Constraints on the Acquisition of Simplex and Complex Words in German

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Abstract

It is a common assumption that prosodic restrictions on the shape of children's early productions refer to the prosodic word (cf. [1]). However, empirical research on word structure has focused almost exclusively on simplex words where the morphosyntactic and prosodic word boundaries coincide ([2], [3], [4], [5]). In this paper, we provide new evidence from the acquisition of German complex words (compounds and particle verbs) showing that the restriction to a single foot indeed holds for the prosodic word, not for the morphosyntactic word. Thus, our results corroborate the crucial function of the prosodic word in language development.

1. Introduction

There is ample empirical evidence that children truncate tri- and quadrisyllabic words to a single foot at the earliest stages of phonological development. For example, simplex words such as German *Elefant* $[[ʔèlə]_F[fánt]_F]_{PW}$ 'elephant' or *Banane* $[ba[náːnə]_F]_{PW}$ 'banana' appear as $[[fánt]_F]_{PW}$ and $[[náːnə]_F]_{PW}$ (disregarding segmental processes). This truncation pattern of simplex tri-and quadrisyllabic words has been observed in many languages (cf. [6], for German, [2], [7] for Dutch, [5], [8] Sesotho, and K'iche), and is usually interpreted as evidence that words in child language are restricted to a single binary foot.

The question we address here is whether the restriction to a single foot targets the morphosyntactic word or the prosodic word. Morphosyntactic and prosodic word often coincide, but can diverge in complex words ([9]). For example, in German as in many other languages, the constituents of compounds are treated as different prosodic words ([10], [11]). If this is also true for compounds in child language and if the restriction to a single foot targets the prosodic word, we expect that single prosodic words (i.e., the constituents of the compound) but not the compounds as a whole are restricted to one foot. On the other hand, if the restriction targets the morphosyntactic word, compounds as a whole unit should be subject to the single foot limit, i.e. children are predicted to truncate complex words just as simplex words to a single foot.

To date, very few studies have dealt with the acquisition of complex words such as compounds, but the available evidence indicates that the single-foot restriction at least in specific stages refers to the prosodic, not to the morphosyntactic word.

As a recent study on the acquisition of Dutch compounds ([12]) indicates, complex words as simplex words underwent the single foot restriction at the early stages of word production. However, compounds displayed more varying truncation patterns: The children truncated either the first or the second constituent of the compound, or they merged parts of the two constituents to a single foot. Comparing the development of tri- and quadrisyllabic simplex words and compounds at a later point, it turned out that compounds could exceed the single foot restriction earlier than tri- and quadrisyllabic simplex words. This is, at a particular point in development, tri- and quadrisyllabic simplex words underwent truncation to a single foot while compounds appeared as a unit consisting of a primary and a secondary stressed foot. The differences in prosodic size and stress patterns between simplex and complex words indicate that at this stage children were aware that there are grammatical differences between them.

In this paper we provide additional evidence for the claim that the single-foot restriction targets prosodic, not morphosyntactic words. Our evidence is based on the successive increase of the prosodic size of simplex words, compounds and particle verbs produced by one German child.

We provide an optimality-theoretic analysis of the data and show that the difference between the prosodic size of simplex and complex words follows from two high-ranked constraints: EXHAUSTIVITY, prohibiting to skip levels of the prosodic hierarchy, and ALIGN(Foot, R; PWord, R) requiring feet to be aligned at the right edge of a prosodic word ([13], [14]). Particle verbs and compounds do not violate EXHAUSTIVITY because each constituent is parsed into a foot and a prosodic word. Furthermore, they do not violate ALIGN(Foot, R; PWord, R) because the feet are aligned at the right edge of prosodic words. In contrast, simplex words consisting of two feet undergo truncation because the leftmost foot violates ALIGN(Foot, R; PWord,R). Likewise, simplex words consisting of a single foot and an unfooted syllable are truncated because EXHAUSTIVITY is violated if there is unparsed structure. Thus, using a constraint-based framework, the patterns of simplex and complex words can be accounted for within a single constraint hierarchy.

2. German simplex and complex words

2.1. Simplex words

Simplex words form a single prosodic word in adult German where, in the regular case, main stress is assigned to the rightmost foot ([10], [15]). Therefore, different word-internal prosodic structures are predicted if words comprise more material than a single foot. They can be composed of two feet, such as *Elefant* $[[ʔèlə]_F[fánt]_F]_{PW}$ 'elephant' or *Schokolade* $[[ʃòko]F[láːdə]F]_{PW}$ 'chocolate' or of a single foot

preceded by an unfooted syllable such as *Salat* [za[lá:t]F]$_{PW}$ 'salad' or *Banane* [ba[ná:nə]$_F$]$_{PW}$ 'banana'.

2.2. Complex words

There is ample evidence from syllabification and stress assignment that compounds such as *Eier-Kuchen*, [ʔa͡ɪʁe]$_{PW}$[kù:xən]$_{PW}$ 'egg cake' and particle verbs such as *ein-kaufen*, [ʔa͡ɪn]$_{PW}$ [ka͡ʊfən]$_{PW}$ 'do shopping' consist of separate prosodic words corresponding to the single constituents. The constituents syllabify separately, thus *Hühner-Ei*, [hý:nɐ]$_{PW}$ [ʔa͡ɪ]$_{PW}$ 'hen egg' is syllabified *Hüh.ner.ei*, not *Hüh.ne.rei,* as would be expected without a phonological boundary between the stems. In this context, *Ei* this is preceded by a glottal stop. Obligatory insertion of glottal stops in German is restricted to onsetless left edges of prosodic words. According to evidence of this sort, we will follow [10] and [17] and assume that the constituents of particle verbs and compounds form prosodic words on their own. Hence *Eierkuchen* has the prosodic structure [ʔa͡ɪʁe]$_{PW}$[kù:xən]$_{PW}$ and *ein-kaufen* is structured as [ʔa͡ɪn]$_{PW}$[ka͡ʊfən]$_{PW}$. While there is general agreement in the literature that German compounds form a higher-level prosodic unit ([10], [17], [11]), few evidence has been provided what type of unit this might be. Since our results are independent of this question, we remain agnostic with respect to this point here.

3. Simplex and complex words in German child language

3.1. Data collection and selection

We analyze data from a boy acquiring German called Wiglaf who has been recorded from age 1;03.08 to 2;01.08 (age given in year; month. day). Recording sessions took place at his home in presence of a parent and the first author. As far as possible, weekly recording sessions were made; however, at the very onset of word production, biweekly recordings took place if the parents reported no progress in language development. Wiglaf's utterances were transcribed phonetically according to IPA (1993) by the first author.

The present study includes Wiglaf's *correct* productions of simplex words comprising more than a single foot, compounds and particle verbs. The data selection procedure was as follows: Wiglaf's correct productions of simplex words, compounds and particle verbs were extracted and, including the age of first emergence in the database, classified into the three categories *simplex, compound,* and *particle verb*. A word has been regarded as correctly produced if it agreed to the adult target in stress pattern and number of syllables. The investigation was restricted to words produced in isolation to reduce contextual effects on the concrete realization (e.g. stress shifts to avoid stress clashes). The investigation started with the emergence of a particle verb as the first prosodic structure bigger than a single foot at age 1;08.06 and ended at age 2;0.11 because the database contained no simplex word bigger than a single foot, compound and particle verb produced in isolation any more. Table 2 shows the number of types in the three categories (*simplex, compound,* and *particle verb*) per recording session.

3.2. Results

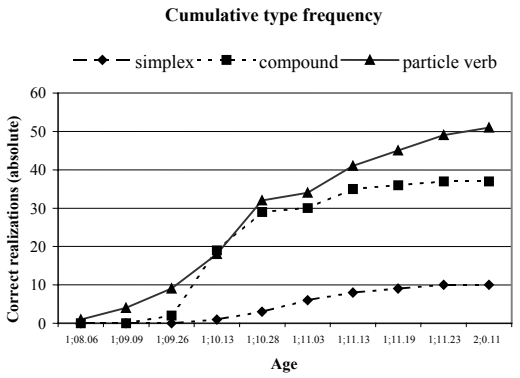
The development of simplex words, compounds and particle verbs is illustrated in Figure 3. The values at each point in time show the types produced in each category in a cumulative fashion.

As Table 2 demonstrates, the first forms comprising more than a single foot were particle verbs at age 1;08.06. Having mastered particle verbs, Wiglaf began to produce compounds at age 1;09.26. Afterwards, simplex targets appeared in the data at age 1;10.13.

Age	Simplex words	Compounds	Particle verbs
	N=	N=	N=
1;08.06	0	0	1
1;09.09	0	0	3
1;09.26	0	2	5
1;10.13	1	17	9
1;10.28	2	10	14
1;11.03	3	1	2
1;11.13	2	5	7
1;11.19	1	1	4
1;11.23	1	1	4
2;0.11	0	0	2

Table 2: The absolute number of types in the different categories (simplex, compound, and particle verb) per recording session

Figure 3: Cumulative type frequency of Wiglaf's simplex words, compounds, and particle verbs per age



It is striking in Figure 3 that the number of correct productions of particle verbs and compounds increased significantly more rapidly than the number of correct productions of simplex words. Once Wiglaf started to produce compounds, their number increased dramatically. From age 1;10.13 on, the curves for compounds and particle verbs began to cluster and took a similar course later on. Note the exponential growth of correctly produced particle verbs and compounds. It shows that Wiglaf has mastered compound stress and that he was able to apply the stress rule to compounds and particle verbs.

4. An OT-Analysis

We capture these data by the assumption that in child German just as in adult German each constituent of a compound or particle word projects its own prosodic word and that prosodic words are restricted to a single binary foot. We show that this state-of-affairs falls out naturally from an optimality-theoretic formalization using a simple re-ranking of the constraints EXHAUSTIVITY, MAX and ALIGN(Foot, R, PWord, R), which are standard constraints in optimality-theoretic treatments of prosodic structure and are independently motivated for adult German.

4.1. Adult German

Our analysis of adult German follows in crucial respects [10], which provides the most detailed optimality-theoretic account of German word stress, but we depart from her analysis in a number of technical details. We assume that the rightward orientation of feet in adult language is due to the constraint ALIGN(Foot, R, PWord, R), which requires that the right edge of all feet in a phonological structure are as close as possible to the right edge of a prosodic word. ([17]). This predicts for example that stress in a word containing three light syllables such as *Banane*, `banana´ is on the second, not on the third syllable (the vowel in *na* is long, but open syllables are generally counted as light in German, cf. [10]).

	ALIGN(Foot, R, PWord, R)
☞ a. [[Ba [na ne]$_F$]$_{PW}$	
b. [[Ba na]$_F$ ne]$_{PW}$	*!

Table 3: ALIGN and the prosodic structure of *Banane*

Since a light single syllable such as *ba* cannot form a foot on its own in German, the winning structure in Table 3 violates the constraint EXHAUSTIVITY ([13]) which requires that all syllables are parsed into feet. This means that the faithfulness constraint MAX (demanding realization of all segments) must be ranked higher than EXHAUSTIVITY to prevent deletion of a syllable:

	MAX	EXH
☞ a. [[Ba [na ne]$_F$]$_{PW}$		*
b. [[na ne]$_F$]$_{PW}$	*!	

Table 4: Ranking of MAX and EXHAUSTIVITY

ALIGN(Foot, R, PWord, R) actually requires that all feet appear right aligned to a prosodic word. This leads to inevitable violations of ALIGN in simple prosodic words containing more than one foot since only one foot can appear at the right word edge. EXHAUSTIVITY must be ranked above ALIGN because otherwise the first two syllables of a quadrisyllabic would remain unfooted. This is incompatible with the secondary stress on the first syllable in such words as in *Schòkoláde*, 'chocolate':

	EXH	ALIGN
☞ a. [[Scho ko]$_F$[la de]$_F$]$_{PW}$		*
b. [Scho ko [la de]$_F$]$_{PW}$	*!	

Table 5: Prosodic structure of *Schokolade*

Table 6 shows the complete ranking with the same example:

	MAX	EXH	ALIGN
☞ a. [[Scho ko]$_F$[la de]$_F$]$_{PW}$			*
b. [Scho ko [la de]$_F$]$_{PW}$		* !	
c. [[la de]$_F$]$_{PW}$	* !		

Table 6: Prosodic structure of *Schokolade*

4.2. Child German

The restriction of prosodic words to a single foot in child German can now be captured by the re-ranking of the constraints responsible for prosodic structure in the adult grammar. Actually candidate c. in Table 6 is the correct output for child German, which follows straightforwardly if MAX is ranked below the other two constraints. The only candidate perfectly satisfying EXHAUSTIVITY and ALIGN is a prosodic word which consists exclusively of a binary foot. The ranking of EXHAUSTIVITY and MAX with respect to each other is irrelevant, therefore they are separated in the Tables by a dotted line. Tables 7 and 8 show the effect of the ranking for a quadrisyllabic and a trisyllabic word:

	EXH	ALIGN	MAX
a. [[Scho ko]$_F$[la de]$_F$]$_{PW}$		*!	
b. [Scho ko [la de]$_F$]$_{PW}$	*!		
☞ c. [[la de]$_F$]$_{PW}$			*

Table 7: Prosodic structure of *Schokolade*

	EXH	ALIGN	MAX
a. [[Ba [na ne]$_F$]$_{PW}$	*!		
b. [[Ba na]$_F$ ne]$_{PW}$	*!	*	
☞ c. [[na ne]$_F$]$_{PW}$			*

Table 8: Prosodic structure of *Banane*

This analysis extends without modifications to complex words under the assumption that each constituent of these must correspond to a prosodic word. Table 9 illustrates this with the compound *Kassetten-rekorder*, [ka[sétən]$_F$]$_{PW}$[ʀe[k͡ɔɐ̯dɐ]$_F$]$_{PW}$ 'tape recorder', produced as [téːtən]$_F$]$_{PW}$[k͡ɔɐ̯dɐ]$_F$]$_{PW}$ by Wiglaf at 1;11.13:

	EXH	ALN	MAX
a. [[Kas[se.tten]$_F$]$_{PW}$[re[kor.der]$_F$]$_{PW}$	**!		
b. [[Kas.set]$_F$ ten]$_{PW}$[re.kor]$_F$der]$_{PW}$	**!	**	
☞ c. [[se.tten]$_F$]$_{PW}$[[kor.der]$_F$]$_{PW}$			**

Table 9: Prosodic structure of *Kassettenrekorder*

In the optimal candidate (candidate c. in Table 9) [se.tten]$_F$ as well as [kor.der]$_F$ are right aligned to a prosodic word boundary, and do hence not violate ALIGN(Foot, R, PWord, R). EXHAUSTIVITY has again the effect to block unfooted syllables.

4.3. An alternative account

While there are analyses treating particle verbs as syntactically merged structures (cf. [18] and references cited there), compounds in German are arguably morphosyntactic words. This makes the assumption untenable that the binary foot restriction in German child language targets the morphosyntactic instead of the prosodic word. An alternative account might stipulate that this restriction holds for *minimal* morphosyntactic words, i.e. morphosyntactic words not containing other morphosyntactic words. However, such an analysis is theoretically highly problematic since it introduces a morphological notion which is otherwise unmotivated and runs counter to the general tenet of prosodic phonology that morpheme structure constraints are defined with respect to prosodic not to morphosyntactic units [9]. In contrast, the prosodically based analysis advocated here is in perfect agreement with prosodic phonology, and follows without any stipulation from well-motivated phonological constraints.

5. Conclusion

Our results show that the prosodic word is an indispensable unit to account for the different restrictions Wiglaf imposes on simplex and complex words. These results are crucial for the understanding of the acquisition of complex word structure and the effects of prosodic constraints in early language production. Further research will have to show how complex words such as compounds are represented at the earliest stages, and how the target language affects timing and pattern of the re-ranking.

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