EFFECTS OF PROSODIC CONSTITUENT LENGTH ON PAUSE REALIZATION

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ABSTRACT

Does prosodic weight in the form of constituent-length affect restructuring of prosodic phrases, as predicted by the theory of Prosodic Phonology (Nespor & Vogel 1986)? As no evidence of such effect could be found in experiments on a Dutch sandhi process, additional testing involved realization of speech pauses in the same phonological environment.

INTRODUCTION

In previous experiments (Menert 1994) we investigated the effect of speech rate and prosodic constituent length on sandhi-processes in Dutch (voice assimilation, consonant degemination). The effect was expected to be mediated through restructuring of prosodic application domains of sandhi rules, which is typically rate and length dependent (cf. Nespor & Vogel 1986). Specifically, I assumed that voice assimilation occurs more frequently inside phi-domains than across phi-boundaries. According to N&V, phi-domains may be extended (allowing more assimilation) in case: a) speech rate is high; and b) the restructuring phis are relatively short.

Method

I expected to find evidence for the above assumptions in a series of experiments focussing on speech rate and voice assimilation. In the sentences used as stimulus material the segmental context allowing for assimilation was located in a fixed position, which was a potential phi-phrase boundary according to the N&V rules. The length of the last constituent was systematically varied, in order to vary the restructuring conditions for phi-phrases, (again following N&V),

as is illustrated in (1) below:

(1) a. [Jan]$_{PHI}$ [vond]$_{PHI}$ [het paard]$_{PHI}$
    [dapper]$_{PHI}$
    'John considerd the horse brave'
  b. [Jan]$_{PHI}$ [vond]$_{PHI}$ [het paard]$_{PHI}$
    [danig dapper]$_{PHI}$
    'John considerd the horse pretty brave'

According to N&V the branching constituent in b. blocks restructuring of the last two phis. If voice assimilation is a phi-bound process, as I assumed here, significantly less assimilations should occur in b. compared to a. Phi-restructuring and thereby wider occurrence of assimilation can be expected in fast speech rate compared to slow or normal rates.

Thirty sentence pairs were read aloud by five speakers at three speech rates (slow, normal, fast). These sentences were similar to those in (1), except for the first constituent, which contained more lexical material, as illustrated in (2).

(2) a. [Maar doktersassistente Ellen]$_{PHI}$
    [vond]$_{PHI}$ [het paard]$_{PHI}$
    [dapper]$_{PHI}$
    'but medical receptionist Ellen considered the horse brave'
  b. [Maar doktersassistente Ellen]$_{PHI}$
    [vond]$_{PHI}$ [het paard]$_{PHI}$ [danig dapper]$_{PHI}$
    'but medical receptionist Ellen considered the horse pretty brave'

The speech was recorded and served as material in perception experiments, in which assimilation occurrence was established by means of perceptual ambiguity of the stimuli.

The expectation was not borne out; while a rate effect on sandhi exists, there proved to be no effect of constituent length on sandhi occurrence. However, this does not yet entirely preclude a length effect on prosodic restructuring, since we may hypothesize that the relevant sandhi processes are relatively insensitive to phi-boundaries.

PAUSE REALIZATION

Introduction

An effect of constituent length on prosodic structuring in Dutch phrases can still be expected. This expectation is based on intuition and on literature, both regarding Dutch and other languages. Evidence for the psychological reality of phrase structure has been described in research literature since the 1960s. Later is has been shown, that the correspondence between the formal linguistic (syntactic) structure and the 'performance structure' (the phonetic organization of spoken material) is not always perfect. This was demonstrated by Grosjean et al. in studies of speech pause duration and distribution (Grosjean, Grosjean & Lane 1979, Grosjean 1980). In a series of production and parsing experiments Grosjean et al. found that pause placement and duration are affected not only by syntactic boundary strength (measured by depth of embedding in the syntactic tree), but also by the length of constituents. By checking their speech production findings in parsing tasks, the results of which were compared with predictions based on the production data, they established that sensitivity to constituent length is part of the internal phonological rule system of native speakers of English.

Vanderslice (1968) makes predictions regarding pauses on the basis of constituent length in his discussion of what I would call intuitive prosody. As for Dutch, there is evidence of such predicted length effects in studies by De Rooij (1979): effects of constituent length are found on realized phrase boundaries marked by intonation.

Method

I have attempted to establish a direct influence of constituent length on prosodic restructuring. The test was intended to score the realizations by the speaker of prosodic boundaries by means of the insertion of a speech pause. The stimulus material used in the sandhi experiments was inspected again, and speech pauses and prepausal lengthening were scored in different rate and constituent length conditions. For this purpose all the original recordings of the five speakers involved in the first experiment were listened to carefully, by myself, a trained phonetician, and a trained phonologist. No measurements were carried out, the occurrence of a pause was decided solely on the basis of auditory asessment. It is therefore very well possible that some instances of what was judged as a pause were in fact cases of perceptually conspicuous lengthening without a real pause.

If, in line with the assumptions and predictions presented in the introduction, the phi-prase restructuring is sensitive to constituent length, more pauses can be expected in the sentences with a branching constituent (as in b. in the above examples) compared to the non-branching ones (as in a. in the examples).

RESULTS

The results of the auditory examination are presented in Table 1.

Table 1. Number of speech pauses realized at the assimilation site in each experimental condition (N = 60 in each cell).

	slow	
	branching	non-branch.
speaker 1	22	31
speaker 2	48	51
speaker 3	22	13
speaker 4	59	56
speaker 5	21	21
mean %	57	57

	normal	
	branching	non-branch.
speaker 1	15	13
speaker 2	20	15
speaker 3	6	0
speaker 4	45	26
speaker 5	3	6
mean %	30	20

The results indicate that some sort of prosodic boundary is realized on the potential phi-boundary: in 57% of the slow rate realizations and in 25% of the normal rate realizations a speech pause was inserted at the predicted phi-boundary in my material. No speech pauses were perceived in the fast speech rate.

The data in Table 1 show that pause placement is not influenced by constituent branching in the stimulus sentence. Only in the normal speech rate condition are the mean pausing percentages slightly higher, but when the individual pausing behaviour is taken into account, only speaker 4 seems to show consistency with respect to branching (for detailed data cf. Menert 1994). This implies that the expected effect (i.e. more frequent pause insertions on boundaries of branching phi-phrases) did not occur, contradicting the theoretical claims in N&V.

Table 2. Number of speech pauses realized in other positions in the sentence, when no pause was realized at the assimilation site, total for both branching conditions (N=120 in each cell).

	slow	normal
speaker 1	16	14
speaker 2	33	58
speaker 3	16	22
speaker 4	6	33
speaker 5	53	23
mean %	21	25

It is obvious from the data that in the slow rate condition more pauses are inserted by the speakers than in the normal rate condition. This is not surprising; more interesting is the observation that the predicted spot for a phi-boundary in fact proves to be a natural position in the sentence for the speaker to insert a speech pause. This can be seen in Table 2: when just one speech pause is inserted, only in about 25% of all realizations the speakers do so in other positions in the sentence than at the predicted phi-boundary. I observed that the position directly preceding the verb was the other favorite for pause insertion. This position is also a predicted phi-boundary in a N&V analysis. As can be seen in the tables, the amount of pausing is very individiual. It can be concluded, however, that the preferred positions for pausing are more or less the same for all speakers (with different rankings of candidates, though), and that they co-occur with phi-phrase boudaries as predicted by the N&V rules.

Additional observation which results from the auditory examination is that the speech pauses were only very rarely combined with a pitch movement. If there was one, it was not a boundary marking tune, as described in IPO-system for Dutch intonation grammar ('t Hart, Collier & Cohen 1990).

The results can be summarized as follows:
- If a speaker of Dutch realizes a phrase boundary within the span of an intonation contour, that is in N&V terms, under the I-phrase level, he does so by means of a speech pause combined with syllable lengthening and no melodic marking (no pitch movement);
- the number of speech pauses of this sort realized by speakers decreases with higer speech rates;
- the realizations of such speech pauses are significantly more frequent om the hypothetical phi-boundary compared to other word-boundaries in the sentence.

DISCUSSION

The results can be interpreted as evidence for realization of phi-phrases. This supports my original assumptions regarding the prosodic structures of the stimulus sentences, particularly the existence of presumed phi-phrases in my spoken material. Similar observations of temporal adjustments, such as pauses and prepausal lengthening, that do not co-occur with an intonation boundary (e.g., marked by a pitch reset) are reported by Blaauw (1994), Bringmann (1991) and De Rooij (1979). These adjustments could be interpreted as markers of the Dutch phi-phrase, an intermediate level between the Intonational phrase and the Clitic group. However, if the realized pauses do demarcate the Dutch phi-phrase, I will have to conclude that these phi-phrases are not sensitive to to constituent branching, and that they do not restructure in the way predicted by the N&V rules.

An additional check of melodic markings on the presumed phi-boundaries in the stimulus material will be done, so as to confirm this result.

As for the problem of the (non)existence of the constituent length effect, there are, in my opinion, two possible areas of further investigation that should be explored before the idea of length-effects in Dutch is dismissed altogether. The first possibility is that such effects can be found in Dutch, if only the length variation is extreme enough. The second possible approach is to test phis at other positions in the sentences than I have done sofar. The choice for placing the supposedly restructuring phi at the end of the sentence was motivated by reasons concerning the application of the N&V phi-formation rules in Dutch, but it could have had some undesirable consequences. It is possible that the realization of the prosodic features towards the end of an utterance may differ from what can be predicted on the basis of of the prosodic behavior throughout the utterance. I would expect there to be a greater chance of finding phi-restructuring triggered by length when the required phi-structure is placed somewhere in the middle of a sentence or utterance.

REFERENCES

[1] Blaauw, E. (1994), The contribution of prosodic boundary markers to the perceptual difference between read and spontaneous speech, *Speech Communication* 14, pp. 359-375.

[2] Bringmann, E. (1991), *The distribution of Dutch reading pauses, the influence of prosodic phrases and punctuation on pause location and duration*, MA thesis, Utrecht University.

[3] 't Hart, J., R. Collier & A. Cohen (1990), *A Perceptual study of intonation: an experimental-phonetic approach to speech melody*, Cambridge University Press.

[3] Grosjean, F., Grosjean, L. & H. Lane (1979), The patterns of silence: performance structures in sentence production, *Cognitive Psychology* 11, pp. 58-81.

[4] Grosjean, F. (1980), Linguistic structures and Performance structures studies in pause distribution, *Temporal Variables in speech: Studies in Honour of Frieda Goldman-Eisler*, the Hague, Mouton, pp. 92-106.

[5] Menert, L. (1994), *Experiments on voice assimilation in Dutch: prosodic structures and tempo*, Dissertation, Utrecht University.

[6] Nespor, M. & I. Vogel (1986), *Prosodic Phonology*, Dordrecht, Foris Publications.

[7] Rooij, J.J. de (1979) *Speech punctuation, an acoustic and perceptual study of some aspects of speech prosody in Dutch*, Diss. Utrecht University.

[8] Vanderslice, R. (1968), Synthetic Elocution, *Working papers in phonetics* 8, University of California, Los Angeles.