ‘to cleave’, *vergruizelen* ‘to pulverise’, *spietsen* ‘to spear’, *prikken* ‘to prick’, *splijten* ‘to split’, *knappen* ‘to crack’, *spreiden* ‘to spread’, *verdelen* ‘to divide’, *ontdoen* ‘to strip of’, *mishandelen* ‘to ill-treat’, *slachten* ‘to slaughter’, *verpulveren* ‘to pulverise’ and *stoten* ‘to push’. It seemed obvious that these verbs do not represent the most central verbs of the domain. They have a meaning which is only applicable to a very specific kind of event. For example, the verb *klieven* ‘to cleave’ can only be used in the literal sense for the specific action of splitting up wood with an axe. This group of verbs does not represent the core of ‘cut and break’ verbs in Dutch.

Based on these MPI data, the first impression of the Dutch semantic domain of ‘cut’ and ‘break’ was that verbs from the first group form the most relevant verbs in this domain.

To make sure no relevant verb was missing from the MPI data, I checked the digitised version of a modern Dutch dictionary called ‘Van Dale Hedendaags Nederlands’. First I placed a filter on the word class ‘verb’, so that verbs were the only entries visible. To decide which of these verbs have a meaning connected to ‘cutting’ and ‘breaking’ I used my native speaker intuitions. All verbs listed in the dictionary were judged according to their measure of belonging to this domain. In the end, I found 85 lemmas of ‘cut and break’ verbs. Among them were a lot of particle verbs; the number of different basic verbs was only 37. The junction of these verbs with the verbs from the MPI data led to a list of 39 basic Dutch verbs for this semantic domain. These are listed in Appendix I.

3.4 Corpus research

The list of basic verbs gives an impression of what verbs belong to the ‘cut and break’ domain in Dutch. Because children have a shorter attention span than adults, an experiment designed to elicit descriptions from them had to consist of a relatively small number of stimuli; this meant that only a few verbs of interest (which I will refer to as “main verbs” from this point on) could serve as the basis for the creation of these stimuli. In order to find out which verbs from the basic list to use as main verbs in the experimental study, I carried out a corpus study. The goal of the corpus study was to narrow down the list of basic verbs to a set of four main verbs that could serve as the basis for the stimuli. To narrow down the list of basic verbs to a set of four main verbs that could serve as the basis for the stimuli, I carried out a corpus study. All the

verbs listed in Appendix I were analysed in the corpus in order to make inferences about their semantics and to determine which verbs are central to this domain.

Along with the main corpus study I did a second corpus study on child language. Because I wanted to include children in the beginning stages of learning 'cut and break' verbs in my experiment, I analysed corpora of spontaneous child speech to establish the age at which children start using the main verbs that I had identified in the first corpus study.

3.4.1 INL Corpus

The corpus used for the first study is the 5-million-word corpus gathered by the *Instituut voor Nederlandse Lexicologie (INL)* 'Institute for Dutch Lexicology'. The corpus consists of texts from books, periodicals, newspapers and TV broadcasts. Although the corpus is restricted by the availability of digitised texts, the diversity of sources makes the corpus suitable for drawing conclusions about Dutch language use (Kruyt, 1995). Access to the corpus for the purpose of this study was granted to me by the INL.

For every verb listed in Appendix I, the frequency of its occurrence and the contexts in which it appeared were retrieved. Because some of the verbs have more than one basic meaning, I filtered the list of occurrences so as to include only the uses of the verbs for literal 'cutting and breaking' events. This filtering removed especially figurative uses of the words, like *geen hout snijden* 'cut no wood' (used to express disapproval of something). The result of the corpus research was a document with all 39 verbs, their frequency of (relevant) occurrences and the examples of occurrences in their contexts. Based on this information, I made some decisions about which verbs would serve as main verbs for the experiment.

Of the list of 39 'cut and break' verbs, seven were used with high frequency (> 20 times) in the corpus: *breken* 'to break', *knippen* 'to cut', *scheuren* 'to tear', *snijden* 'to cut', *splitsen* 'to split up', *steken* 'to stab' and *zagen* 'to saw'. The particle-verb combination *kapot maken* 'make broken' was used rather frequently, too. This complex verb can be used very broadly, for almost all instances of 'breaking'. It is hard to describe its exact meaning, so I did not select it as one of my main verbs, but in the analysis of the experiment I will come back to it. Of the other seven verbs, *splitsen* and *steken* did not appear in the MPI data at all. The reason they appeared in the corpus so often has to do with their specific meaning in sailing jargon. One of the sources of the corpus data is a magazine for aquatics and these two verbs were used a lot in this source. Because the jargon meaning is in fact a 'cut'-like meaning the verbs were not filtered out, but the high frequency is not representative for Dutch everyday speech, so these two verbs were excluded as main verbs for the experiment. Of the five verbs left, the four most crucial verbs in the 'cut and break' domain for Dutch were identified. Very specific for Dutch is the distinction between *knippen* and *snijden*, so I wanted to include these verbs in any event. Of the three verbs left, *zagen* has a meaning closely related to the already selected verbs *knippen* and *snijden*, while the other two verbs *breken* and

scheuren represent a very different part of the domain. After these considerations the set of main verbs chosen for the experiment were:

breken – knippen – snijden – scheuren

These four verbs were analysed both extensionally and intensionally. The extensional analyses consisted of identifying all the contexts in which each of the verbs was used in the INL corpus, and noting the different instruments, results and objects of the events described, since these were likely to be important for the meaning of the verb. According to Schaefer (1984), these parts of the verb's extension provide cues to the probable meaning, its intension. To give an idea of what information children need to have in order to choose the right verb in Dutch, a few things can be noted about the intensions of the main verbs, based on the INL corpus:

- *Knippen* requires a scissor-like instrument with two opposing blades. The cut made by the instrument has to have the result that the original object consists of two separated pieces, although these pieces can still be connected to the original object. The object can not be a liquid substance.
- *Snijden*, as opposed to *knippen*, requires a knife-like instrument with at least one edge that has the sharpness to cut through the material of the object. The requirements for the cut are the same as with *knippen*. The object can not be liquid.
- *Breken* does not require any specific instrument, but if a scissor-like of knife-like instrument (as described in the two preceding bullets) is used in the canonical way, *breken* is not applicable. The nature of the break is an immediate, smooth and total separation of a part of, or the entire original object. For *breken*, as opposed to for *knippen* and *snijden*, the pieces have to end up totally separate from each other and have to be two or more pieces of the original object that were not identifiable as separated parts before the break. The object has to be solid, and fairly rigid.
- *Scheuren*, like *breken* does not require any specific instrument, but if a scissor-like of knife-like instrument (as described in the first two bullets) is used in the canonical way, *scheuren* is not applicable. The nature of the break and the object are very different from those associated with *breken*. The break is performed by tearing two pieces of the object from each other in the opposite direction. This break does not have to be smooth or complete, so the pieces can still be connected to the original object and the pieces often show frayed ends. The object has to be a non-liquid thing and if an agent performs the action, the object has to be flexible. The non-agentive use of *scheuren* is often connected to solid, natural materials like rock and wood (e.g., one of the instances in the INL corpus was: *De mast scheurde door de storm.* 'The mast tore by the storm')

These notions about the intensions give a characterisation of the most important aspects of meaning for each main verb. To give a good semantic analysis of all these verbs, much more information is needed about their usage in the Dutch language. But the analysis will do as a starting-point for this study, since it gives an idea of what the differences between the verbs are.

3.4.2 CHILDES-corpora

The second corpus study I did was designed to find out the age at which children start to use the verbs. Corpora of spontaneous child speech have been organised by Brian MacWhinney and presented in the Child Language Data Exchange System (CHILDES). In this system researchers share their child speech data from more than 25 languages. Some corpora for Dutch were also included, so I took this archive to find an answer to the question of what age Dutch children start to use the main verbs I had identified in the 'cut and break' domain.

There are five Dutch corpora, comprising samples of the speech of 28 different children. I downloaded these corpora from the Internet (http://childes.psy.cmu.edu/data/germanic/dutch). Analysis revealed that only nine of the 28 children used at least one of the verbs *knippen*, *snijden*, *breken* and *scheuren*. These 9 children are presented in the CHILDES corpora called 'Groningen', 'Schaerlaekens' and 'Van Kampen'. All occurrences of the main 'cut and break' verbs (*knippen*, *snijden*, *breken* and *scheuren*) and those of the complex verb *kapot maken* 'make broken' are listed in Table 1. The reason I included *kapot maken* in this study is because this verb was kept in focus in the analysis, although it was not taken as a "main verb" in designing stimuli. Erroneous uses of the verbs are marked with an asterisk (*). All contexts of occurrence are reported in the context column (note that children often use a word repeatedly in one particular context).

The verbs *knippen* and *kapot maken* appeared relatively often in the child language corpora. This can probably be ascribed to the contexts of playing and tinkering in which most of the speech was recorded. The use of the verb *snijden* was restricted to food, the use of *scheuren* to paper. The correct use of the verb *breken* was rarely present in the corpora. Overall, children around 3 years of age started using *knippen, snijden, breken* and *scheuren*, but the differences between the nine children are huge. The verb *breken* occurred especially late.

On the basis of this corpus research, we can conclude that the first uses of the set of main 'cut' and 'break' verbs in Dutch, as selected in § 3.4.1, emerged between 3;0 and 5;0. Therefore, the youngest age group in the experiment was between 3;0 and 5;0 (years; months).

3.5 Summary

This chapter has set the stage for the study described in the following chapters. First, four main verbs were selected from the entire domain of Dutch verbs that describe 'cut and break' actions. These four verbs were the starting point for the design of the stimuli, as described in the next chapter. Second, the approximate age at which Dutch children start to produce these verbs was determined, a piece of information used in deciding on the appropriate age groups for the experiment. We will now turn to the experiment.

Table 1. Occurrences of the main 'cut and break' verbs and *kapot maken* in CHILDES

Verb	Frequency CHILDES data	Context	Age of appearance
breken 'to break'	16	* taking out jigsaw puzzle pieces from a puzzle breaking off pencil points talking about breaking one's neck, hand * describing a picture of a house ruined by fire	2;06;11 5;05;14 3;05;18
knippen 'to cut'	57	mother cutting hair with scissors cutting paper with scissors cutting fingernails with nailclipper cutting cards with scissors cutting cloth with scissors cutting a piece of tape off the roll with scissors	2;10;13 2;11;06 2;11;27 3;06;03 3;09;19 4;07;25
uitknippen 'to cut out'		cutting a figure out of a piece of paper with scissors	4;00;06
snijden 'to cut'	18	cutting a piece of bread with a knife cutting a carrot in slices with a knife cutting a piece off a sausage with a knife cutting oneself in the hand with a knife	3;01;02 4;02;02
uit-/doorsnijden 'to cut out/through'		cutting figures out of clay	4;00;06
kapot maken 'broken-make'	34	talking about breaking toys smashing clay puppets taking apart the pieces of a puzzle preventing baby sister from breaking a paper tree/house	3;04;01 3;00;15 3;01;14
scheuren 'to tear'	11	tearing a piece of paper in two halves tearing pieces off paper	2;03 3;08;01

4 Method

4.1 Stimuli

The stimulus set of video clips that was used in the cross linguistic MPI 'cut and break' project (Bohnemeyer e.a., 2002), developed by Bohnemeyer, Bowerman and Brown (2001) was made to elicit descriptions of events from adults. In the present study I have used this method for eliciting descriptions from children. The method is a good way to collect natural speech about objects and events. Participants see an event and describe it in the way they find most appropriate. As opposed to a classification task such as that used by Schaefer (1984), the elicitation procedure used in the present experiment results in natural speech rather than explicit sorting. A classification task is more a judgment task than a language production task. It runs the risk that participants will classify actions as members of categories of verbs that they would never actually use for these actions in spontaneous speech.

The original MPI video clips were rather boring, because the actors acting out the events did not show any facial expressions at all. Since I wanted to focus on children, I had to create a new stimulus set that children would find attractive. In the development of the new stimuli I wanted to pay attention to features of the events which may be relevant to the meaning of the verb, as discussed in § 3.4.1, e.g. using a 'knife-like instrument' for *snijden*, or acting on a 'flexible object' for *scheuren*. Those features may serve as cues that play a role in speakers' decisions about what verb to use, as proposed by Schaefer (1984). A set of events that adults were likely to label with one of the four main verbs *knippen, snijden, breken* and *scheuren* served as the basis for making the stimuli, so that which verb adults would use to describe the stimuli could be predicted in advance. A subdivision in the stimulus set was made between familiar and unusual events, named "core" (familiar) and "strange" (unusual) events. The "core" events were events described by 'cut and break' verbs that occurred relatively high-frequent in the corpus. An event was considered "core" if the verb was used for it more than once in the INL corpus data. For every main verb I selected the most frequently occurring events, which resulted in four "core" events per verb, for a total of 16 "core" events.

The "strange" events displayed actions that were described by a main verb in the corpus only once or are not at all, but which are possible to be described by one of the main verbs. The reason to include these "strange" events was to test how productive children are in the application of a verb to novel events; do they apply a verb based on an abstract representation, or have they simply learned a description for certain very high frequency events? It was hard to say in advance with which verb the "strange" event will be described by the participants. To make an assessment of the verbs most likely to describe the events I based my ideas on my own native speaker intuitions, which I checked with my friends and colleagues. For only a few of the really odd stimuli was the labelling uncertain a priori. For the

others it was possible to make a prediction about the verb that would be used by the adults. Some of the "strange" events were taken from rare uses in the corpus data. Others were created by varying factors in the "core" events like the kind of object acted on, the instrument and the manner in which the action was carried out. The final number of "strange" events included in the stimulus set was 12. Together with the 16 "core" events, the total set of test stimuli comprised 28 events.

To explain the participants what they were supposed to do, some warm-up items were added to start with. As well as the warm-up items there were also filler items, interspersed through the experimental items. The goal of breaking up the experimental items was to minimise the influence of earlier stimuli on later ones. A second reason for including some filler items was to minimise another problem that could arise with young children. In analysing of the CHILDES data I found that children aged around 3;0 used the particle *kapot* 'broken' in combination with a auxiliary verb like *maken, doen, gaan* 'make, do, go' a lot. This combination can be used correctly for almost every 'cut and break' event. To make sure that the children I tested in the experiment would not simply say *kapot maken* all the time without really looking at the films, I selected events well outside of the 'cut and break' domain as the filler items. In sum, the filler items minimised the possibility of semantic priming between items. The warm-up items and the filler items were thus, six normal, everyday events that did not involve 'cutting' or 'breaking'. For a complete overview of all events recorded, see Table 2.

The acting and videotaping of these events took place at the Max Planck Institute in Nijmegen in cooperation with the staff of the Language and Cognition group and the Language Acquisition group, especially Melissa Bowerman and Asifa Majid. For each event I made a script that specified how the event should be acted out. The actors were instructed on how to act in as child-friendly a way as possible. We used many different actors to have variety in the films, and these actors all showed clear facial expressions like 'desiring' in the case of breaking chocolate or 'enjoying' in the case of eating a cookie. In addition to ensuring clear facial expressions, we used bright-coloured clothing and tablecloths. Some of the clips were recorded indoors and others outdoors. The goal of these manipulations was to make the events attractive and interesting for children to look at.

After video recording, the tape with the items was digitised by a member of the Max Planck technical staff. With the help of a multimedia-editing program called MyFlix, I edited the tape into multiple clips, each with a clear beginning and ending. After every item I inserted a black screen lasting five seconds to give the subject time to describe the event. There was a set of 34 items used in the experiment: 28 real test items, 2 warming up items, and 4 filler items.

Table 2. Complete list of stimulus events

Nr.	**"core" events**
	Knippen
1	Cutting paper with scissors
2	Cutting nails with a nailclipper
3	Cutting hair with scissors
4	Cutting cloth with scissors
	Breken
5	Breaking a bar of chocolate by hand.
6	Breaking a glass by bumping it off a table with an elbow
7	Breaking a twig by hand
8	Breaking a baguette by hand
	Scheuren
9	Tearing a piece of cloth by hand
10	Tearing a slice of bread in two pieces by hand
11	Tearing open a plastic bag by hand
12	Tearing a sheet of paper off a notepad by hand
	Snijden
13	Cutting a slice of bread with a knife
14	Cutting a banana in pieces with a knife
15	Cutting a twig off a tree with a knife
28	Cutting a rope in two pieces with a knife
	"strange" events
16	Cutting a piece off a banana with scissors
17	Cutting a piece of cake with a piece of a broken pot
18	Cutting the tip off a nail with a pair of pliers
19	Breaking a piece of a rope with a chisel and hammer
20	Tearing a piece of paper along a knife
21	Tearing a banana peel in two with a pair of pliers
22	Cutting bread with scissors
23	Cutting cardboard with a knife
24	Cutting a twig off a tree with an axe
25	Breaking a pot with a hammer
26	Cutting an egg in slices with a wire egg cutter
27	Cutting a bunch of spring onions by moving it abruptly against a static knife
	Filler events
	Eating a cookie
	Kicking a ball
	Drawing a face
	Opening a jar
	Throwing a ball
	Drinking a glass of juice

The test items were divided into two blocks, block A and block B, consisting each of two "core" events per verb and six of the twelve "strange" events. We made this division into two blocks in case the youngest children could not concentrate for as long as it took to play 34 video clips. By creating two blocks, labelled A and B, we made sure that even if children only responded to the first half of the clips, there would be enough data to analyse that were relevant to all the main verbs. Items in each block had two different random orders (A1 and A2, B1 and B2), with the proviso that the first event to be described was "core" and not "strange", and that no more than three events likely to be described by the same verb occurred consecutively. To control further for order effects, four different versions of the stimulus set were created by counterbalancing these blocks as follows: A1+B1, A2+B2, B1+A1 and B2+A2. After the insertion of two filler events at the beginning and four at equal distances in between the other items, the stimulus sets were complete. Each of these films lasts 10 minutes and 10 seconds. The order of the stimuli in all four films is shown in Appendix II. The films can be viewed by means of Appendix III, the CD-ROM.

4.2 Participants

The participants in the experiment were 23 children and 12 adults, all native speakers of Dutch. In order to be able to investigate the development of 'cut and break' verbs, we compared two different children's age groups: early and advanced language acquisition. The adults were included as the group having fully acquired the language. The choice of the children's age groups was based partly on the data from the CHILDES corpora and partly on the study performed by Schaefer (1984). The early language acquisition group was between 3 and 5 years old, as discussed in § 3.4.2. The group with advanced language acquisition was between 6 and 7 years old.

The youngest group of participants was recruited from the day nursery 'de Hoogvlieger' and the after-school children's care centre 'de Zeppelin' in the south of Amsterdam. Because there were not enough 4-year-olds present in these institutions, a few 3-year-olds were included, too. Eventually twelve monolingual Dutch children varying in age from 3;2 (years; months) to 4;11 took part in the youngest group of the experiment, after having received permission from their parents. The mean age of this youngest age group was exactly 4;0 years. All the children in this group lived in a rather highly educated part of Amsterdam and showed normal language development, as well as I could assess informally.

Eleven older children at the after-school children's care centre 'de Zeppelin' also took part in the experiment. This second group of participants consisted of children aged between 6;1 and 7;0 years, with a mean of 6;7. This group was comparable to the youngest group in the sense that they were monolingual Dutch children who lived in a highly educated part of Amsterdam. Unfortunately these were all the 6-year-old children available at the time of testing, so this group only had eleven participants while the two other groups each had twelve participants.

The group of twelve adults also consisted of highly educated, native speakers of Dutch living in Amsterdam. They were university and *HBO* 'higher professional education' students studying diverse disciplines, and they varied in age from 18;9 to 23;9 years, with a mean of 21;7.

4.3 Procedure

For the two youngest groups, the testing took place in the playroom at the after-school children's care centre 'de Zeppelin'. The children felt at ease and all the equipment was available. A small table was placed in the playroom. A laptop stood on this table in front of me, i.e., the experimenter, and a computer monitor stood in front of the child. Both experimenter and child were seated on small chairs at adjacent sides of the table. The child could see the clips on the monitor but the experimenter could not. If necessary, the experimenter could glance at the monitor. The entire setting of the table with the computer monitor, the child and the experimenter was filmed with a video camera on a tripod, controlled by the experimenter with a remote control.

Because even 3-year-old children were included in the youngest age group and we wanted them to enjoy the experiment throughout the entire set of 34 clips, we included a bear in the experiment with the six 3-year-olds. This bear played a little game with the children, which is described in Table 3. An advantage of playing the game with the bear was that during the testing, the bear could ask for a more detailed description of the action. After all, he could not see the clips but wanted to know exactly what happened. The children were willing to take part in the game and succeeded in describing the events shown to them very well. Even the youngest children understood the intention of the task. The bear was omitted with the 4-year-old and 6-year-old children. They were given the instructions as described in Table 4. This procedure worked very well for all older children. If the children were not able to describe the clip after watching it once, the clip was shown a second time. The bear or the experimenter could help by telling the child what objects play a role in the clip, but the use of a 'cut and break'-type verb was avoided. If the child was still not able to tell what happened after the second viewing, we moved on to the following clip. Testing of the adults took place at the experimenter's house. The adults were seated behind the laptop or a PC and were given the instructions shown in Table 5.

During the experiment the participants were allowed to ask the experimenter questions; this created a relaxed setting. The experimenter did not reveal anything about the goal of the experiment, nor did she use any 'cut and break'-type verbs until after the last clip was described. The same goes for the bear with the younger children.

The inclusion of the warm-up items was, as described earlier, to allow the participants to practice what they were supposed to do. All participants were able to describe these warm-up events, showing that they understood the task. One 4-year-old girl had a lot of trouble concentrating, and a 3-year-old girl was

very shy and produced only two or three words per clip. But even these two participants succeeded in watching all the clips and describing them.

Table 3. Game played with the 3-year-olds.

E	= Experimenter
B	= Bear
S	= Subject
E:	*Hallo, ik heet Marian. Hoe heet jij?* 'Hi, my name is Marian. What's yours?' <S tells name>
E:	*Ok, <naam>, heb je zin om een paar filmpjes te kijken samen met mij en met de beer?* 'Ok, <name>, do you feel like watching a few movies together with me and the bear?'
B:	(breekt in zin in) *Hallo, ik ben Jim de beer.* (interrupts the sentence) 'Hi, I am Jim the bear.'
E:	(tegen kind) *Ja, dit is Jim, hij vindt het heel leuk om spelletjes te doen.* (to subject) 'Yes, this is Jim the bear and he likes to play games very much.' (tegen Jim) *En Jim, weet je nog een leuk spelletje om vandaag met <naam> te doen?* (to Jim) 'And Jim, do you know a nice little game to play with <name> today?
B:	*Ja, ik weet iets leuks. Als we de filmpjes gaan kijken dan kijk ik niet mee en dan moet <naam> mij precies vertellen wat er gebeurt, ok <naam> ?* 'Yes, I do know something nice. When it's time to watch the clips I won't watch them and <name> should tell me exactly what happens, ok <name>?' <S hopefully says yes, otherwise some further asking>
E:	*Nou, nu gaan we de filmpjes kijken. Jim kan ze nu niet zien, maar jij mag aan Jim vertellen wat er gebeurt, dat is een leuk spelletje he? Ok, dan gaan we beginnen. Je mag echt zoveel mogelijk vertellen van wat er gebeurt, want Jim kan natuurlijk niets zien.* 'Well, let's watch the clips then. Jim can't see them right now, but you can tell Jim what happens, that's a nice game, isn't it? Ok, let's get started. You may really tell as much as you can about what happens, because Jim can't see a thing.'

Table 4. Instruction to 4-year-olds and 6-year-olds

Heb je zin om allemaal korte video-filmpjes te kijken?
'Do you feel like watching all kinds of short video clips?'
Je gaat allemaal mensen zien die dingen doen, en je mag aan mij precies vertellen wat er gebeurt, OK?
'You will see people who do things, and you may tell me exactly what happens, OK?'
Als het te snel gaat of als je het filmpje nog een keer wilt zien dan mag je het zeggen.
'If it goes too fast, or if you want to see a clip another time, you can say so.'

Table 5. Instruction to adults

Je gaat zo meteen filmpjes zien waarin mensen een actie uitvoeren. De bedoeling is dat je met een normale Nederlandse zin deze actie beschrijft. Als je bijvoorbeeld een man ziet die een boek uit een kast haalt dan zeg je: "Hij haalt een boek uit de kast." Snap je?
'In a minute you will see video clips in which people perform actions. The task for you is to describe this action with a normal Dutch sentence. For example, if you see a man taking a book out of a closet you say: "He is taking a book out of a closet." Do you understand?'
Als je tussendoor even na wilt denken dan kun je elk moment stoppen door op de spatiebalk te drukken. De filmpjes gaan weer verder als je nog een keer op de spatiebalk duwt. Klaar om te beginnen?
'If you want a moment to think between two clips you can stop at any moment you like by pressing the space bar. The clips continue when you press the space bar again. Ready to start?'

5 Results

5.1 Overview of response patterns

After recording the participants, I transcribed all the semantically relevant data from the tapes. I ignored phonological mistakes; for example, if the subject said *klippen* (a non-existent verb in Dutch) instead of *knippen*, the response was counted as *knippen*. To give an impression of how the participants described the events, I give some transcripts for every age group (see the included CD-ROM for some real time examples). A three-year-old girl named Lizzy described stimulus 3 ('cutting hair with scissors') and stimulus 9 ('tearing a piece of cloth by hand') as in example 1:

1) Lizzy, 3;5 :
   a) *Knippen. In de haren.*
      'Cut (with scissor-like instrument). In the hair.'
   b) *Hij doet dat gordijn kapot.*
      'He does that curtain broken.'

One of the six-year-olds, a boy named Tamar, described stimulus 7 ('breaking a twig by hand') and stimulus 17 ('cutting a piece of cake with a piece of a broken pot') as in example 2:

2) Tamar, 6;6 :
   a) *Breekt een tak.*
      'Breaks a twig.'
   b) *Snee heel raar een taart, vies.*
      'Cut (with knife-like instrument)-PAST TENSE a cake in a very strange way, dirty.'

And finally, some examples from an adult participant, named Alle, describing stimulus 6 ('breaking a glass by bumping it off a table with an elbow') and stimulus 20 ('tearing a piece of paper along a knife').

3) Alle, 23;8 :
   a) *Oeps, ze gooit een glas om en die breekt.*
      'Oops, she knocks over a glass and it breaks.'
   b) *Ze scheurt het papier langs het mes.*
      'She tears the paper along the knife.'

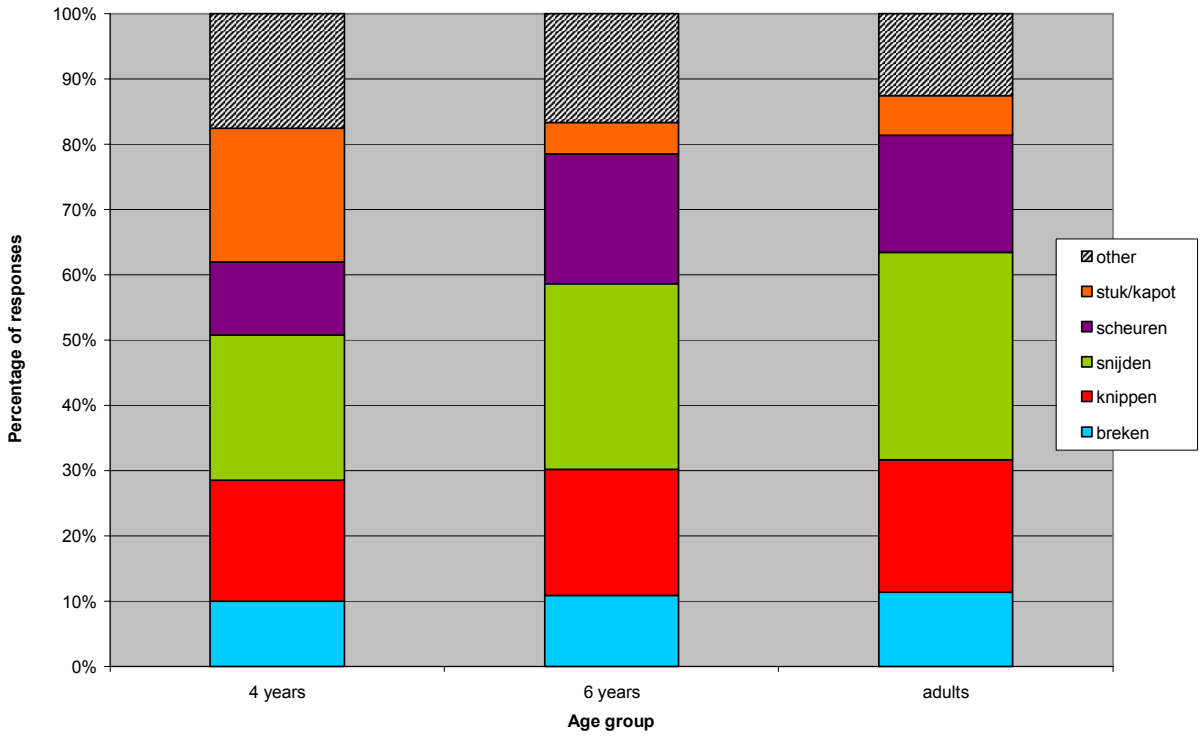
The relevant semantic responses were scored for every subject and for every stimulus on the basis of the transcription. In consultation with Melissa Bowerman and Asifa Majid from the Max Planck Institute, I decided to count as a relevant response the following:

1. a full 'cut and break' verb (one of basic verbs listed in Appendix I)
2. *kapot* or *stuk* 'broken' (whether or not in combination with an auxiliary verb)
3. *stukjes* 'pieces' (whether or not in combination with the preposition *in* 'in' and an auxiliary verb)

Every time one of these three types of responses was given in a sentence, the response was scored. If a subject used more than one response in the description, all responses were scored. If a subject did not use any of these responses, the 'cut and break' event was not described adequately, so no response was scored at all. For the main verbs of interest, the raw frequencies of response per test stimulus are shown in Table 6 (see Table 2 in section 4.1 for the numbering of the stimuli).

The pattern revealed by the scoring of relevant responses is easier to grasp when graphed. Figure 1 gives an overview of the data. It shows the proportion of main verbs, and *kapot* or *stuk* (+ auxiliary) and all remaining responses which are the 'other' responses (i.e. 'cut' and 'break' verbs other than the main ones and *stukjes* responses). Note that these bars indicate the percentage of responses, irrespective of the kind of event that was described.

Figure 1. Overview of response patterns



The data in both Table 6 and Figure 1 suggest some global differences across the age groups. Adults used more main verbs than children did, as can be seen from the 'other' category of the figure. Since this category is larger with children, we know that children used less main verbs, than adults did.

Table 6. Answering patterns for the main verbs

	breken			*knippen*			*snijden*			*scheuren*		
stimulus	4s	6s	Adults	4s	6s	Adults	4s	6s	Adults	4s	6s	Adults
1	1	0	0	11	11	12	0	0	0	0	0	0
2	0	0	0	12	11	12	0	0	0	0	0	0
3	0	0	0	12	11	12	0	0	0	0	0	0
4	0	0	0	11	10	12	1	0	0	0	0	0
5	7	10	12	0	0	0	0	0	0	0	0	0
6	0	1	2	0	0	0	0	0	0	0	0	0
7	6	9	12	0	0	0	0	0	0	0	1	0
8	5	3	10	0	0	0	0	1	0	1	6	2
9	1	0	0	0	0	0	0	0	0	7	10	12
10	2	1	2	0	0	0	0	0	0	2	10	9
11	3	0	0	0	0	0	0	0	0	5	9	10
12	0	0	0	0	0	0	0	0	0	8	9	12
13	0	0	0	0	0	0	11	10	12	0	0	0
14	0	0	0	0	0	0	11	11	12	0	0	0
15	0	1	0	0	0	0	9	9	11	0	0	0
16	0	0	0	11	11	12	1	0	0	0	0	0
17	0	0	0	0	0	0	9	11	12	0	0	0
18	1	3	0	3	3	9	0	0	0	0	0	0
19	2	2	0	0	0	0	0	2	1	0	0	0
20	0	0	0	0	0	0	0	0	4	9	11	8
21	0	0	0	2	1	1	1	1	1	3	5	9
22	0	0	0	1	2	0	9	9	12	0	0	0
23	1	0	0	0	0	0	8	11	11	1	0	0
24	2	0	0	0	0	0	3	5	4	1	0	0
25	0	0	1	0	0	0	0	0	0	0	0	0
26	2	1	0	0	0	0	3	6	8	0	0	0
27	1	2	0	0	0	0	4	3	10	0	2	0
28	0	0	0	0	0	0	6	10	12	0	0	0

The response pattern of the 4-year-olds seemed to differ from the adult pattern. As we expected, the youngest age group used *stuk/kapot* a lot. In comparison to the 4-year-olds and the adults, the 6-year-olds were more similar to the adults than to the 4-year-olds. This is an interesting fact in light of Schaefer's findings. Dutch 6-year-old children performed remarkably similarly to adults in describing 'cut and break' events, whereas the English-speaking first graders from Schaefer's study performed more like the preschoolers than like the adults.

Although Figure 1 and Table 6 give us a general impression of the data, not much is said about the exact relationship between the stimuli and the verbs. To be able to answer the research questions, we have to take a closer look at the uses of specific verbs for particular stimuli.

5.2 Target verb use

One way to analyse the relationship between the stimuli and the verbs is to score all responses for their "correctness" in describing the particular stimulus. But in the case of spontaneous speech it is not entirely straightforward to establish what is or is not "correct". The features of events that determine the participant's choice of verb are often very subtle and for some stimuli multiple verbs may be possible. So if we want to analyse the data by "correctness", a criterion has to be used to decide when a response is counted as correct. The consequence of using such a criterion is that stimuli that do not satisfy the criterion have to be excluded from the analysis. There are other ways to look at the data which do not require making this kind of decision. A possible procedure is to observe how similarly age groups categorise the stimuli, and how similarly they use the verbs. One way to analyse such similarity data is with a method called Correspondence Analysis. We will turn to an analysis of the data using a "correctness" criterion first, and then go on to describe a Correspondence Analysis.

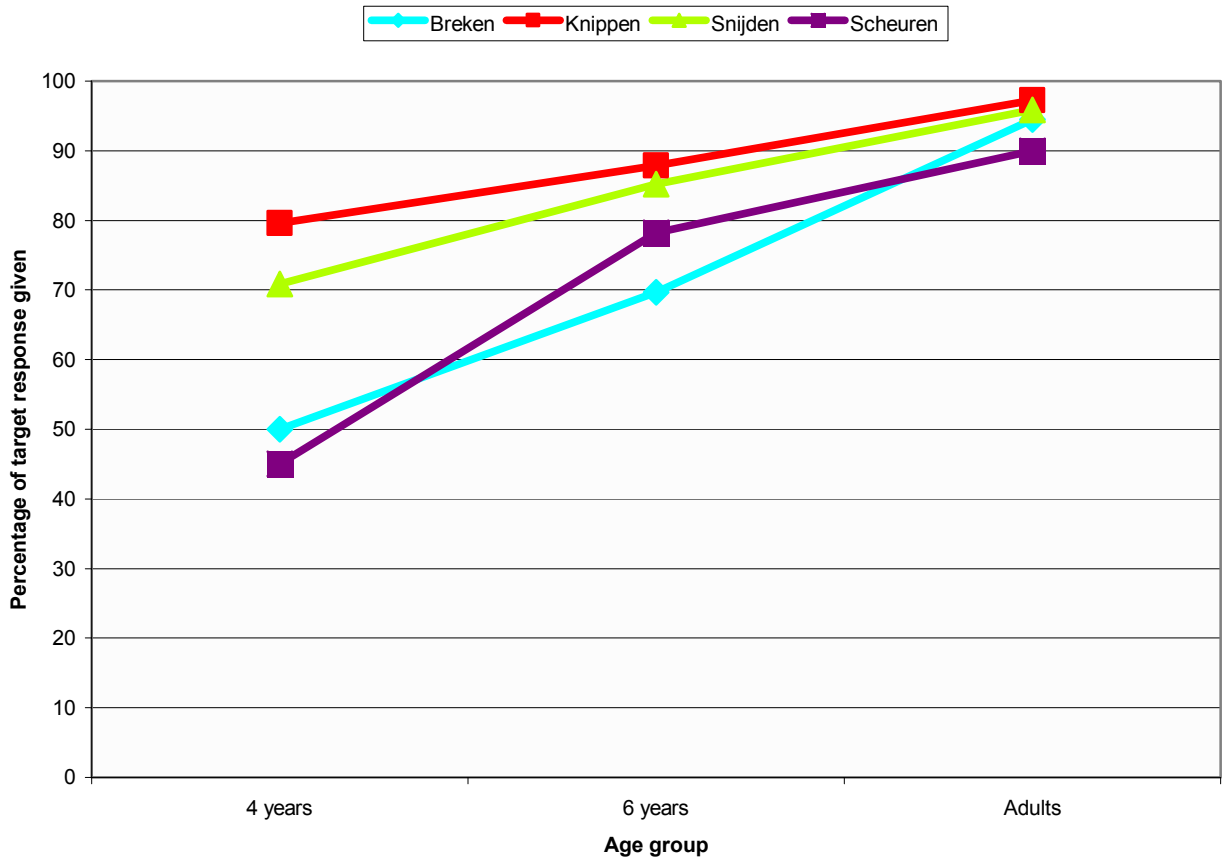
The criterion I used to establish a relationship between a particular verb and a particular stimulus was the use of a specific verb for a specific stimulus item by 75% or more of the adults (the percentage of 75% was arbitrary chosen). So if nine or more of the adults used the same verb for a stimulus, that verb was considered the target verb for the corresponding stimulus item. Take for example the first stimulus, 'cutting paper with scissors', for which all 12 adults used the verb *knippen* (see Table 6). According to the criterion of correctness the target verb for stimulus 1 is *knippen*. Of the 28 stimuli, 22 met this criterion and were assigned a target verb. These target stimuli are listed under their target verbs in Table 7, as are the stimuli that did not satisfy the criterion. The target verb is *knippen* for 6 stimuli, *breken* for 3*, scheuren* for 5 and *snijden* for 8.

Table 7. Target verbs and stimuli (75% adult use criterion)

Nr.	**Target *knippen* stimuli**
1	Cutting paper with scissors
2	Cutting nails with a nailclipper
3	Cutting hair with scissors
4	Cutting cloth with scissors
16	Cutting a piece off a banana with scissors
18	Cutting the tip off a nail with a pair of pliers
	Target *breken* stimuli
5	Breaking a bar of chocolate by hand.
7	Breaking a twig by hand
8	Breaking a baguette by hand
	Target *scheuren s*timuli
9	Tearing a piece of cloth by hand
10	Tearing a slice of bread in two pieces by hand
11	Tearing open a plastic bag by hand
12	Tearing a sheet of paper off a notepad by hand
21	Tearing a banana peel in two with a pair of pliers
	Target *snijden* stimuli
13	Cutting a slice of bread with a knife
14	Cutting a banana in pieces with a knife
15	Cutting a twig off a tree with a knife
17	Cutting a piece of cake with a piece of a broken pot
22	Cutting bread with scissors
23	Cutting cardboard with a knife
27	Cutting a bunch of spring onions by moving it abruptly against a static knife
28	Cutting a rope in two pieces with a knife
	Stimuli not meeting the criterion (not target stimuli)
6	Breaking a glass by bumping it off a table with an elbow
19	Breaking a piece of a rope with a chisel and hammer
20	Tearing a piece of paper along a knife
24	Cutting a twig off a tree with an axe
25	Breaking a pot with a hammer
26	Cutting an egg in slices with a wire egg cutter

Let us examine how well the different age groups responded to the target stimuli. In Figure 2 the percentage of correct uses of the target verbs are scored for each age group.

Figure 2. Percentage of target verb use by age group



On visual inspection the main verbs seem to fall into two groups: *knippen* and *snijden* on the one hand and *breken* and *scheuren* on the other. The three age groups seem to differ from each other in the response patterns, for we see rising lines with an increase in age. Statistical analysis by means of a mixed ANOVA (between subjects: age (3) x within subjects: verbs (4)) confirmed that there was a main effect of age group ($F(2,32) = 12.98$; $p < .001$), but Scheffe's post-hoc test showed that only the differences between the 4-year-olds and the 6-year-olds and between 4-year-olds and adults were significant, where the mean difference between 4-year-olds and adults was larger than the mean difference between the 4-year-olds and the 6-year-olds. The youngest age group apparently uses fewer target verbs ($M = 14.3$) for the stimuli than the 6-year-olds ($M = 18.0$) and the adults ($M = 20.6$), but the 6-year-olds do not differ significantly from the adults in their target verb use. There was also a main effect of verb type ($F(3,96) = 8.09$; $p < .001$). Because post-hoc tests could not be done by means of an ANOVA for the within subjects variable, multiple comparisons by T-tests were used to confirm between which verbs this difference was significant. These T-tests confirmed the first impression that the verbs fall into two groups: comparisons

between the verbs *breken* and *knippen* (t (34) = 3.05), *breken* and *snijden* (t (34) = 2.92) *knippen* and *scheuren* (t (34) = 4.01) and *snijden* and *scheuren* (t (34) = 3.23) were significant ($p < .01$), showing that there are differences in the frequency with which the verbs in these pairs were used for their target stimuli. There is no difference between *knippen* and *snijden* in the frequency with which they were used correctly for their own target stimuli (t (34) = 1.23, $p = .23$) and the same is true for *breken* and *scheuren* (t (34) = 0.12, $p = .91$). The interaction between age and verb was significant (F (6,96) = 2.18; $p = .05$). In order to investigate the interaction further, I conducted three one-way within-factor ANOVAs for each of the age groups. These showed that adults (F (3,33) = 0.90; $p = .45$) and 6 year olds (F (3,30) = 2.44; $p = .08$) did not differ in the rate with which they applied correct verbs. These outcomes for the adults are not interesting, because we made sure that adults used more than 75% of all the verbs correctly, so we knew in advance that they would not treat the verbs very differently. However the 4-year-olds were not equally correct with all verbs (F (3,33) = 5.79; $p < .01$). Paired T-tests showed that they were better for *knippen* and *snijden* than they were for *scheuren* and, more marginally, for *breken*. The only significant differences at a significance level of .008 (.05 divided by 6 pairs) were between *knippen* and *scheuren* (t (11) = 3.96; $p < .008$) and *snijden* and *scheuren* (t (11) = 3.68; $p < .008$), but the differences between *knippen* and *breken* (t (11) = 2.28; $p < .05$) and *snijden* and *breken* (t (11) = 2.16; $p = .05$) were more outstanding than those between *knippen* and *snijden* (t (11) = 1.02; $p = .33$) and *breken* and *scheuren* (t (11) = 0.52; $p = .62$).

The identification of target verbs for stimuli gives the opportunity to study not only children's "correct" uses, but also their "errors". Which target verbs were most likely to be replaced by which other verbs? An overview of such errors is shown in the confusion matrices of Table 8 and Table 9. The main alternative response for the youngest age group was undeniably *kapot.* The earlier observation in Figure 1, that the youngest age group used *kapot* more often than the other age groups, is confirmed by these findings. The most remarkable instances of overextension showed up in the *breken/scheuren* interface. These two verbs are closely related in Dutch, but the main difference in meaning has to do with the nature of the 'break'. The youngest age group used *breken* six times for a *scheuren* stimulus. The 6-year-olds showed a reverse pattern, using *scheuren* for six *breken* stimuli. Further examination of the data reveals that the overextension by 6-year-olds was restricted to stimulus 8, 'the breaking of a baguette'. Over half of the 6-year-olds described this event with the verb *scheuren*. The nature of the 'break' in stimulus 8 is in fact more like *scheuren* than like *breken*, for it is not an immediate, smooth break, but more a tearing break that ends up frayed. Although the 6-year-olds seemed to interpret this kind of breaking correctly as *scheuren*, adults happened to call the breaking of this kind of bread *breken*, presumably for historical reasons. From this particular confusion we could conclude that the 6-year-olds did show real knowledge of the meaning of *scheuren*. The reverse pattern in the 4-year-olds was spread over several different *scheuren* stimuli. The 4-year-olds did not have clear knowledge of the meaning of *scheuren* yet, for they replaced it often by *breken* or *kapot*.

Table 8. Confusion matrix of 4-year-olds

		REPLACED BY				
	4-year-olds	breken	knippen	snijden	scheuren	kapot
TARGET VERB	breken	0	0	0	1	9
	knippen	2	0	2	0	4
	snijden	2	1	0	1	12
	scheuren	6	2	1	0	20

Table 9. Confusion matrix of 6-year-olds

		REPLACED BY				
	6-year-olds	breken	knippen	snijden	scheuren	kapot
TARGET VERB	breken	0	0	1	6	0
	knippen	2	0	0	0	0
	snijden	3	2	0	2	2
	scheuren	1	1	0	0	2

5.3 Semantics of the verbs

Analysis of “correct” answers and confusion matrices does not reveal exactly which meanings children and adults attributed to the verbs. To answer the question of which features distinguished the events to which the verbs were applied and what can be said about the development of sensitivity to these features, we have to get back to the data again. I will give a tentative analysis of the semantics of the different verbs.

The participants of all age groups agreed which events had to be described with the verb *knippen*. Except for stimulus 18, ‘cutting the tip off a nail with a pair of pliers’ more than 90% of the participants in every age group agreed on the use of *knippen* for the stimuli that were designed as *knippen* stimuli (1, 2, 3, 4, 16 and 18). The fact that only 75% of the adults and less than 25% of both child groups used the verb *knippen* for stimulus 18 probably has to do with the unfamiliarity of the action to the children. For all other stimuli the subjects interpreted the action with a two-bladed, scissor-like instrument correctly as *knippen*.

It was much harder to say what the exact features were that determined the participants' choice for the verb *breken*. Of the six stimuli that were designed as *breken* stimuli (5, 6, 7, 8, 19 and 25), only three were actually often described with *breken* by the participants. Stimulus 5, 'breaking a bar of chocolate by hand' and stimulus 7 'breaking a twig by hand' were typical *breken* events, according to all adult subjects. Apparently the combination of the features relevant for *breken* (i.e. instrument 'hand', result 'in two pieces' and nature of the break 'smooth, immediate') was the most salient indication for adults to use the verb *breken*. Children had a lot of trouble interpreting all these features correctly. For stimulus 25 ('breaking a pot with a hammer'), which was designed as a *breken* stimulus, 75% of the adults said *kapot slaan* 'slam broken'. The instrument 'hammer' clearly biased the subjects against *breken* in favour of a verb that stresses the action of 'slamming'. Children showed a much more diffuse pattern: they had a lot of trouble giving the right weight to the different features of this event and used *kapot (maken)* '(make) broken' a lot. I will come back to this phenomenon later on.

The pattern for *scheuren* was somewhat intermediate between that of the previously discussed verbs *knippen* and *breken*. Every stimulus that was designed as a *scheuren* stimulus (9, 10, 11, 12, 20 and 21) was actually described with *scheuren* by at least 8 of the 12 adults. The 6-year-old children showed roughly the same pattern, but the 4-year-olds lag behind. Especially stimulus 10, 'tearing a piece of bread by hand', stimulus 11, 'tearing open a plastic bag by hand' and stimulus 21, 'tearing a banana peel in two with a pair of pliers', caused a lot of trouble for the youngest age group. Remarkably they did better on the stimuli for which the adults all agreed: stimulus 9 'tearing a piece of cloth by hand' and stimulus 12 'tearing a sheet of paper off a notepad'. The shape and material of the objects involved in these stimuli -- two-dimensional and flexible -- may well be the features associated with a prototypical *scheuren* event for the adults.

For the verb *snijden* some stimuli gave a very clear response pattern and others a very diffuse one. To start out with the clear pattern: the great majority of subjects in every age group described stimuli 13, 'cutting a slice of bread with a knife' , 14, 'cutting a banana in pieces with a knife', 15, 'cutting a twig off a tree with a knife', 17, 'cutting a piece of cake with a piece of a broken pot', 22, 'cutting bread with scissors' and 23, 'cutting cardboard with a knife' with the verb *snijden*. These stimuli were all designed as *snijden* stimuli, together with the stimuli 24, 'cutting a twig off a tree with an axe', 26, 'cutting an egg in slices with a wire egg cutter', 27, 'cutting a bunch of spring onions by moving it abruptly against a static knife' and 28, 'cutting a rope with a knife'. These last four stimuli displayed a very diffuse pattern among the age groups. Stimulus 28 was described as *snijden* by all adults and all but one 6-year-old, but only half of the 4-year-olds used this verb. An important difference between the first group of stimuli (13, 14, 15, 17, 22 and 23) and stimuli 26, 27 and 28 is that the latter show a single movement of 'cutting', while all stimuli in the first group involve repeated movements. Since the subjects had trouble describing these, the feature of 'repeated movement' might have played an important role for *snijden*, in addition to the

instrument ‘sharp-edged’. Subjects vacillated between *zagen* ‘saw’ and *snijden* in their descriptions of stimulus 24 ‘cutting a twig of a tree with an axe’. It could be the case that the instrument ‘axe’ resembles a saw and that the effect was increased by the sawing movement and the presence of a tree. The importance of the feature ‘instrument’ is very clear when we compare this stimulus with stimulus 15 ‘cutting a twig of a tree with a knife’. The only difference between these stimuli is the instrument: axe versus knife. About half of the subjects said *zagen* for stimulus 24, while none of the subjects used this verb for stimulus 15.

This first impression of which features were relevant for the use of a particular verb indicates that for *knippen* and *snijden* the instrument was important, while for *scheuren* the object played an important role and for *breken* it was the combination of features that was important. Overall, children had more trouble determining the relevant distinctions for the meaning of the verbs than adults did. Only for *knippen* did the relevant features seem to be well established in even the youngest age group.

5.4 Similarity

The statistical analysis reported was based on the “correct” use of verbs, as established by the 75% criterion. Now let us see how similarly the age groups categorise the stimuli and use the verbs, independently of “correctness”. The information that was lost in the previous analysis by excluding the stimuli that did not meet the criterion can be included in an analysis of similarity. The statistical method used for this purpose is Correspondence Analysis (henceforth: CA), also called Dual Optimal Scaling. In this method, the perceived similarity of each stimulus to each other stimulus is assessed by determining how similarly subjects labelled them. For example, two stimuli that are both called *breken* by all subjects are completely similar, two that are never called by the same verb are completely dissimilar, and two that are labelled by the same verbs to some extent are intermediate in similarity. At the same time as the pattern of labelling is used to assess the perceived similarity of the stimuli, the distribution of the verbs across stimuli is used to assess the perceived similarity of the verbs: verbs are more similar to the extent that they are used for the same stimuli. The similarity of the stimuli to each other, and of the verbs to each other, is displayed in terms of physical closeness: the more similar two stimuli or two verbs are, the closer together they fall in a multidimensional similarity space. The places of all stimuli and verbs in this multidimensional similarity space are observable in figures that plot two dimensions at a time against each other. The numbering of the different dimensions in CA indicates the relative strength of the similarities they represent. That is, the stimuli or verbs that show the most similarity to each other, and the least similarity to the other stimuli or verbs, are picked out by the first dimension. This picking out can be observed in the plot by the fact that a certain group of stimuli or verbs is positioned differently along the axis of the first dimension, as opposed to the other stimuli and verbs. The group of stimuli or verbs with the second most outstanding similarity to each other are positioned differently on the axis of the second dimension, and so on. In the current analysis 93,8 % of the inertia (a certain measure in CA that is more

or less comparable to variance) was explained by the first three dimensions, so I limited the analyses to three dimensions.

5.4.1 Similarity structure of the stimuli

Analysis with CA allows observation of the way in which the participants implicitly think of the stimuli and verbs as similar to each other. Such an analysis can be done for different age groups, or different languages, so a comparison can be made without the need for a "correctness" analysis. The current study is based only on Dutch, so comparison to different languages is not an issue. But since the study took place within the framework of the larger cross linguistic project at the MPI, comparison with the other languages with CA can and probably will be done in the future. For now the analyses were aimed at the establishment of which groups of stimuli were treated as similar to each other and how similarly verbs were used in every age group. In analysing the similarity structure of the stimuli I took all age groups together, with the goal of seeing which stimuli grouped together overall and which stimuli did not group with other stimuli. In analysing the similarity structure of the verbs I compared the different age groups with each other. One of the main reasons for leaving out the age group comparison with the stimuli, but including it with the verbs, was that with the verbs all age groups could be together plotted into a single figure, while with the stimuli several different plots would be needed. Otherwise the overload of same-numbered points would make it impossible to interpret the plot. Subsequently the relationship in similarity between the stimuli and the verbs is visualised by plotting both the stimuli and the verbs for different age groups in a single figure.

To start with the analysis of the stimuli, I requested SPSS to generate the plots of how similar the stimuli are to each other. These plots, shown in Figures 3 and 4, indicate the degree to which, across all subjects in all age groups, the 28 stimuli were described with the same verbs.

In both figures, four clear groups of stimuli popped out. Group 1 is very obvious in Figure 3 and consists of the stimuli 1, 2, 3, 4, 16 and 18. In the target verb analysis of the previous section, these stimuli were all *knippen* stimuli. Since this group popped out clearly in the first dimension (to be read off the x-axis of Figure 5), the similarity among these stimuli, and their distinctions from the other stimuli, was the most outstanding aspect of the similarity structure of the data (recall the function of dimensions in CA). Group 2 is the largest group and is manifested especially clearly on the second dimension in Figure 4. Stimuli falling into this group are 13, 14, 15, 17, 22, 23, 24, 26, 27 and 28; they are associated with the verb *snijden*. Although stimuli 24 and 26 did not meet the 75% criterion in the target analysis, they still grouped together with the other stimuli described by the target verb *snijden*. Here we see the advantage of this analysis technique, since it can assess the relative similarity of stimuli on the basis of how they are labelled regardless of whether the label is deemed "correct".

The third and fourth groups were not as clear as the first two groups. In Figure 3 they fall very close together as if they form one big group. It is only on the third dimension in Figure 4 that they are drawn apart into two clearly different groups. The difference between these groups was thus not as strong as that between the first two groups. Group 3 is formed by the stimuli 5, 6, 7 and 25, all stimuli associated with the verb *breken*. Stimulus 25 -- 'breaking a pot with a hammer' -- was not a target stimulus in the target verb analysis but it is now clustered with the target *breken* stimuli. Group 4, formed by stimuli 9, 10, 11, 12, 20 and 21, consists of the target *scheuren* stimuli, with the addition of stimulus 20 – 'tearing a piece of paper along a knife' --, which was omitted from the target verb analysis because it did not reach the 75% criterion.

Only two of the 28 stimuli did not clearly fall into a cluster of stimuli: 8 and 19. Apparently these two stimuli were treated very differently from all other stimuli in the sense that the participants showed different response patterns for them. The events associated with these stimuli were 'breaking a baguette' and 'breaking a piece of rope with a hammer and chisel'. All the other 26 stimuli fell into one or another of four different groups, corresponding to the verbs *knippen, snijden, breken* and *scheuren*.

Figure 3. Similarity of the stimuli in the first and second dimensions

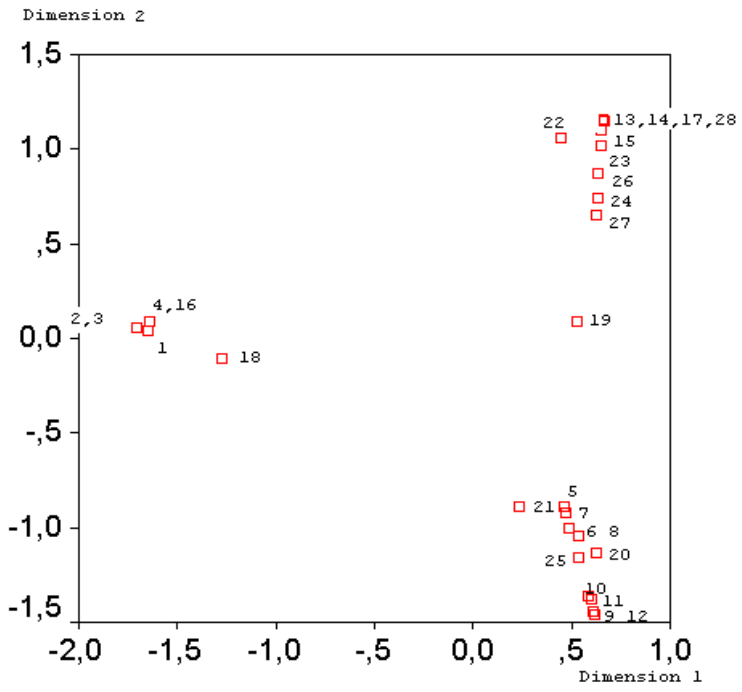
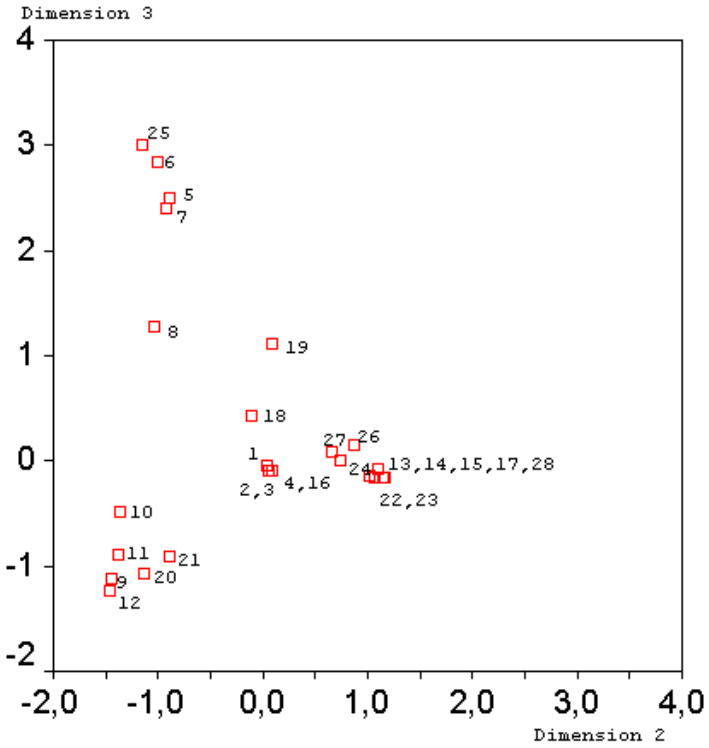


Figure 4. Similarity of the stimuli in the second and third dimensions



5.4.2 Verbs

The stimuli fell into four groups because the stimuli within each group were described in a similar way by the participants, and differently from the stimuli in the other groups. What about the verbs? Do they also display a similarity structure, in the sense that some verbs were more similar to each other than others because they were used for the same stimuli? And did the three age groups differ in the way they use the verbs? In Figures 5 and 6 the similarity structure of the verbs for every age group was plotted. The age groups are indicated before the verb: “4” is for the youngest age group, “6” for the older children and “ADULT” for the adult group. The position of the points in the plots reveals how similarly the verb was used by participants of the indicated age group to every other verb by participants of all ages. The most distinctively used verbs are distinguished in the first dimension, the most distinctive after that in the second, etcetera. That is, the verbs that are most distinctive in the first dimension are applied to the stimuli that are the least often labelled by any other verb.

Roughly the same four groups appear as in Figures 3 and 4. In dimension 1 *knippen* pops out as the verb used most distinctively, followed by the verb *snijden* in dimension 2, as can be observed in Figure 5. The verbs *breken* and *scheuren* are clearly distinguished in dimension 3, see Figure 6. All three age groups largely agreed on the use of *knippen* and *snijden*: notice how closely the points representing these

Figure 5. Similarity of the verbs in the first and second dimensions

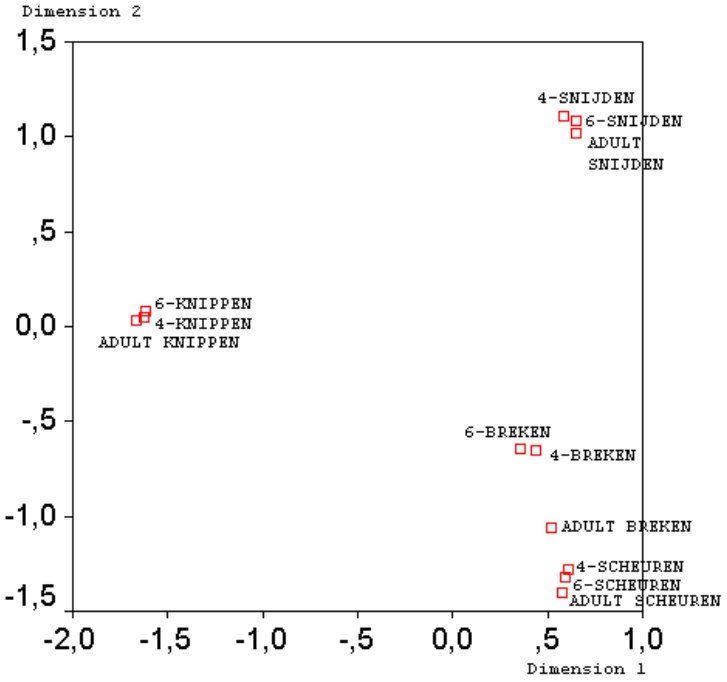
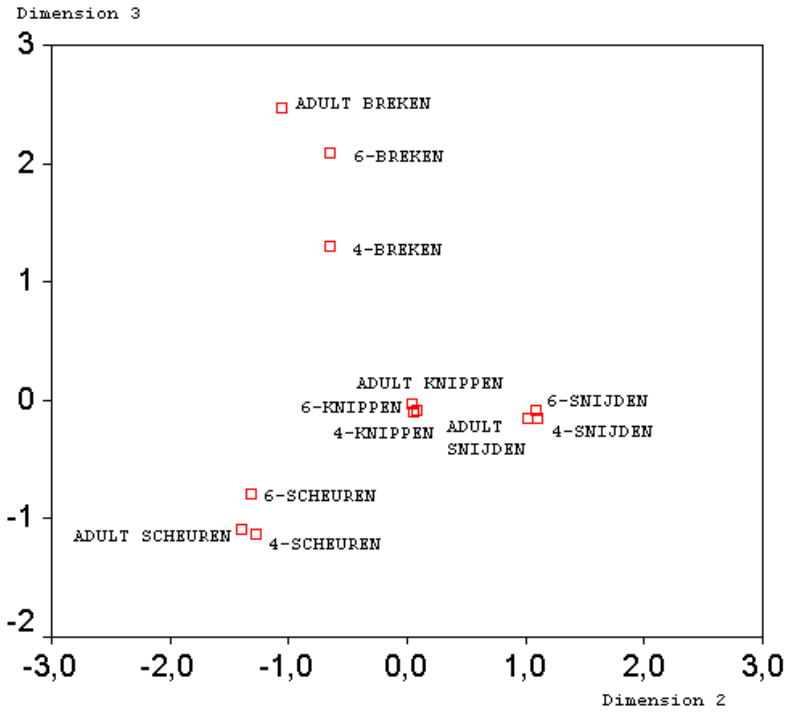


Figure 6. Similarity of the verbs in the second and third dimensions



verbs for the three age groups are clustered together. This reflects the fact that subjects of all ages tended to apply these verbs to the same set of stimuli.

The verbs *breken* and *scheuren* were used less straightforwardly by the age groups. We see a rather diffuse pattern, especially in the *breken* uses. The children's use of this verb clearly differed from that of the adults. Adults treated *breken* as a verb clearly dissimilar from the other verbs: notice the distances between the verbs in Figures 5 and 6. But children's use of *breken* overlapped more with that of the other verbs, especially in the youngest age group: notice that the 4-BREKEN point in Figure 6 is pulled closer to the other verbs than the 6-BREKEN and ADULT BREKEN. This pattern can be attributed to the tendency of the youngest age group to use *breken* for stimuli that adults described with another verb. Remember that we have seen at the end of section 5.2 that 4-year-olds overextended *breken* to *scheuren* situations and that 6-year-olds overextended *scheuren* to *breken* situations.

5.4.3 Relationship between stimuli and verbs

To get a better idea of the relationship between the stimuli and the verbs, CA allows us to plot both variables into a single figure. In doing this, one can see which stimuli were responsible for the positioning of each verb, and which verbs were responsible for the positioning of the stimuli. The most important information we get from such a combined figure is the closeness of certain verbs to certain groups of stimuli. In Figures 7 and 8 such a combined plot for both the stimuli and the verbs has been done for the three dimensions.[2]

Of course the same four groups of stimuli and verbs appear in these figures as we saw when the stimuli and verbs were plotted separately. But the interesting thing about Figures 7 and 8 is that we can see that some stimuli fall very close together with their verbs, while others flutter around more. For *knippen* and *snijden,* almost all stimuli fall in the exact same place as their verbs (see especially Figure 8). This means that almost every stimulus in these clusters was described consistently with either *knippen* or *snijden*. The descriptions of stimuli 24, 26 and 27 were apparently less consistent: these stimuli were most typically described with *snijden*, but they fall somewhat closer to other verb clusters than most of the *snijden* items. For *scheuren* and *breken* we see that none of the stimuli fall exactly together with the verbs. This means the participants did not consistently describe certain stimuli with either of these verbs. The use of *breken* is especially inconsistent: there is scarcely a core set of stimuli to which *breken* was routinely applied, and, conversely, the stimuli were often described with other verbs.

Recall that the set of stimuli contained a difference between "core" and "strange" stimuli (see section 4.1). Looking at the difference between these "core" and "strange" stimuli in these figures, we see

[2] These plots show the positions a little differently from the previous two sets of plots, because analyzing both stimuli and verbs in the same analysis requires some mathematical compromises.

Figure 7. Joint plot of stimuli and responses for first and second dimension

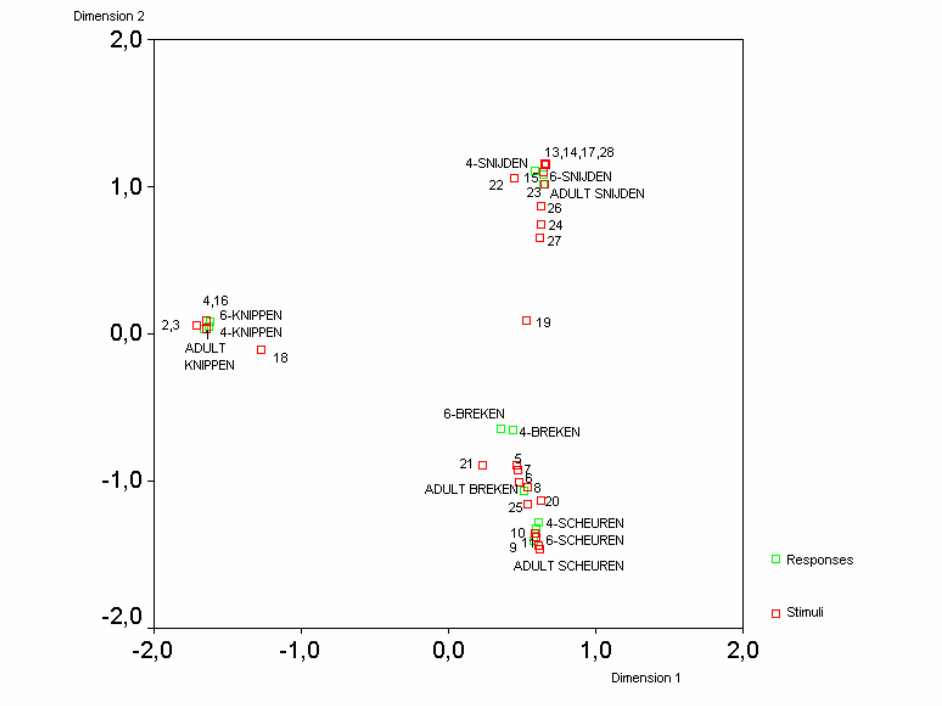
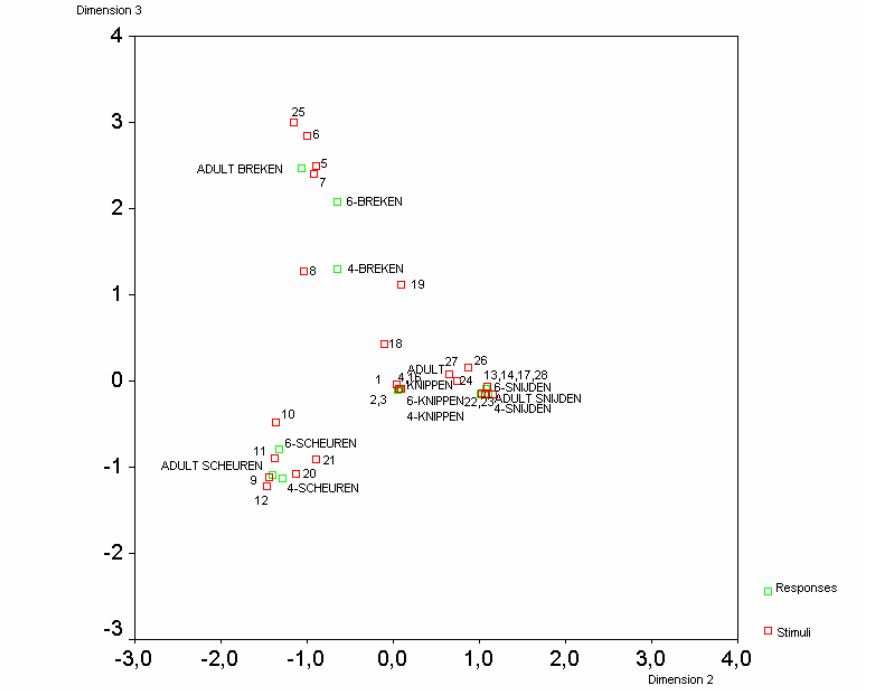


Figure 8. Joint plot of stimuli and responses for third and fourth dimension



that in general the association of the verbs with “strange” stimuli (like 18, ‘cutting the tip off a nail with a pair of pliers’, 21, ‘tearing a banana peel in two with a pair of pliers’, 24, ’cutting a twig off a tree with an axe’, 25, ‘breaking a pot with a hammer’, 26, ‘cutting an egg in slices with a wire egg cutter’ and 27, ‘cutting a bunch of spring onions by moving it abruptly against a static knife’) is looser than with “core” stimuli (like 1, ‘cutting paper with scissors’, 2, ‘cutting nails with a nailclipper’, 3, ‘cutting hair with scissors’ and 4, ‘cutting cloth with scissors’, 28, ‘cutting a rope in two pieces with a knife’). Four of the “strange” stimuli do, however, show a very tight association with the verbs (namely stimuli 16, ‘cutting a piece off a banana with scissors’, 20, ‘tearing a piece of paper along a knife’, 22, ‘cutting bread with scissors’ and 23, ‘cutting cardboard with a knife’). The events represented by these stimuli were evidently interpreted very consistently by participants as belonging to one or another of the main verb categories. Only one “core” stimulus did not belong to any group at all. This is the earlier-mentioned stimulus 8, which depicts ‘breaking a baguette by hand’.

The classification analysis performed with CA completes the picture of the data. Now it is clear how the stimuli fall into distinct groups on the basis of how they were linguistically described, and which verbs were consistently associated with these groups. Moreover the relationship between the stimuli and the verbs has become clearer by observing the strength of the associations between them. Since we now know the results of the study, we can start interpreting these results by referring back to the theory.

6 Discussion

The results of the study as presented in the previous chapter will be linked to some theoretical issues of word acquisition in the present chapter. First the semantic categories belonging to the 'cut and break' domain in Dutch will be analysed by the outcomes of this study. Special attention will hereby be given to the organisation of semantic categories in light of the study carried out on English by Schaefer (1984). Second the outcomes of this study will be analysed in whether they state anything about the major theoretical issues about the different sources playing a role in word acquisition, as discussed in chapter 2.

6.1 Semantic categories of 'cut and break' in Dutch

The comparison between children and adults in the way they describe 'cut and break' events reveals some interesting points about the organisation of the semantic categories in this domain. The children's semantic categories showed both similarities and differences to those of adults.

Turning first to the similarities, the unambiguous categorisation of *knippen* and *snijden* events by children and adults alike is remarkable. Children as young as three tended to organise these categories in the same way as adults did. In comparison to Schaefer's (1984) study, Dutch children seem to have done a better job overall in categorising the 'cut and break' domain than same-age English-speaking children. Schaefer suggested that some features playing a role in the meaning of a verb, like the instrument used in the action, could have been weighted too heavily by his subjects; for example, they tended to classify all events involving a knife as instances of 'cutting', including peeling fruit and stabbing a board with the tip of a knife. In Dutch, all events described by the verb *knippen* involve scissors or a scissor-like instrument performing an action where the blades come together. Additionally, almost all events described by *snijden* involve an instrument with at least one sharp side, prototypically a knife. For events to be described by *breken* or *scheuren* the instrument can never be a scissor-like or knife-like instrument used in the prototypical way. So if the Dutch children in my study, like the learners of English from Schaefer's study, weigh the feature 'instrument' heavily, they had an easier time in describing the events involving *knippen* and *snijden*, because Dutch *does* weigh the instrument heavily in these categories. Another interesting point in the comparison between Dutch and English is that English does not make a distinction like that between *knippen* and *snijden* in Dutch. For all events described by one of these two verbs in Dutch, English uses the single verb 'cut', requiring a blade(-like) instrument irrespective of what kind of blade. Young children mastered the Dutch subdivision of this category very early. The relevant feature of the instrument that is used for the action was noted correctly by the children, which points to an influence of these meaning-related features on the formation of Dutch semantic categories. This early subdivision by Dutch children also indicates that even very specific categories can be learned early in language development. As opposed to earlier theories like Clark's (1973), which stated that semantic development

goes from global features to more specific ones, these data showed clearly that children have access to very specific categories at an early stage of development. The fact that English-speaking children did not mark the *knippen-snijden* distinction spontaneously, e.g., by underextending the use of 'cut' for only one of these categories, supports the idea that input from the target language promotes these specific categories. The similarity between children and adults in the categorisation of *knippen* and *snijden* events provides evidence for the influence of language-specific features on the formation of semantic categories.

The more difficult categories, -- those for which the children categorised differently from adults--, were those of *scheuren* and *breken*. The boundaries of these semantic categories were apparently set in different places by speakers of different ages. In their semantic organisation of these two verbs children showed an interesting pattern. Whereas 4-year-old children used *breken* and *kapot maken* for events adults would call *scheuren*, 6-year-olds showed the reverse pattern, using *scheuren* for events adults would call *breken*. This shift indicates that the semantic organisation of these verbs undergoes change during the first years of language acquisition. It takes time for children to find out which events exactly fall within the scope of certain semantic categories. A possible explanation for the difference between the clear categorisation of *knippen* and *snijden* and the more diffuse categorisation of *breken* and *scheuren* may be the relevance of specific features to the different categories. With the theory of Schaefer (1984) in mind, we could state that the features relevant for the meaning of *breken* and *scheuren* have to do with the nature of the break, the kind of object, and the result of the action. The relevance of these features in the events does not automatically push for the application of *breken* and *scheuren*. The same set of features is relevant for the use of other verbs too, as will be discussed in the following section.

Another interesting phenomenon in the light of Schaefer's theory is the possibility in Dutch to say *kapot maken* for a wide variety of 'cut and break' events. Although this is possible, the use of more specific verbs seems more likely – recall that the adults did not use *kapot maken* for any of the events at all --. The exact semantics of *kapot maken* are hard to define, for its meaning is very broad. Features like the instrument or the specific action do not seem to be relevant for this verb. The only cue that could be relevant is the result of the action, because the particle *kapot* clearly indicates that the result of the action is something like 'object in a broken state'. Imagine that children have acquired this verb and know that it is applicable to every action that results in a broken object. If they see an event with such a result and do not have the idea that another verb is more suitable -- e.g., the "scissors" verb *knippen* -- they will be eager to apply *kapot maken* to it. This pattern points to a heavy reliance on the 'result' feature alone in situations where other features do not give a satisfactory cue. If this interpretation is correct, children should use the verb *kapot maken* for events where the result is 'object in a broken state' and where the feature 'instrument' does not push for another verb. Analysis of the 4-year-olds' data revealed that these children used *kapot maken* chiefly for events adults would call *scheuren* or *breken.* Uses of *kapot maken* for events adults called *knippen* or *snijden* always involved a "strange" event such as 'cutting a bunch of

spring onions by moving it abruptly against a static knife'. In the "strange" events, the purpose to which the instrument is put is unfamiliar. This apparently triggered doubts about the applicability of the verb *knippen* or *snijden*, so children chose the safe way out by using *kapot maken.* The fact that few of the children used *kapot maken* for a "core" event of *knippen* or *snijden* indicates -- as Schaefer already had suggested for English -- that they rely heavily on the cue provided by the instrument.

Drawing on our knowledge of the Dutch organisation of the 'cut and break' domain, we can see some clear evidence in this study that children relied more on the feature 'instrument' than on features like 'action' or 'result'. Children construct their semantic categories by determining the proper weights of the semantic features that define the categories. In doing so, they arrive surprisingly early at some very specific categories. Semantic categories that rely less on the feature 'instrument' are acquired later and are less consistently. These findings can be linked back to the research questions in section 3.3, which sounded as follows:

1. Do children and adults differ in the way they organise their semantic categories of 'cutting and breaking' events?
2. Do certain meaning-related features (like the instrument or the manner of action) play a salient role in the categorisation?
3. Is the way children learn the categories in a domain influenced by the adult-like way of organising the domain semantically?

After this study on the semantic organisation of 'cut and break' in Dutch we might state the following about the first two questions:

1. Children and adults do indeed differ in the way they organise the semantic categories of their language. This is indicated in this study by the fact that the youngest age group often described stimuli differently from the adults.
2. Semantic features like the nature of the instrument played an important role in the categorisation of the events presented to the participants. Semantic categories like *knippen* and *snijden*, which are strongly determined by the feature 'instrument' in Dutch, are easier for children to grasp than categories that rely less on this feature. This view is supported by the usage pattern of *kapot maken*, which was restricted to "core" events denoting *breken* and *scheuren* actions – i.e., actions not involving scissors or blades – and to "strange" events in which scissors or blades were used in an unfamiliar way.

The only thing that can be said about the third research question is that the adult-like organisation of semantic categories does probably influence children's way of categorising. This remark is, however, based only on the fact that the youngest Dutch children already showed the Dutch organisation of the semantic categories, including the *knippen*-category that English lacks. Since the English-speaking children from Schaefer's (1984) study did not spontaneously make the distinction between the categories

of *knippen* and *snijden*, and the Dutch-speaking children from this study did, the input of adult language seems to have had an influence on their early lexical development. I will come back to this in the next, concluding section.

6.2 The larger picture

Although the size of this study limits the conclusions that can be drawn, I do want to give some attention to the big questions posed in the first chapters about the role of language and cognition in the process of word acquisition. In line with the cognitive revolution of the 1970s, cognition has been widely accepted as the basic source for semantic development. Although this point of view is still supported by most linguists and psychologists, recent investigations have challenged the idea that conceptual development alone forms the basis for semantic development. Observation of the comprehension and production of very young children gives evidence that the target language also influences children's early semantic organisation (Bowerman & Choi, 2001, see section 2.1.2 for discussion). Cognition and linguistic input seem to interact in early language acquisition.

The early language specificity indicated by the present study cannot be interpreted as proving an influence of language on early conceptual notions. This is because real challenges to the cognitive viewpoint can arise only in the study of very young children -- linguistic influences on the language development of 4-year-olds do not prove that cognition is not the only source for semantic categories in, for example, the first two years of linguistic development --. This larger point would require a more thorough investigation of the early conceptual and linguistic development of children learning different languages and at younger ages, probably even before language production begins (as Bowerman & Choi did for spatial notions). In the domain of 'cut and break' the only other language we have acquisition data from is English (within the context of the larger Max Planck 'cut and break' project, data collection using the present "child-friendly" video clips is under way among learners of several different languages). The most remarkable difference between English and Dutch is the subdivision of the category of the English verb 'cut' by the Dutch verbs *knippen* and *snijden*, as discussed in section 6.1. This difference is a partitioning and not a crosscutting of categories. English children tended to extend 'cut' to almost all cutting events, whereas Dutch children subdivided this category according to the Dutch distinction between *knippen* and *snijden.* The specific Dutch categories of *knippen* and *snijden* were acquired early and correctly, which suggests an early influence on the development of semantic categories by the Dutch way of treating the feature 'instrument'. But since it is based on a single comparison this hypothesis is somewhat speculative. What *is* clear from this study is that the domain of 'cut and break' is very suitable for cross-linguistic investigation. Comparison with many more languages could potentially provide evidence for more subdivided and crosscutting semantic domains among very young children, pointing to early linguistic influences on semantic category formation.

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Appendix I

List of Dutch verbs in 'cut' and 'break' domain

1.	*barsten*	'to burst'	*21.*	*rukken*	'to tug'
2.	*bikken*	'to chip'	*22.*	*scheiden*	'to separate'
3.	*breken*	'to break'	*23.*	*scheuren*	'to tear'
4.	*hakken*	'to chip'	*24.*	*slaan*	'to hit'
5.	*kapot gaan*	'broken-go'	*25.*	*slijpen*	'to grind'
6.	*kapot maken*	'broken-make'	*26.*	*snijden*	'to cut'
7.	*kappen*	'to fell'	*27.*	*snoeien*	'to prune'
8.	*klieven*	'to cleave'	*28.*	*spietsen*	'to spear'
9.	*kloven*	'to chop'	*29.*	*splijten*	'to split'
10.	*knakken*	'to crack'	*30.*	*splinteren*	'to splinter'
11.	*knappen*	'to snap'	*31.*	*splitsen*	'to split'
12.	*knijpen*	'to pinch'	*32.*	*stampen*	'to pound'
13.	*knippen*	'to cut'	*33.*	*steken*	'to stab'
14.	*kraken*	'to crack'	*34.*	*stuk maken*	'broken-make'
15.	*krakken*	'to crack'	*35.*	*vellen*	'to fell'
16.	*pellen*	'to peel'	*36.*	*verdelen*	'to divide'
17.	*perforeren*	'to perforate'	*37.*	*verpulveren*	'to pulverise'
18.	*priemen*	'to pierce'	*38.*	*versnipperen*	'to cut into bits'
19.	*prikken*	'to prick'	*39.*	*zagen*	'to saw'
20.	*rijten*	'to rip'			

Appendix II

Contents of film 1

1. Drinking a glass of juice
2. Throwing a ball
3. Cutting paper with scissors
4. Breaking a twig by hand
5. Cutting a slice of bread with a knife
6. Tearing a piece of paper along a knife
7. Tearing a piece of cloth by hand
8. Drawing a face
9. Cutting nails with a nailclipper
10. Breaking a bar of chocolate by hand.
11. Cutting a piece of cake with a piece of a broken pot
12. Cutting an egg in slices with a wire egg cutter
13. Breaking a pot with a hammer
14. Eating a cookie
15. Cutting a twig off a tree with a knife
16. Cutting the tip off a nail with a pair of pliers
17. Cutting cardboard with a knife
18. Tearing a slice of bread in two pieces by hand
19. Cutting hair with scissors
20. Tearing open a plastic bag by hand
21. Cutting a banana in pieces with a knife
22. Kicking a ball
23. Breaking a baguette by hand
24. Tearing a banana peel in two with a pair of pliers
25. Tearing a sheet of paper off a notepad by hand
26. Cutting cloth with scissors
27. Cutting bread with scissors
28. Opening a jar
29. Cutting a bunch of spring onions by moving it abruptly against a static knife
30. Cutting a twig off a tree with an axe
31. Breaking a glass by bumping it off a table with an elbow
32. Breaking a piece of a rope with a chisel and hammer
33. Cutting a piece off a banana with scissors
34. Cutting a rope in two pieces with a knife

Contents of film 2

1. Eating a cookie
2. Kicking a ball
3. Cutting paper with scissors
4. Tearing a piece of cloth by hand
5. Breaking a pot with a hammer
6. Breaking a bar of chocolate by hand.
7. Cutting the tip off a nail with a pair of pliers
8. Drawing a face
9. Tearing a piece of paper along a knife
10. Cutting a twig off a tree with a knife

11. Cutting a piece of cake with a piece of a broken pot
12. Cutting an egg in slices with a wire egg cutter
13. Cutting a slice of bread with a knife
14. Drinking a glass of juice
15. Breaking a twig by hand
16. Cutting cardboard with a knife
17. Tearing a slice of bread in two pieces by hand
18. Cutting nails with a nailclipper
19. Cutting a banana in pieces with a knife
20. Tearing open a plastic bag by hand
21. Cutting a rope in two pieces with a knife
22. Opening a jar
23. Cutting a piece off a banana with scissors
24. Breaking a glass by bumping it off a table with an elbow
25. Cutting bread with scissors
26. Cutting hair with scissors
27. Cutting a bunch of spring onions by moving it abruptly against a static knife
28. Throwing a ball
29. Cutting a twig off a tree with an axe
30. Breaking a baguette by hand
31. Breaking a piece of a rope with a chisel and hammer
32. Tearing a sheet of paper off a notepad by hand
33. Tearing a banana peel in two with a pair of pliers
34. Cutting cloth with scissors

Contents of film 3

1. Opening a jar
2. Drinking a glass of juice
3. Cutting hair with scissors
4. Tearing open a plastic bag by hand
5. Cutting a banana in pieces with a knife
6. Breaking a baguette by hand
7. Tearing a banana peel in two with a pair of pliers
8. Throwing a ball
9. Tearing a sheet of paper off a notepad by hand
10. Cutting cloth with scissors
11. Cutting bread with scissors
12. Cutting a bunch of spring onions by moving it abruptly against a static knife
13. Cutting a twig off a tree with an axe
14. Eating a cookie
15. Breaking a glass by bumping it off a table with an elbow
16. Breaking a piece of a rope with a chisel and hammer
17. Cutting a piece off a banana with scissors
18. Cutting a rope in two pieces with a knife
19. Cutting paper with scissors
20. Breaking a twig by hand
21. Cutting a slice of bread with a knife
22. Kicking a ball
23. Tearing a piece of paper along a knife
24. Tearing a piece of cloth by hand

25. Cutting nails with a nailclipper
26. Breaking a bar of chocolate by hand.
27. Cutting a piece of cake with a piece of a broken pot
28. Drawing a face
29. Cutting an egg in slices with a wire egg cutter
30. Breaking a pot with a hammer
31. Cutting a twig off a tree with a knife
32. Cutting the tip off a nail with a pair of pliers
33. Cutting cardboard with a knife
34. Tearing a slice of bread in two pieces by hand

Contents of film 4

1. Drawing a face
2. Kicking a ball
3. Cutting a banana in pieces with a knife
4. Tearing open a plastic bag by hand
5. Cutting a rope in two pieces with a knife
6. Cutting a piece off a banana with scissors
7. Breaking a glass by bumping it off a table with an elbow
8. Drinking a glass of juice
9. Cutting bread with scissors
10. Cutting hair with scissors
11. Cutting a bunch of spring onions by moving it abruptly against a static knife
12. Cutting a twig off a tree with an axe
13. Breaking a baguette by hand
14. Throwing a ball
15. Breaking a piece of a rope with a chisel and hammer
16. Tearing a sheet of paper off a notepad by hand
17. Tearing a banana peel in two with a pair of pliers
18. Cutting cloth with scissors
19. Cutting paper with scissors
20. Tearing a piece of cloth by hand
21. Breaking a pot with a hammer
22. Eating a cookie
23. Breaking a bar of chocolate by hand.
24. Cutting the tip off a nail with a pair of pliers
25. Tearing a piece of paper along a knife
26. Cutting a twig off a tree with a knife
27. Cutting a piece of cake with a piece of a broken pot
28. Opening a jar
29. Cutting an egg in slices with a wire egg cutter
30. Cutting a slice of bread with a knife
31. Breaking a twig by hand
32. Cutting cardboard with a knife
33. Tearing a slice of bread in two pieces by hand
34. Cutting nails with a nailclipper

Appendix III

CD ROM including:

- All four films with stimuli
- A data example for every age group