

## PROSODY IN THE PERCEPTION OF SYNTACTIC BOUNDARIES

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### ABSTRACT

*Previous experiments on Swedish indicate (a) that it is possible to differentiate between syntactic boundaries on the basis of prosodic cues alone, (b) that the best results are obtained when pre- and post-boundary information is combined with information about the boundary itself (the silent interval), (c) that a fairly good categorization may be based exclusively on pre-boundary cues and (d) that, for the majority of the subjects tested, the silent interval appears to be the stronger cue when in conflict with other prosodic cues. The experiments to be reported are an extension of this work. A new test series has been designed applying the signal detection theory in order to explore in more detail how pre-boundary information combines with information about the boundary. Two tasks are compared: categorical judgments of type of boundary, and perceptual responses to the semantic information of the sequences.*

**Keywords:** Perception, prosody, syntactic boundaries, signal detection theory, Swedish.

### 1. INTRODUCTION

There is ample evidence of systematic relationships between syntax and prosody. Prosody can provide cues to syntactic structure for the listener. This has been convincingly shown as concerns syntactic ambiguity. Otherwise ambiguous structures may be successfully disambiguated via prosody. Investigations of such structural ambiguities in sets of sentence pairs in English include /5/ and /7/, and in Swedish /1/.

The experiments on Swedish as well as those on English point to duration, in particular pausing and lengthening of syllables in pre-boundary position, and intonation as the main contributors to the syntactic disambiguation. The application or non-application of phonological rules may serve as additional cues /6/. Other alternative boundary signalling strategies are discussed in /1/.

Other studies of prosodic correlates to syntactic structure include /2/ and /3/, the former focussing on durational cues to syntax at specific constituent boundaries and the latter on Fo correlates to different clause and phrase boundaries.

Strangert /8/ investigated prosodic/phonetic characteristics of perceived pauses at sentence, clause and phrase boundaries in text reading. Silent intervals were measured as well as Fo (including onset and offset values, and voicing irregularities) and temporal characteristics before and after the boundary. The results indicated that the different types of boundary were signalled acoustically in different ways. Generally, the higher the rank of the boundary, the stronger were its acoustic correlates. Moreover, silence appeared as a powerful perceptual cue, though not a necessary one, as there were many perceived pauses with either a very short silent interval or with no silent interval at all.

### 2. DIFFERENTIATION BETWEEN SYNTACTIC BOUNDARIES ON THE BASIS OF PROSODY

A number of perception experiments /9/ were designed to explore whether it is possible to differentiate between syntactic boundaries on the basis of prosodic cues alone. Listeners were presented with sequences in Swedish which had been cut after recording so that they would be identical in segmental composition while having different syntactic structures. The following cut test sequences, including a sentence boundary (1), a clause boundary (2) and a phrase boundary (3) occurred - with minor modifications - in all the experiments:

- (1) *Han blev tvungen att ta 9.15-tåget. Sedan .....*  
'He had to take the 9.15 train. After .....
- (2) *Han blev tvungen att ta 9.15-tåget, sedan .....*  
'He had to take the 9.15 train after .....
- (3) *Han blev tvungen att ta 9.15-tåget sedan .....*  
'He had to take the 9.15 train since .....

All the material was read four times by a male speaker. Acoustic analyses revealed pre- and post-boundary differences between each of the three sequences in addition to differences concerning the boundary itself (the duration of silence). Representative examples of waveforms and Fo-contours of the test sequences are shown in Figure 1. Apart from the very evident differences in the silent intervals, there are apparent Fo differences immediately before and after the boundary. Measurements also point to the presence of pre-boundary

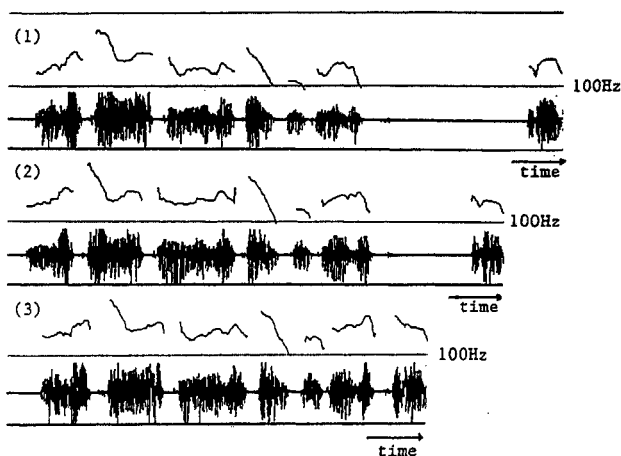


Figure 1. Waveforms and F<sub>0</sub>-contours of test sequences containing a sentence boundary (a), a clause boundary (b) and a phrase boundary (c), with the onset of the boundary as the line-up point.

lengthening, as the mean duration of the last word before the boundary, (*t*)<sub>đget</sub>, differed by about 120 msec comparing the sequence containing a sentence boundary with the sequence containing a phrase boundary (423 msec vs 310 msec).

The subjects participating in the experiments were required to judge what kind of boundary occurred after 9.15-*t*<sub>đget</sub> by indicating whether there was a period (sentence boundary), a comma (clause boundary) or nothing (phrase boundary) following that word.

In one experiment the test sequences were the same as presented above, containing pre-boundary, boundary and post-boundary information. In another, the sequences were cut immediately before the boundary to find out if pre-boundary information alone would be enough to differentiate between the boundaries. Still other experiments were run to explore the respective contributions of the silent interval and pre- and post-boundary information. In those cases the sequences were manipulated in such a way that the different cues were sometimes in conflict.

The results indicate (a) that it is possible to differentiate between syntactic boundaries on the basis of prosodic cues alone, (b) that the best results are obtained when pre- and post-boundary information is combined with information about the boundary itself (the silent interval), (c) that a fairly good categorization may be based exclusively on pre-boundary cues and (d) that, for the majority of the subjects tested, the silent interval appears to be the stronger cue when in conflict with other prosodic cues.

### 3. ELABORATING THE EXPERIMENTS

The experiments to be reported are an extension of the previous ones in order to make possible more refined analyses of the data. A new test series has been designed applying the

signal detection theory /10/ in order to explore *how* pre-boundary information combines with information about the boundary and with nonlinguistic factors. Questions that these experiments seek to answer are: Would it be possible to separate the effects of pre-boundary information from the information contained in the boundary itself? Would it be appropriate to talk about "multistage discrimination", that is, does the discrimination proceed in steps? These new experiments in particular aim at improved understanding of the results summarized in points (c) and (d) above.

Another purpose is to change the task of the listener from the meta-analysis required in the previous experiments (judging boundary type by marking a period, a comma or nothing) into a more "natural" one with closer correspondence to normal listening with focus on semantic content. To achieve this, we are currently testing a material consisting of instructions, similar to those in /10/, requiring responses in the form of appropriate actions to these instructions.

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