The use of prosodic information for disambiguation by German children: An experimental investigation¹

Heidi Altmann  
University of Delaware, USA  
haltmann@udel.edu

and

Barış Kabak  
University of Konstanz, Germany  
Baris.Kabak@uni-konstanz.de

Address for correspondence:  
Barış Kabak  
Department of Linguistics  
University of Konstanz  
Fach D174  
78457 Konstanz, Germany  
Phone: +49-7531-884758  
Fax: +49-7531-884160  
E-mail: Baris.Kabak@uni-konstanz.de

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Abstract

This paper investigates children’s use of stress differences for the disambiguation of segmentally homophonous complex verb pairs in German (e.g., ümstellen ‘to rearrange’ vs. umstëllen ‘to surround’). It has been previously reported that children fail to distinguish between homophonous structures (e.g., höt dog from hot dóg) based on prosodic information (e.g., Vogel & Raimy, 2002; Atkinson-King, 1973); however these studies did not control whether the lexical representation of both members of such pairs are equally available for children. In a picture-selection study with a pre-recorded story that asks children to indicate which picture goes with the verb being named in the story, we tested whether German children are able to distinguish separable vs. non-separable prefix verb pairs, which are not only distinguished solely on the basis of their stress differences but also on their morphosyntactic behavior. Our results suggest that even with the provision of extra contextual and linguistic information, children by the age of eleven cannot consistently establish a link between stress placement and meaning contrast. We argue that the difficulty lies in the acquisition of higher prosodic constituents, and there seems to be no preference for one type of prosodic structure over the other.
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1. Introduction

The way children use prosody is a highly controversial topic. Although children rarely make production errors with respect to main word stress placement from the emergence of speech (e.g., Jaeger, 1999), they do not seem to make use of distinctive prosodic patterns for otherwise segmentally homophonous strings until rather late in their development. This interesting discrepancy between the production and perception of prosody has drawn some attention in the acquisition literature. While it has been widely reported that infants become sensitive to the rhythmic patterns of the language they are exposed to (e.g., Jusczyk, et al. 1993; Sansavini et al., 1997), several other studies have suggested that children could not make use of prosodic information to disambiguate various types of structures. For instance, studies on Dutch sentential stress patterns (e.g. Vogel et al., 1979), and British English soccer reports (Cruttenden, 1974) reported that children, until very late in childhood (by the age of 12 years in Vogel et al. (1979) and by the age of 10 in Cruttenden (1974)) could not interpret segmentally ambiguous stimulus pairs in an adult-like manner. Furthermore, while children are able to produce novel compounds by the age of two (Clark, German, & Lane, 1985) and even the variants of segmentally homophonous constructions that only differ in stress placement (e.g., hót dog vs. hot dóg) as early as age six (Ashby, 1992), it is not before the age of twelve that they become able to
perceptually distinguish compounds (e.g., *höt dog*) from their corresponding phrases (*hot dóg*) (Atkinson-King, 1973; Vogel & Raimy, 2002). Such a large gap between adult-like behavior for production and perception in children’s acquisition of prosodic structure is puzzling, and the universal validity of this discrepancy as well as the nature of the apparent difficulty on the perceptual side of prosody necessitate further research.

Previous studies investigated children’s perception of potentially ambiguous pairs based solely on phonological characteristics. By testing children on a different word class, in this case verbs, on a different language, in this case German, this study attempts to provide further insight into the way children match prosodic cues with particular morphosyntactic structures. German has minimal verb pairs (e.g., *ümstellen* ‘to rearrange’ vs. *umstéllen* ‘to surround’) that can be distinguished at both the prosodic and the morphosyntactic level. The presence of several linguistic criteria, other than just prosody, that contrast the members of such homophonous verb pairs in German makes the contrast more strongly rooted in the language. This provides us with an independent tool to examine whether each possible interpretation is in fact equally available to children regardless of whether they can rely on prosodic information. In the following, we will first provide an overview of two relevant examples of previous work in more detail. We then discuss in how far the conclusions in these studies are limited and why some modifications in methodology
may be necessary. Second, we present background information about Standard German complex verbs to motivate why such structures constitute a valid test case for the issue at hand. We then present the results from an experimental study and suggest that even with the provision of extra contextual and linguistic information, children cannot establish a link between a particular meaning and its prosodic representation. Based on our findings, we argue that the missing link is due to the relative difficulty in the acquisition of higher prosodic constituents, and there seems to be no apparent preference for one type of prosodic structure over the other, possibly due to an item effect.

2. Previous Studies

Here we present two pieces of relevant work, Atkinson-King (1973) and its follow-up Vogel & Raimy (2002). Both of these studies investigated children’s acquisition of word stress in American English, based on their ability to correctly discriminate compounds from phrases. The experimental protocols employed in these experiments were, to a great extent, similar in that they both presented the test items without contextual information. For example, Vogel & Raimy (2002) presented children with two pictures, one modeling the compound meaning and the other the corresponding phrasal meaning. They then required their subjects to place a ‘sticky’ (a Post-It note) upon hearing a compound or a phrase (e.g., *The hót dog is over here.* *The hót dog gets the sticky.*) Despite the fact that the later study was more carefully
designed and analyzed, both yielded similar results, indicating that children under the age of twelve did not perform adult-like.

Unlike in such experimental settings, natural speech typically involves a discourse context. Due to the lack of such context, these studies rely on the crucial assumption that children will interpret the two images that they are shown to be contrastive at some level. For instance, after the introduction of the utterance *hot dog* (regardless of where stress appears), it is assumed that children will access the same segmental representation, namely [hat dog], upon seeing the corresponding pictures in front of them (in one picture a dog that is sweating because it is hot; and a bun with a the food item ‘hot dog’ in it in the other). That is, the task heavily relies on an assumption that by just looking at the pictures in front of them, children would automatically consider that the pictures correspond to phonological representations that are minimally different from one another. Given that there were no contextual cues available to the children in both studies, they were assumed to have had to rely solely on prosodic information to distinguish between two potentially possible interpretations and failed to recognize phrasal patterns. Furthermore, the two possible meanings of strings such as *hot dog* do not have equal status in natural speech. For instance, the compound meaning is lexicalized, and more frequent than the phrasal meaning. In fact, Vogel & Raimy (2002) found that a compound interpretation was strongly preferred when younger children had a lexical entry for a
certain word combination. Overall, a preference for the more commonly used structure became evident: If children knew a compound, they preferred a compound interpretation regardless of prosodic information in the speech string; if children did not know a compound, they preferred a phrasal interpretation. These findings were supported by the inclusion of novel compounds in Vogel & Raimy’s study. It turned out that novel compounds were not perceived as compounds but rather interpreted as phrases. However, even adults had some problems allowing novel compounds to be compounds. Familiarity with test items can not be the only possible factor in play here, however, since Atkinson-King (1973) did train her subjects on actual test items and still could not find adult-like interpretation before the age of twelve. Vogel & Raimy conclude that the ability to distinguish between compound vs. phrasal stress takes long to acquire in comparison to lexical stress since they require the acquisition of higher level phonological constituents within the prosodic hierarchy, namely the Clitic Group and the Phonological Phrase.

In order to eradicate a potential lexical bias for one member of a prosodically minimal pair over the other, it is necessary to present such pairs in a context that makes both interpretations equally available to children. Furthermore, the members of a minimal pair should differ in more than just prosodic structure such that a difference in stress pattern goes along with another structural difference (e.g., a morphosyntactic property). This is necessary to guarantee that the meaning
difference is not just a matter of a prosodic difference. In fact, the meaning of the individual parts of certain English compounds is usually transparent to the meaning of the whole compound. This also applies to several compounds used in Vogel & Raimy’s (2002) study. For instance, a big bird (a well-known Sesame Street character) is physically a big bird, and high chairs are intuitively high. It is, therefore, necessary to have pairs where the semantic difference is more substantial. Finally, to arrive at broader generalizations, stress differences that arise from the availability of different prosodic structures (i.e., other than compound vs. phrase) should be tested. In this respect, the question remains as to whether children can disambiguate segmentally homophonous constructions that occupy the same prosodic constituency in the hierarchy. In light of these observations, below we introduce a study that investigated the use of prosodic information for the disambiguation of German complex verbs employing a more carefully controlled experimental protocol.

3. Present Study

We employed German separable and non-separable prefix verbs, which constitute minimal pairs in terms of not only their phonological representation but also their morphosyntactic behavior. Given the availability of such structural differences, it is assumed that the difference between the minimal pairs we employed is well
grounded and sufficiently salient in the language. Below, we turn to the properties of German complex verbs and developmental patterns in their acquisition.

3.1. **German complex verbs and their acquisition**

Complex verbs are frequently used in Standard German adult and child language. As opposed to Romance languages, where, for example, manner of motion or directionality is encoded in the verbal root, German expresses directional, temporal, or aspectual information in noninflectional affixes (Fleischer & Barz, 1992; Talmy, 1991). Within the class of complex verbs, we can find two distinct kinds of such verbs: separable prefix verbs (SPVs) and non-separable prefix verbs (NSPVs). While both SPVs and NSPVs consist of a prefix and a verb root, they can be identified by different (a) prosodic, (b) morphosyntactic, and, to a certain extent, (c) semantic properties. We now briefly examine these properties one by one.

(a) **Prosody:**

SPVs and NSPVs are segmentally identical in infinitival usage, and can only be distinguished by placement of word stress. While SPVs always carry main word stress on the prefix (e.g., *wiederholen* ‘to fetch again’), NSPVs are stressed on the verb root with their prefixes being unstressed (e.g., *wiederholen* ‘to review’). On the basis of the possibility of their deletion in coordinate constructions as well as their prosodic independence, Wiese (1996) assumes that separable prefixes constitute their own Phonological Word (PW), while the unseparable ones do not. Following Wiese,
we assume the prosodic representations given in (1) below to distinguish SPVs from NSPVs.

(1) $\text{SPV}$

```
               PW'
              /    /
             PW  PW
            /    /
           F    F  wieder  holen
```

$\text{NSPV}$

```
               PW'
              /    /
             PW  PW
            /  F  |
           wieder holen
```

Essentially, the SPVs are similar to compound structures since they consist of two PWs subsumed under the same PW’. The stress rule relevant to PW’ promotes the stress of the leftmost PW. NSPVs, on the other hand, consist of a prefix (which is itself a foot due to its internal stress pattern) that adjoins to the PW containing the verb root. It should be noted that even in analyses that assume the Clitic Group as a prosodic constituent between the PW and the Phonological Phrase (e.g., Nespor & Vogel, 1986), both SPVs and NSPVs must dominated by the same prosodic constituent, the difference lying in the internal organization of this constituent. However, what remains constant is that both SPVs and NSPVs occupy a prosodic domain crucially higher than a PW, where word stress is assigned.
(b) Morphosyntax:

The prefix and the root in SPVs are free morphemes, as evidenced by the fact they can be moved and deleted. The prefix in NSPVs, however, is always a bound morpheme and the root may or may not be free. If used in an independent clause as a finite verb, the finite verbal root of SPVs stands in second position in the clause, and the prefix is stranded clause-finally (e.g., *Der Junge holt den Ball wieder* ‘The boy fetches the ball again.’). For NSPVs, the prefix can never be separated from the verbal root, which means that the whole verbal complex must undergo syntactic movement into second position in independent clauses (e.g., *Der Junge wiederholt die Chemieformeln* ‘The boy reviews the chemistry formulas.’).

(c) Semantics:

The prefixes of SPVs usually have lexical meaning and the prefix+root complex frequently gets a compositional interpretation. Most of the prefixes that can function as separable prefixes for verbs can also be used as prepositions. The prefixes of NSPVs may modify the meaning of the verbal root (e.g., by adding resultative reading). Often such verbs have abstract or even idiomatic meanings.

Table 1 summarizes the three categorical distinctions between the two types of complex verbs in German using the example *wieder+holen* ‘again+fetch’, which exists both as SPV (‘to fetch again’) and NSPV (‘to repeat/ to review’).
Table 1: The complex verb *wiederholen* (literally: *to fetch again*) and its characteristics in separable and non-separable usage. Boldface indicates stressed element.

<table>
<thead>
<tr>
<th>wiederholen</th>
<th>SPV</th>
<th>NSPV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prosody</strong></td>
<td><em>Der Hund soll die Puppe wiederholen.</em></td>
<td><em>Der Schüler soll die Vokabeln wiederholen.</em></td>
</tr>
<tr>
<td></td>
<td>‘The dog is supposed to fetch the doll again.’</td>
<td>‘The student is supposed to review the vocabulary.’</td>
</tr>
<tr>
<td></td>
<td>(word stress on prefix)</td>
<td>(word stress on verbal root)</td>
</tr>
<tr>
<td><strong>Syntax / Morphology</strong></td>
<td><em>Der Hund holt die Puppe wieder.</em></td>
<td><em>Der Student wiederholt die Vokabeln.</em></td>
</tr>
<tr>
<td></td>
<td>‘The dog fetches the doll again.’</td>
<td>‘The student reviews the vocabulary.’</td>
</tr>
<tr>
<td></td>
<td>(prefix stranded clause-finally)</td>
<td>(prefix moved with verbal root)</td>
</tr>
<tr>
<td><strong>Semantics</strong></td>
<td>“<em>fetch again</em>” = <em>fetch again</em></td>
<td>“<em>fetch again</em>” ≠ <em>review</em></td>
</tr>
<tr>
<td></td>
<td>(literal, compositional meaning)</td>
<td>(abstract, idiomatic meaning)</td>
</tr>
</tbody>
</table>

As such, complex verbs presumably require the acquisition and integration of a number of knowledge components, such as identifying their morphosyntactic behavior and the resultant meaning of the composition of root and prefix (Behrens, 1998). Despite their complex nature, SPVs are highly productive not only in German adult language but also in child language. Behrens (1998), based on a survey of the CHILDES database, states that the proportion of SPVs found in German children’s overall verb usage (19% of tokens) is higher than that for Dutch (11%) or English (12%) children. Between two and four years of age, Behrens did not see an age trend in relation to this proportion within verbs, and German children are described to
combine “well over 50% of the verb roots with at least one prefix [=NSPV] or particle [=SPV]” (Behrens, 1998: 695). However, NSPVs are almost completely absent before four years of age, which indicates that separable prefix use is much more frequent than non-separable prefix use. In a follow-up study on Behrens’ analysis of CHILDES data, Altmann (1999) found that NSPVs were very rare before age four and they were never incorrectly separated. As for SPVs, the children first incorrectly moved the whole complex to the verb second (V2) position in main clauses. In an intermediate stage, they most frequently use modal verbs in combination with SPVs, which allows them to leave the prefix+root complex in its uninflected form clause-finally since the finite modal must go to V2. Finally, not too long after age four, children are able to use SPVs and NSPVs adult-like.

For several reasons, SPVs and NSPVs constitute proper test cases then for an investigation of the perception of prosodic information in complex verbs. First, children seem to be comfortable using complex verbs and there is no account of misplacement of word stress in the development of such verbs. If at all, such inaccuracies must be extremely rare, comparable to stress assignment errors English and Spanish speaking young children make when they focus on rather difficult sounds in unstressed syllables (e.g., Hochberg, 1998). Second, verbal prefixes are frequent in child language and thus they are familiar with their meaning, assuming that the comprehension of morphemes precedes their productive application. Third,
when children first use both types of complex verbs, they are able to use them in
their uninflected and unseparated form, which increases the possibility that they use
prosody to distinguish between different meanings of segmentally identical complex
verb pairs. Fourth, by around age four, children seem to have acquired the different
morphosyntactic properties of the different types of complex verbs, and they never
incorrectly separate non-separable units, while they start separating roots from
prefixes where allowed. Finally, by employing SPVs and NSPVs, we keep the level
of the prosodic constituent constant (i.e., the recursive-Phonological Word (PW’),
the Clitic Group (CG), or the Phonological Phrase (PPh) depending on the prosodic
model), yet allowing for a stress difference between the two kinds of verbs.

3.2. Experiments

The main purpose of our experiments was to find out if German children show a
comparably late developmental pattern regarding the use of prosodic information in
perception as English children did in the previous studies. In particular, we wanted to
know if German children can disambiguate segmentally homophonal verb
constructions based on placement of word stress when the prosodic contrast between
such constructions is further supported by morphosyntactic cues. A total of 36
German children from the ages of 7;5 to 10;11 participated in this study. 10 adult
speakers of German formed our control group. The study consisted of two
experiments: Experiment 1 involved the distinction of complex minimal verb pairs in
their infinitival forms (N=19, age 9;1-10;11). Experiment 2 was conducted as a post-test and investigated younger children’s discriminability of the same complex verb pairs in their inflected finite form (N=17, age 7;5-8;11).

3.2.1. Experiment 1

Based on Vogel & Raimy’s study, we predict that children would show preference for one type of complex verb constructions as a default answer if they do not utilize the prosodic information for distinction of meaning. We expect separable prefix verbs to be easier to identify for children than non-separable prefix verbs, considering that separable forms:

   a) stem from a very frequent and productive morphological process,
   b) emerge earlier in child utterances,
   c) are usually more semantically transparent, and,
   d) are stressed on a more salient position (word initially).

3.2.2. Subjects

Nineteen children in the age range of 9;1 to 10;11 and ten adults were tested. The children were recruited in two after-school care facilities operated by a local church close to the city of Nuremberg, Germany. The adults were used as a control group to identify adult behavior on the task. None of the participants had any hearing problems.
3.2.3. Materials

Although German has a number of separable and non-separable minimal verb pairs, only very few of them could be used in the experiment for the following reasons. First, the meaning of NSPVs is often abstract and may not be known by children. Therefore, we had to make sure that both members of a minimal pair were commonly used. Unfortunately, there are no frequency counts available for the separable and non-separable forms of German complex verbs in child language. Therefore, we adopted the following procedures in finding appropriate test items. First, we assumed that if each member of a pair had an entry in a bilingual dictionary, this would indicate some level of frequency of use in the language. Thus, we consulted the PONS German-English dictionary and made a list of pairs for SPVs and their corresponding NSPVs. Second, since we would be contrasting the members of a pair in context, we also made sure that the members of each pair can take semantically similar kinds of objects as their arguments and create equally plausible situations. In this respect, for instance, “durchlaufen” (to undergo [a process]) and “durchlaufen” (to walk through) could not constitute an appropriate pair since they do not allow semantically the same kinds of objects. Third, we consulted an additional fifteen adult native speakers of German and asked them to indicate whether for each pair they felt that one member was more frequent than the other or if they thought both members were rather infrequently used in daily life. Only verb
pairs that were indicated to have comparably high frequency were chosen. The result of the selection and frequency matching process yielded the following five appropriate test pairs given in (2) to be used in the experiment:

(2) Test pairs

(i) **durchbrechen**: to snap, to break in two (e.g. a twig)

(ii) **überziehen**: to put on (e.g. an outer layer of clothing)

(iii) **umfahren**: to knock down by means of driving

(iv) **umstellen**: to rearrange

(v) **wiederholen**: to fetch again

3.2.4. Method

Just like the previous studies, we chose a picture selection task for this experiment. However, different from these studies, we embedded each verb pair in a picture story. These picture stories included two (groups of) agents sharing a particular feature (e.g. a parrot and a dog = animals) performing the action of the verb
condition (i.e. wiederholen (separable) or wiederholen (non-separable)) on the same object NP (e.g. a doll). The pictures were presented on a 30x42 cm cardboard sheet, which was divided into an upper and a lower half. Both the upper and the lower halves consisted of two pictures depicting the respective action of one member of a given verb pair (e.g. a dog fetching the doll again versus a parrot saying “the doll” repeatedly). Each subject was asked to look at the pictures in sequence and listen to their descriptions, which were pre-recorded on an audio CD to ensure consistency. The stories were played at a reasonable and comfortable rate and volume. Both members of each verb pair were used once within the storyline in their inflected (finite) form. At the end of the description for each sheet, a question (again pre-recorded) asked the child to identify the agent who performed the action of the verb condition that was tested. The verb in the question was presented in the infinitival form, for which the correct answer could only be based on placement of stress. The children could indicate their choice either by pointing at a character in the story, or by answering verbally.

It should be noted that both members of a verb pair were primed in their inflected form in stories. This was done in order to ‘label’ the action for the children with the verb to be tested such that they would not intuitively think of a different way of describing the action and thus disallow an objective comparison between the two meanings (in the sample story in (3) below fährt den Kinderwagen um ‘knocks down the baby carriage’ in the upper half, and umfährt den Kinderwagen ‘drives
around the baby carriage’ in the lower half). That is, we wanted to let the children know that the two actions depicted in front of them are both lexically um+fahren. Second, the question was phrased in a way that permitted natural usage of the infinitive in order to keep everything else constant and only vary the stress pattern on the verb to be tested from one condition to the other. In addition, we did not use modal verb constructions, because they might have triggered an interpretation of the agents’ intentionality. Thus, we decided to employ a structure that is frequently found in colloquial speech and child-directed speech, albeit not in any written form: “Which [agent] + tut (does)+ [object] + V(inf) ?”. None of the subjects had any problems accepting or understanding this structure.

An example for the stories used in the experiment is given in (3) below (See Appendix I for the complete set of pictures used in the experiment, and Appendix II for the stories and their English translations).

(3) Example story in Experiment 1

Here we see two boys who are going rollerskating.

(the experimenter points to the story line depicted on the upper half of the sheet.)

Up here, this boy is going rollerskating. Unfortunately, there is a baby carriage in his way. The boy is too fast and can’t avoid the baby carriage any more. He knocks down (= ‘fährt…um’) the baby carriage. And, the carriage falls to the ground.”
Down here, we see another boy who is going rollerskating, too. There is also a baby carriage in his way, but thank God, he is not too fast. He drives around (= ‘umfährt’) the baby carriage. Nothing happens to the baby carriage.

And the question is:

Which boy does “umfahren”/ “umfahren” the baby carriage?

[Welcher Junge tut den Kinderwagen umfahren/ umfahren?]
present. Even-numbered children (n=9) heard two questions in which the test verb was stressed on the prefix (SPV) and three questions in which the test verb was stressed on the root (NSPV), odd-numbered children (n=10) heard them in the opposite way. No child saw the same picture story or verb twice. All in all, excluding practice items, one test session took about 10 minutes.

3.2.5. Results and discussion

Contrary to our expectations, we could not find a significant relationship between condition and performance across verbs. For SPVs, the children responded correctly in 67.3% of the test cases, for NSPVs in 54.9%. Both of these scores are close to chance level, and we also found that adults had almost perfect responses scores (100% for SPVs and 92% for NSPVs). A Chi-Square analysis confirmed that there was a significant relationship between age group (children vs. adults) and performance ($p<.001$). The overall responses for each verb and each condition are presented in Table 2:
Table 2: Raw scores and % correct across subject groups for NSPVs and SPVs.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Children-raw</th>
<th>Children-%</th>
<th>Adult-raw</th>
<th>Adult-%</th>
</tr>
</thead>
<tbody>
<tr>
<td>durchbrechen</td>
<td>NSPV: 4 of 10</td>
<td>40</td>
<td>4 of 5</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>SPV: 4 of 9</td>
<td>44.4</td>
<td>5 of 5</td>
<td>100</td>
</tr>
<tr>
<td>uberziehen</td>
<td>NSPV: 10 of 10</td>
<td>100</td>
<td>5 of 5</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>SPV: 6 of 9</td>
<td>66.7</td>
<td>5 of 5</td>
<td>100</td>
</tr>
<tr>
<td>umstellen</td>
<td>NSPV: 4 of 9</td>
<td>44.4</td>
<td>5 of 5</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>SPV: 8 of 10</td>
<td>80</td>
<td>5 of 5</td>
<td>100</td>
</tr>
<tr>
<td>wiederholen</td>
<td>NSPV: 0 of 9</td>
<td>0</td>
<td>4 of 5</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>SPV: 9 of 10</td>
<td>90</td>
<td>5 of 5</td>
<td>100</td>
</tr>
<tr>
<td>umfahren</td>
<td>NSPV: 9 of 10</td>
<td>90</td>
<td>5 of 5</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>SPV: 5 of 9</td>
<td>55.6</td>
<td>5 of 5</td>
<td>100</td>
</tr>
<tr>
<td>TOTAL:</td>
<td>59 of 95</td>
<td>62.1</td>
<td>48 of 50</td>
<td>96</td>
</tr>
</tbody>
</table>

Contrary to our expectations, we could not see an overall preference for one interpretation (separable or non-separable) over the other. While the children had very high identification scores for two non-separable verbs, *überziehen* (100% correct) and *umfahren* (90% correct), as well as for two separable verbs, *umstellen* (80% correct) and *wiederholen* (90% correct), they showed poor identification for their counterparts, the separable condition for *überziehen* (66.7% correct) and *umfahren* (55.6% correct), and the non-separable condition for *umstellen* (44.4% correct) and *wiederholen* (0%). The complete ignorance for *wiederholen* as a NSPV is striking. Furthermore, only for one verb pair, *durchbrechen*, both conditions resulted in correct responses around chance level: SPV 44.4%, NSPV 44%.
We find these results rather unexpected, especially given that no obvious pattern across conditions emerged (i.e., preference for one or the other condition across verbs). The very poor identification of *wiederholen* in the non-separable condition, may be due to the fact that the children did not know this verb in this condition although, however, every school children should be familiar with the meaning of ‘to review/ to repeat’. In addition, the correct identification of *durchbrechen* in both conditions at chance level might be caused by the rather subtle character of the meaning difference between the separable and inseparable conditions of this verb (i.e., ‘to break through’ vs. ‘to break into two’).

### 3.3. Experiment 2

Keeping in mind the effect that Vogel & Raimy (2002) found for nonce or unknown compounds, a second experiment was created to see if children do actually know the members of the pairs we have used.

#### 3.3.1. Materials and Subjects:

The same verb pairs were used in this second experiment. To avoid a familiarity effect, we recruited different participants. To be able to safely generalize if older children should or should not know a given condition for a given verb, we tested younger children than in Experiment 1. Our assumption here was that if younger children correctly identify a verb condition based on the particular morphosyntactic
frame that goes with it, they are able to access its lexical meaning, consequently, older children can also be inferred to know it. We tested seventeen children between the ages of 7;5 and 8;11.

3.3.2. Method

The procedure was almost exactly the same as in the previous experiment, however now the verbs were not introduced within the story telling. The subjects saw the same pictures as before and heard a very similar description of the pictures, which was only modified slightly from the stories used in Experiment 1. Most importantly, the (priming) sentence containing the test verb was replaced by a sentence using a different verb that would roughly convey the meaning of the test verb. (4) provides the complete story that children heard for the same pictures as the one we gave in (3) as an example for Experiment 1:

(4) An example story in Experiment 2:

(The experimenter points to the upper picture.)

*Up here, this boy is going rollerskating. Unfortunately, there is a baby carriage in his way. The boy is too fast and can’t avoid the baby carriage any more. The baby carriage falls to the ground, and the boy looks very sad.*
(The experimenter points to the lower picture.)

Down here, we see another boy who is going rollerskating, too. There is also a baby carriage in his way, but thank God, he is not too fast. He manages to avoid the baby carriage. Nothing happens to the baby carriage.

And the question is:

Which boy knocks over the baby carriage? / Which boy drives around the baby carriage?

[Welcher Junge fährt den Kinderwagen um? / Welcher Junge umfährt den Kinderwagen?]

It should be noted that the test questions were also different now. They were asked in the form of “Which [agent] + V[fin] + [object] (prefix/Ø)? Presumably, there is no potential structural ambiguity in this question. In the separable condition, the object would be followed by the prefix, which is split from the finite verb stem and stranded clause-finally (e.g., *Welcher Junge fährt den Kinderwagen um?* ‘Which boy knocks the baby carriage down?’). In the non-separable condition, the prefix would not be split from the finite verb stem and moved to second position with the stem (e.g., *Welcher Junge umfährt den Kinderwagen?” ‘Which boy drives around the baby carriage?’). Just as in Experiment 1, there were filler items. Even-numbered children (n=8) heard two questions in which the test verb was stressed on the prefix (SPV) and three questions in which the test verb was stressed on the root (NSPV),
odd-numbered children (n=9) heard them in the opposite way. No child saw the same picture story or verb twice. All in all, excluding practice items, one test session took about 10 minutes.

3.3.3. Results and comparison of the experiments

We labeled a given verb as “available” to older children if at least 75% of the children correctly identified it. Those cases with a success rate of between 60% and 75% were labeled as “possibly available” as the performance is intermediate but still over the 50% chance level. According to this criterion, all conditions were identified correctly beyond chance level. Table 3 displays the raw scores and percentages of correct responses for each condition, where we also indicated whether older children successfully identified the verb form in Experiment 1 based on prosodic information.
Table 3: Raw scores and percentage correct for the identification of verb forms in Experiment 2.

<table>
<thead>
<tr>
<th>verb</th>
<th>Condition</th>
<th>Raw</th>
<th>%</th>
<th>Available?</th>
<th>Discriminated in Exp. 1?</th>
</tr>
</thead>
<tbody>
<tr>
<td>durchbrechen</td>
<td>NSPV</td>
<td>6 of 8</td>
<td>75</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SPV</td>
<td>7 of 9</td>
<td>77.8</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>überziehen</td>
<td>NSPV</td>
<td>7 of 8</td>
<td>87.5</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td>SPV</td>
<td>6 of 9</td>
<td>66.7</td>
<td>Possibly</td>
<td></td>
</tr>
<tr>
<td>umstellen</td>
<td>NSPV</td>
<td>9 of 9</td>
<td>100</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td>SPV</td>
<td>8 of 8</td>
<td>100</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>wiedeholen</td>
<td>NSPV</td>
<td>7 of 9</td>
<td>77.8</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SPV</td>
<td>8 of 8</td>
<td>100</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>umfahren</td>
<td>NSPV</td>
<td>5 of 8</td>
<td>62.5</td>
<td>Possibly</td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td>SPV</td>
<td>9 of 9</td>
<td>100</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL:</strong></td>
<td></td>
<td><strong>72 of 85</strong></td>
<td><strong>84.7</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results from both experiments suggest that potential preferences for a certain verb meaning (verb condition), which we found to vary from one verb pair to another in the prosody experiment, were not necessarily due to lack of familiarity with the counterpart meaning. Experiment 2 indicated that younger children between the ages of 7;5 and 8;11 know most of the meanings of the verb pairs that we tested. Both the separable and the non-separable conditions of *durchbrechen*, *umstellen* and *wiedeholen* were labeled as “available” to children above the 75% criterion level.
Despite this, for *umstellen* and *wiederholen*, the prosody could only be correctly identified with the separable verb stress. The children, however, showed preference for none of the conditions of *durchbrechen* based on prosodic information. The results regarding these three verbs indicate that knowing the meaning of a particular form does not guarantee the ability to correctly identify its prosody. Furthermore, we can state that it was not the case that the separable condition was easier to identify for the children in Experiment 1 than the non-separable form across verbs, since for *überziehen* the non-separable form had more correct responses in Experiment 1 than its separable counterpart. Although Experiment 2 hinted that the latter condition may not be familiar to all the children for this verb, we should not take this as a basis to conclude that familiarity with a verb condition automatically leads to a better identification of its prosodic cues. This is especially apparent with *umfahren*, which all children correctly identified in Experiment 2 in the separable condition, while the older children in Experiment 1 performed better for the non-separable meaning (90% correct), which did not yield any convincing evidence for familiarity in the Experiment 2 (62.5% correct).

In summary, these results do not indicate a general tendency for better recognition of one condition over the other. It was not the case that the member of a verb pair that was more familiar to the younger children had better chances to be identified correctly based on prosodic cues. Instead, the less familiar member could sometimes
be recognized more easily than the assumedly more familiar member (cf. umfahren), or familiarity with both members corresponded to poor identification of either condition in Experiment 1 (e.g., durchbrechen). Therefore, none of our expectations could be supported. Not only did the separable member of a verb pair not appear to be easier to identify, despite the theoretical arguments in favor of it (cf. section 3.2 above), but also no overall better performance for one verb type over the other could be found.

4. General discussion and conclusions

The morphosyntactic features of German complex verbs allowed us to compare children’s performance on prosodic identification with their familiarity with both meanings of our test verb pairs, an important confound in the previous studies. Our results, however, could only partially support findings from previous research. The one factor that could be confirmed in our study was that the acquisition of prosodic discrimination seems to be a very late development. The children were mostly aware that our test pairs had two distinct meanings, however, they could not distinguish between them based solely on prosodic cues. Assuming that the separable and non-separable prefix verbs in German are represented with different prosodic structures in adult grammar (cf. Section 3.1), it could be suggested that the stress assignment processes for SPV and NSPVs, although they occupy the same prosodic constituent, have not yet been fully acquired by the age of eleven. This supports Vogel &
Raimy’s (2002) conclusions, since such processes, as opposed to lexical stress, crucially involve the acquisition of a higher level phonological constituent (i.e., a domain higher than the PW). Furthermore, it seems that providing extra contextual and linguistic information did not help children for establishing a connection between word stress placement and meaning differences. Although the number of test items had to be limited for several reasons, we found an obvious non-pattern regarding the children’s responses for prosodic information. Two verb pairs had more correct responses for the separable meaning, other two verb pairs had more correct responses for the non-separable meaning, and a fifth pair showed indecisive results with both meanings around chance level. This may suggest that “separable” vs. “non-separable” for infinitival verb forms do not yield any default prosodic representation to which children can resort when there is ambiguity. In fact, Vogel & Raimy (2002), found such an effect for English compound interpretation when the children had a lexical entry for a given word combination, and for phrasal interpretation when children did not have such an entry. Since we were dealing with stress differences that lead to a meaning difference crucially at the same prosodic level, it is perhaps not surprising that no default pattern could arise. The best plausible explanation then seems to be that there was an item effect at work: For different complex verb pairs, children preferred different interpretations. However, it is not clear why less familiar verb forms that could still be better identified by the children. We suggest that children rely more on morphosyntactic cues to distinguish
between the members of a minimal pair (hence good performance in Experiment 2). When presented with a structurally ambiguous question where the answer relies on the identification of the right prosodic structure, however, one of the competitors is more likely to win, possibly due to an effect of overall frequency. This could be due to the likelihood that frequent forms are represented in the lexicon with their prosodic information. Since we have no frequency information of the items we have used, we will leave this possibility as an open question. Whatever the source of default strategies could be, our results stand firm in showing that the morphosyntactic properties that distinguished SPVs from NSPVs (in Experiment 1) could not consistently trigger the access of the relevant prosodic structure. For a more global investigation of complex verbs, it would be preferable to have more verb pairs, where frequency of occurrence is controlled. Using nonce verb pairs, future studies could eradicate any such effect. Especially since German provides the kind of structures (e.g., finite structures) that enable one to teach subjects the meaning of such nonce pairs without introducing prosodic information, future studies can investigate whether German speakers associate the (non)-separability of a prefix in a nonce complex verb in the infinitival form to a particular prosodic representation.
References:


APPENDICES

Appendix I: Picture stories used in the experiments (in alphabetical order)

1. durchbrechen
2. überziehen
4. umfahren
5. umstellen
6. wiederholen
Appendix II: Test stories used in Experiment 1 and 2 (translated into English, in alphabetical order)

Note: Stress on the test verb in the questions is either on the prefix or on the stem depending on the condition.

*Experiment 1:*

1. “durchbrechen” (to break in two / to break through)

   “Here we have two Supermen.”

   *upper half:*

   “The first one here wants to show how strong he is. He picks up a wall and breaks it in two (*bricht … durch*), just like that. Now he has half the wall in each hand.”

   *lower half:*

   “Here we have another Superman. He is flying around and then there is a wall in his way. He thinks “That can’t stop me”, flies straight on, and breaks through (*durchbricht*) the wall. Now there is a hole in the wall.”

   *Question:*

   “Welcher Superman tut die Mauer durchbrechen?”

2. “überziehen” (to throw over (an outher layer of clothing) / to put covers on bedding):

   “Here we see two girls.”

   *upper half:*

   “The first girl has her favorite blanket (=*Decke*). The girl is getting cold, so she takes the blanket and throws it over (*zieht … über*). Now she’s cozy and warm.”

   *lower half:*

   “Here we have another Superman. He is flying around and then there is a wall in his way. He thinks “That can’t stop me”, flies straight on, and breaks through (*durchbricht*) the wall. Now there is a hole in the wall.”

   *Question:*

   “Welcher Superman tut die Mauer durchbrechen?”
“This girl here is helping her mother. She takes the comforter cover and puts it over (überzieht) the comforter (=Decke). Tonight everybody will sleep in clean bedding.”

*Question:*
“Welches Mädchen tut die Decke überziehen?”

3. “umfahren” (to knock down while driving / to drive around):

Here we see two boys who are going rollerskating.

*upper half:*

“Up here, this boy is going rollerskating. Unfortunately, there is a baby carriage in his way. The boy is too fast and can’t avoid the baby carriage any more. He knocks down (=fährt...um) the baby carriage. And, the carriage falls to the ground.”

*lower half:*

“Down here, we see another boy who is going rollerskating, too. There is also a baby carriage in his way, but thank God, he is not too fast. He drives around (=umfährt) the baby carriage. Nothing happens to the baby carriage.”

*Question:*
“Welcher Junge tut den Kinderwagen umfahren?”

4. “umstellen” (to rearrange / to surround):

“Here we have a lot of children.”

*upper half:*

“These children here found a chest. They don’t know what is in it, and they all come one after another, surround (umstellen) the chest, and are very curious.”

*lower half:*

The children here have a chest in their room, but they don’t like where it is any more and move (stellen...um) the chest. They pick it up and carry it to the other side of the room.”
Question:
“Welche Kinder tun die Kiste umstellen?”

5. “wiederholen” (to fetch again / to repeat, to review)

“Now we see some animals.”

upper half:

“Here we have a parrot on a bar, and some toys on the floor. All of a sudden, the dolls falls over. The parrot gets scared and repeats (wiederholt): “The doll, the doll, the doll.”

lower half:

“Here we see a boy and his dog. They play a game: The boy throws away the doll, and the dog runs after it and fetches the doll again (holt … wieder). Then they start all over.

Question:
“Welches Tier tut die Puppe wiederholen?”

Experiment 2:

1. “durchbrechen” (to break in two / to break through)

“Here we have two Supermen.”

upper half:

“The first one here wants to show how strong he is. He picks up a wall and causes it to break (macht ... kaputt), just like that. Now he has half the wall in each hand.”

lower half:

“Here we have another Superman. He is flying around and then there is a wall in his way. He thinks “That can’t stop me”, flies straight on, then there is a BANG. Now there is a hole in the wall.”

Question:
“Welcher Superman bricht die Mauer durch?” / “Welcher Superman durchbricht die Mauer?”

2. “überziehen” (to throw over (an outher layer of clothing) / to put covers on bedding):

“Here we see two girls.”

upper half:

“The first girl has her favorite blanket (=Decke). The girl is getting cold, so she takes the blanket and wraps it around herself. Now she’s cozy and warm.”

lower half:

“This girl here is helping her mother. She takes the comforter cover and puts (=steckt) the comforter (=Decke) in its cover. Tonight everybody will sleep in clean bedding.”

Question:
“Welches Mädchen zieht die Decke über?” / “Welches Mädchen überzieht die Decke?”

3. “umfahren” (to knock down while driving / to drive around):

Here we see two boys who are going rollerskating.

upper half:

“Up here, this boy is going rollerskating. Unfortunately, there is a baby carriage in his way. The boy is too fast and can’t avoid the baby carriage any more. The baby carriage falls to the ground, and the boy looks very sad.”

lower half:

“Down here, we see another boy who is going rollerskating, too. There is also a baby carriage in his way, but thank God, he is not too fast. He manages to avoid the baby carriage. Nothing happens to the baby carriage.”

Question:
“Welcher Junge fährt den Kinderwagen um?” / “Welcher Junge umfährt den Kinderwagen?”
4. “umstellen” (ro rearrange / to surround):

“Here we have a lot of children.”

*upper half:*

“These children here found a chest. They don’t know what is in it, and they all come one after another. They stand in a circle and look at the chest curiously

*lower half:*

The children here have a chest in their room, but they don’t like where it is any more. They simply pick it up and carry it to the other side of the room.”

*Question:*

“Welche Kinder umstellen die Kiste?” / ”Welche Kinder stellen die Kiste um?”

5. “wiederholen” (to fetch again / to repeat, to review)

“Now we see some animals.”

*upper half:*

“Here we have a parrot on a bar, and some toys on the floor. All of a sudden, the doll falls over. The parrot gets scared and shouts over and over: “The doll, the doll, the doll.”

*lower half:*

“Here we see a boy and his dog. They play a game: The boy throws away the doll, and the dog runs after it and brings the doll back. Then they start all over.

*Question:*

“Welches Tier holt die Puppe wieder?” / “Welches Tier wiederholt die Puppe?”