Prosodic phrasing in German sentence production: optimal length vs. argument structure

Petra Augurzky

Institute for Natural Language Processing, University of Stuttgart, Germany

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Abstract

In the last few decades, language research has been characterized by an increasing interest in the role of prosody in sentence processing. Besides signalling disambiguation, prosodic phrasing has been shown to be sensitive to balancing demands. The present experiment examined the interaction of both domains in the production of *DPI-DP2-V* constructions in German. Acoustic analyses indicate that the need to signal argument structure is mediated by prosodic balance: A general tendency of grouping arguments together with their respective heads was observed, which was increased in saliency when prosodic balance supported such a phrasing.

Key words: sentence production, argument structure, prosodic balance

Introduction

In the last few decades, language research has been characterized by an increasing interest in the role of prosody in sentence processing. For example, it has been examined experimentally whether prosodic phrasing is used as a disambiguating cue in sentence comprehension and production (e.g. Schafer et al., 2000; Snedeker and Trueswell, 2003). Besides signalling disambiguation, prosodic phrasing has been shown to be sensitive to prosodic balance (i.e. a tendency for realizing prosodic phrases of comparable length, see Fodor, 2002).

Up to now, research on the relation between balance and ambiguity resolution has predominately focused on adjunct attachment. For example, it has been demonstrated that the interpretation of so-called “relative clause attachment ambiguities” is sensitive toward the length of the potential attachment sites, as well as the length of the relative clause (e.g. Fernández, 2003). However, constraints on prosodic phrasing might be more closely related to the processing of sentential core elements (e.g. Schafer et al., 2000). Moreover, considering current phonological theory, length has often been rather loosely defined as an experimental factor. One notable exception comes from a study in Hebrew, in which the exact number of accented elements and their impact on balance was controlled (see Shaked, 2007). Given this background, the present experiment was intended to reveal the mechanisms that constrain the production of argument structure ambiguities in German.

Sentence production study

The present study explored the interaction between balance and argument structure in German sentence production ($n = 10$ German speakers). For this purpose, the acoustic properties of *DPI-DP2-V* constructions were analyzed.

Materials and method

Materials were tightly controlled considering the number of accented elements. Depending on the transitivity information of the clause-final verb, experimental sentences could be interpreted as involving two arguments (TE and TL) or as a possessive construction (IE and IL).

Table 1. Experimental stimuli. Conditions are coded with respect to TRANSITIVITY (first letter: T = transitive; I = intransitive) and BALANCE (second letter: E = expected early break; L = expected late break).

Condition	Example
TE	..., dass g�estern der F�hrer # der R�chterin gedr�ht hat. ..., that yesterday the driver the judge threatened _{TRANS} has ..., “that the driver threatened the judge yesterday”
TL	..., dass der F�hrer der R�chterin # zum wiederh�lten Mal gedr�ht hat. ..., that the driver the judge to-the repeated time threatened _{TRANS} has ..., “that the driver threatened the judge repeatedly”
IE	..., dass g�estern der F�hrer # der R�chterin geg�lft hat. ..., that yesterday the driver the judge golfed _{INTRANS} has ..., “that the driver of the judge golfed yesterday”
IL	..., dass der F�hrer der R�chterin # zum wiederh�lten Mal geg�lft hat. ..., that the driver the judge to-the repeated time golfed _{INTRANS} has ..., “that the driver of the judge golfed repeatedly”

Based upon accentual information, conditions TE and IE should preferably exhibit a prosodic boundary between the two DPs (cf. Selkirk, 2000), as indicated by the '#' diacritic. By contrast, the accent structure in TL and IL should lead to a phrasing where a prosodic boundary follows the second DP. Whereas a break separating both DPs is associated with a one-argument reading, a break after the second DP is associated with a possessive interpretation (e.g. Augurzky and Schlesewsky, under revision), thus leading to a potential tension between length and argument structure.

Results

Acoustic analyses (F0 and duration) for the single items in the complement clause are given in Table 1. Generally, consistent acoustic differences between conditions were restricted to the boundary regions. For N1 duration, a main effect of TRANSITIVITY was found ($F(1,9) = 6.64$; $p < .04$). For N2

duration, a main effect of TRANSITIVITY was found ($F(1,9) = 5.04$; $p = .05$), as well as an effect of BALANCE ($F(1,9) = 11.7$; $p < .01$). Differences in maximal F0 values were restricted to N2: An effect of BALANCE was found ($F(1,9) = 66.84$; $p < .001$).

Table 2. Mean durational values and F0 maxima for the single words in each condition. W_{acc} stands for the final accented word in the complement clause.

Words	Mean Duration in ms				F0 maxima in Hz			
	TE	TL	IE	IL	TE	TL	IE	IL
dass	201	197	201	196	121	118	119	123
D1	127	137	124	133	130	136	130	136
N1	510	508	440	428	155	160	154	158
D2	125	123	114	112	129	131	132	133
N2	499	552	536	588	143	156	144	159
W_{acc}	507	506	508	510	190	197	196	207

An additional analysis was carried out in order to investigate F0 contours of N1 and N2. No significant effects were observed for N1. F0 contours for N2 are given in Figure 2. Conditions differ from point 4 on (point 4 to point 8: All F values > 9).

Figure 1. F0 contour for the second noun in the complement clause. For this analysis, the noun was divided into seven fragments of equal length. Mean F0 values at each resulting measurement point were calculated.

Discussion

The present experiment examined whether prosodic balance and the need to signal argument structure constrain the production of German *DP-DP-V*

ambiguities. As durational analyses indicate, sentences were disambiguated with respect to their argument structure: N1 duration was increased in the transitive conditions, whereas N2 duration was increased for the intransitive conditions. Thus, generally, arguments seem to be planned together with their heads (cf. Watson and Gibson, 2004). Interestingly, acoustic differences due to argument structure were restricted to durational parameters. No F0 differences between transitive and intransitive constructions were observed. This finding indicates that prosodic phrase boundaries due to argument structure are not reflected by tonal properties. In addition, prosodic balance also affected phrasing. However, this effect only occurred at the second potential boundary region, i.e., on N2. When the ideally balanced output biased toward a late break, N2 duration was significantly increased. Moreover, an F0 increase was observed for the late boundary condition. Finally, whereas durational differences were more salient for the transitivity effect (75 ms on N1 and 73 ms on N2 vs. 53 ms on N2 for the balance effect), balance was additionally realized by the F0 parameter. Whether these differences can be interpreted in terms of reflecting different phonological levels (e.g. major vs. minor phrases) has to be examined in future phonological analyses of the materials, as well as in additional perception studies, which are currently underway.

In sum, we found evidence for a prosodic disambiguation of argument structure ambiguities which is additionally constrained by prosodic balance.

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