PROSODIC PHRASING IN ELLIPTIC AND NON-ELLIPTIC COORDINATIONS

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ABSTRACT

This paper reports a prosodic difference between elliptic and non-elliptic coordinations in German. Findings of a speech production experiment indicate that ellipsis has an effect on prosodic phrasing and that speakers avoid phrase boundaries between an elliptic gap and its filler. The data is incompatible with accounts stating that phonetically empty material resurfaces in the form of increased segment duration and greater pitch excursion at the gap. The results are evaluated against the Sense Unit Condition on intonational phrasing.

Keywords: prosody, cataphoric ellipsis, speech production.

1. INTRODUCTION

This study addresses the specific effects of ellipsis on the prosodic composition of sentences. Ellipses in general pose a problem for the understanding of sentence processing since material that is phonetically missing from the surface has to be recovered by listeners in order to arrive at the correct interpretation of the sentence.

[2] and [8] entertain the *Prosodic Gap Hypothesis* (PGH), according to which speakers use prosody to signal missing material. They report evidence in favour of explicit prosodic marking of lexically unfilled positions, namely for anaphoric ellipsis [2] and for wh-gaps [8]. Both studies find increased segment duration and greater pitch excursion just before the gap. Although [11] did not find converging evidence in an experiment comparing the influence of wh-gaps on prosody in different phrasal positions, the PGH is still debated [7, 4].

The present inquiry examines the existence of prosodic cues to cataphoric ellipsis in a speech production experiment. Cataphoric ellipsis is a productive process in coordination structures in which the conjuncts share a common element. The ellipsis site is located at the end of the first conjunct. Its counterpart appears in the same structural position of the second conjunct.

(1) Die Kinder mögen Apfel~~saft~~ und Kirschsaft.
The children like apple ~~juice~~ and cherry juice.

Prosodic properties of coordinations involving cataphoric ellipsis in German were described by [4]. On the first conjunct, they find rising pitch contours followed by a high boundary tone at the conjunction. The second conjunct bears a falling pitch contour. These findings are consistent with tonal analyses of non-elliptic coordinations [12, 13]. [4] report a particularly steep rise in pitch at the ellipsis site and hypothesise that this might be a signal to ellipsis provided by speakers. However, since the authors did not contrast their material to sentences which do not involve ellipsis, strong evidence for this hypothesis is lacking.

A speech production experiment was set up in order to clarify whether an effect of ellipsis on prosody can be confirmed and what the prosodic characteristics of this effect are. To answer these questions a direct phonetic comparison of non-elliptic and elliptic sentences is required. Sentences displaying a global ambiguity with respect to an elliptic vs. non-elliptic reading were chosen as a test bed for this exploration. The relevant sentences are exemplified in (2) and (3). The ellipsis in (3) is represented by a hyphen according to German orthographic rules.

(2) Die Bienen mögen Limonen und Guavensirup
The bees like limes and guava syrup

(3) Die Bienen mögen Limonen- und Guavensirup
The bees like lime syrup and guava syrup

2. METHODS

2.1. Reading materials

The stimuli for the production experiment consist of 8 sentences exhibiting a global ambiguity between an elliptic and a non-elliptic reading. All experimental sentences display the same constituent order exemplified in (4):

(4) [Det][subjNP][V][objNP1][Conj][Compound objNP2]

The stimuli are controlled for number of syllables and stress pattern. All subject NPs and verbs are disyllabic trochees, the first object NP and the modifier of the compound are either disyllabic trochees (50%) or trisyllabics with penultimate stress (50%). The compound head is a disyllabic trochee. The words chosen for the experimental sentences are highly sonorant in order to allow for a maximally accurate pitch analysis.

Each stimulus sentence was assigned to both the elliptic and the non-elliptic condition. The resulting 16 sentences were embedded in 62 filler sentences. This set of 78 items was fed into a DMDX presentation [5] and pseudo-randomised for each subject such that sentences of the same condition did not appear adjacently and corresponding sentences of the two conditions had a maximal distance.

2.2. Subjects

15 undergraduate students (6 male, 9 female), mostly from the Berlin and Brandenburg region in northern Germany, took part in the experiment. All were native speakers of German and reported no speech or hearing impairments. They either received course credit or were paid.

2.3. Recordings

Recordings took place in an acoustically shielded room with an AT4033a audio-technica studio microphone. Each subject was seated in front of a 15’’ computer screen with the microphone placed approximately 30cm from the subject’s mouth. A keyboard was placed on a table within close reach of the subject. Recordings were made on a computer using the RecordVocal function of DMDX and a C-Media Wave soundcard at a sampling rate of 44.1 kHz with 16 bit resolution.

2.4. Procedure

After a short instruction and three practice items (not part of the experimental set) the first sentence was presented on the screen. In order to enhance reading fluency, subjects were asked to familiarise themselves with the sentence and to press the space bar key afterwards. On pressing the space bar, the screen blanked for 200ms until the sentence reappeared on the screen. At this point, the subject’s task was to read the sentence aloud. After that, a new sentence appeared on the screen and the procedure was repeated. For each sentence, there was only one realisation by subject. If hesitations or slips of the tongue occurred, no corrections were recorded.

2.5. Data analysis

The data of the 15 subjects contained only few hesitations or slips of the tongue (5%); the affected sentences were discarded. All in all, 228 sentences were analysed, 114 of which were non-elliptic items; 114 sentences involved cataphoric ellipsis. All sentences were manually labelled by the author, using the GToBi transcription convention [3].

Pitch and duration analyses of the sentences were carried out using the acoustic speech analysis software package Praat [1]. As for the pitch analysis, the pitch objects were automatically smoothed (frequency band 10 Hz), in order to reduce microprosodic perturbations. Obvious errors of the F_0 algorithm were corrected by hand. All pitch values were normalised, using the utterance-wide mean pitch in Hz as the normalising factor for the relevant pitch values of that sentence [6].

The syllable durations of the conjoined objects and pause durations before the conjunction (if applicable) were measured. Normalised pitch minimum and maximum were calculated for each syllable of the critical regions.

3. RESULTS

In Table 1 and 2, the GToBi results are summarised for the two conditions. There are seven instances (all non-elliptic versions) which exhibit a low boundary tone (L%) before the conjunction. All other realisations display a rise in pitch towards the conjunction irrespective of the characteristics of the phrase break. The most common pitch accent on the first object NP in this data set is the L*+H rise.

The percentage of pauses at the conjunction is significantly higher in non-elliptic coordinations (59% vs. 34% in elliptic sentences; Fisher’s $z = 3.58$, $p<0.001$). Correspondingly, the proportion of intermediate phrase boundary tones is significantly higher in the non-elliptic condition compared to the elliptic versions ($z = 5.16$, $p<0.001$).

Table 1: Pitch accents, boundary tones and pauses (with percentages) on the 1st Object NP and at the conjunction.

	Non-elliptic sentences	Elliptic sentences
Pitch accent		
L*+H	101 (89%)	111 (97%)
L+H*	7 (6%)	3 (3%)
H*	2 (2%)	0 (0%)
H+!H*	1 (1%)	0 (0%)
H+L*	3 (2%)	0 (0%)
Boundary tone		
H-	71 (62%)	38 (33%)
no T-	36 (32%)	76 (67%)
L%	7 (6%)	0 (0%)
Pause		
Yes	67 (59%)	39 (34%)
No	47 (41%)	75 (66%)

As for the second conjunct, the most common contours are downstepped pitch accents and steep falls (H+L*). Comparing the distribution of the four observed accent types, no significant difference was found between the two conditions (χ^2=3.68, df=2, p=0.298).

Table 2: Number of pitch accent types (with percentages) on the 2nd Object NP.

	Non-elliptic sentences	Elliptic sentences
Pitch accent		
H+!H*	42 (37%)	46 (40%)
H+L*	37 (32%)	28 (25%)
H*	29 (25%)	37 (32%)
L+H*	5 (4%)	2 (2%)
unclear	1 (1%)	1 (1%)

For the analyses of syllable duration and pitch, the seven realisations with low boundary tones at the conjunction are treated as exceptional and were consequently excluded from further analysis. Data analysis was performed applying a linear mixed effects model [9] with condition as fixed factor and subjects and sentences as random factors.

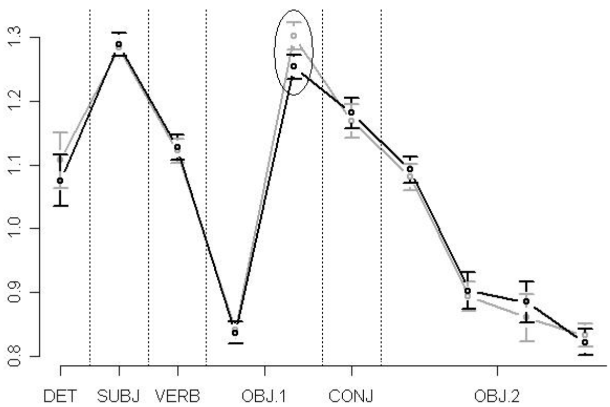
As Table 3 shows, ellipsis does not have a significant influence on the duration of the stressed syllable of the first object NP. However, duration of the last syllable of the first conjunct is significantly shorter in elliptic sentences than in non-elliptic sentences. No significant differences in syllable duration between elliptic and non-elliptic versions were found on the second object NP.

Figure 1 displays mean pitch minima and maxima including 95% confidence intervals for the two conditions at critical regions of the sentences. The rise in pitch towards the conjunction and, correspondingly, the maximum pitch on the last syllable of the first object NP is significantly higher in the non-elliptic sentences (t=-3.42, df = 219, p<0.001) and matches the initial pitch maximum on the subject. The corresponding rise in the elliptic sentences does not reach the level of the sentence initial maximum pitch.

Table 3: Mean duration of syllables.

	Non-elliptic sentences	Elliptic sentences
Stressed syllable of 1st objNP	257ms	258ms
	t=-0.327, df=219, p= 0.744	
Last syllable of 1st objNP	176ms	151ms
	t=-5.514, df=219, p<0.0001	
Stressed syllable of 2nd objNP	187ms	188ms
	t=-0.019, df=219, p=0.98	

Figure 1: Normalised mean pitch extremes with 95% confidence intervals for elliptic (black) and non-elliptic (grey) versions.



4. DISCUSSION

The results show clearly that speakers differentiate between elliptic and non-elliptic sentences when reading aloud and that they use prosodic means to do so: The final syllable of the first conjunct is longer in the non-elliptic versions, the number of ip-level boundary tones is higher and the rise at the conjunction is upstepped compared to the elliptic sentences. Additionally, there is a higher number of pauses between the conjuncts in the non-elliptic sentences. These phenomena are articulate cues of a phrase break. The boundary between the conjuncts is noticeably less marked in the elliptic sentences. Both tonal (pitch excursion at the end of the first object NP) and durational cues (syllable duration, pausing) are used to mark the differences between elliptic and non-elliptic sentences.

Obviously, the formation of prosodic domains is different in the two conditions. A generalisation of the data leads to the following representation in the two conditions:

(5) $((\ldots NP\alpha)_{ip}$ (and $NP\beta\ NP\gamma)_{ip})_{IP}$

(6) $((\ldots NP\alpha\ \cancel{NP\gamma}$ and $NP\beta\ NP\gamma)_{ip})_{IP}$

While the non-elliptic condition is realised with two intermediate phrases, the elliptic version contains just one ip. In the case of an ellipsis, a phrase boundary between the elliptic gap and its filler is avoided. The ellipsis thus renders a less complex prosodic structure compared to non-elliptic sentences.

The results confirm that ellipses have an effect on the prosodic contour of utterances. However, in opposition to the PGH [2, 8], ellipses are not marked by greater pitch excursion and lengthening of segments immediately preceding the gap but rather by less prosodic deflection compared to non-elliptic sentences. The hypothesis that empty elements resurface as *additional* prosodic structure can be refuted at least for the instances of cataphoric ellipsis scrutinised here.

The divergence in intonational phrasing tendencies between elliptic and non-elliptic coordinations cannot easily be attributed to syntax-phonology interface constraints since there is no difference concerning the distribution of syntactic phrase boundaries between the two conditions. A semantic constraint on intonational phrasing like the Sense Unit Condition (SUC, [10]) is more promising when interpreting the data. Applied to the intermediate phrase level, this condition states that the immediate syntactic constituents of an ip must entertain a head-argument or head-modifier relationship. One noteworthy qualification has to be made here in order to successfully relate the SUC to the data: The immediate constituents of the ip must be overtly realised. This is exemplified in (7-10): The non-elliptic sentences (7) and (8) are equally acceptable since the conjuncts either form a sense unit together or each conjunct is a sense unit by itself. However, if the overt noun *lime* is not an argument of *like* but the elliptic *lime ~~syrup~~* is (9-10), the revised SUC makes the prediction that a phrase boundary between the elliptic gap and its filler is marked. This situation is paralleled in the data of the present experiment, where a phrase boundary at the conjunct is rare in elliptic sentences.

(7) The bees like limes and guava syrup
(8) The bees like limes // and guava syrup
(9) The bees like lime ~~syrup~~ and guava syrup
(10) [M]The bees like lime ~~syrup~~ // and guava syrup

It is the issue of further research whether the results here can be generalised to other instances of filler-gap sentences and how the effect of ellipsis might interact with other factors known to influence prosodic phrasing. Also, it is not clear whether listeners make use of the prosodic difference between elliptic and non-elliptic sentences to resolve the ambiguity.

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