FINAL LENGTHENING AT PROSODIC BOUNDARIES IN DUTCH

E. Hofhuis, C. Gussenhoven and A. Rietveld
Department of Language and Speech
Nijmegen University
Nijmegen, The Netherlands

ABSTRACT

In this paper we describe an experiment that was set up to measure segmental lengthening before five types of prosodic boundaries, ranging from the Prosodic Word boundary to the Utterance boundary.

INTRODUCTION

It has been shown by several researchers [1], [2] that segments are longer at syntactic boundaries, and that the amount of lengthening increases with the boundary's place in the syntactic hierarchy. However, we assume that it is prosodic structure that regulates the rhythm of language, and that final lengthening therefore occurs at prosodic boundaries. In earlier experiments we have found this to be true for boundaries below the word level [3]. In the experiment described below we investigated final lengthening at boundaries ranging from the Prosodic Word boundary to the Utterance boundary.

METHOD

Our experiment was set up to test the influence prosodic boundaries have on the durations of the segments that precede them. We based our definitions of the relevant prosodic boundaries in Dutch on [4].

We devised five carrier sentences in which target words could be placed before one of five prosodic boundaries. The lowest boundary we tested was a Prosodic Word boundary within a compound. The next boundary was a Prosodic Word boundary at the end of a morphological word, for which the target word was an adjective within an NP. In prosodic theory there is no difference between these two boundaries, although morpho-syntactically there is. The next higher boundary to be tested was the Phonological Phrase (PPh) boundary, which occurred at the end of an NP in our material. The highest boundary was the Utterance boundary.

To rule out any possible effect of sentence length we made sure that all carrier sentences had the same number of words before and after the target word position. Since it is not clear whether the shortening effect of the number of words following a target word can pass the Utterance boundary, or alternatively, whether the Utterance-final lengthening effect is distinct from the lengthening before the end of a discourse, we added a small sentence after the Utterance boundary, consisting of the same two words that followed the PPh-boundary. In order to be able to answer this question we also included the Utterance boundary without this following sentence in our materials.

Material

It has been pointed out by [5], among others, that segment classes may differ in the amount of lengthening they show at boundaries. Therefore, we chose target words ending in segments from four consonant classes, each of which followed a long as well as a short vowel. This resulted in the following target words:

Table 1. Target words.

	liq	nas	fric	stop
V	bɑr	kɑn	pɑs	mɑt
VV	bar	kan	pas	mat

We also included bisyllabic target words in our material, but we will not go into that part of the experiment in this paper.

The target words were placed in carrier sentences in the five boundary positions described above. This led to meaningful sentences in nearly all cases. Our speakers received instructions about the non-meaningful cases to enable them to treat these sentences as normal, meaningful sentences. The sentences were read by two male native speakers of Dutch. Each item was repeated ten times by each speaker. The sentences were recorded in a sound-proof studio. Durations were measured using a wave-form segmenting program.

RESULTS

We performed ANOVA's on each of the four subsets (liquids, fricatives, nasals and stops). For every subset the variable 'boundary' had a significant effect on the vowel and the consonant directly preceding the boundary. For liquids and their preceding vowels this was $F(4,172)=111.4$, $p<.001$ and $F(4,172)=27.1$, $p<.001$ respectively. For nasals the values are $F(4,173)=143.4$ $p<.001$ for the vowel and $F(4,173)=161.76$, $p<.001$ for the nasal. For fricatives they are $F(4,176)=179.3$, $p<.001$ for the vowel and $F(4,176)=471.38$, $p<.001$ for the fricative and finally for stops: $F(4,169)=71.45$, $p<.001$ for the vowel and $F(4,169)=47.35$, $p<.001$ for the stop. This means that the durations of every type of consonant and all vowels preceding them are significantly influenced by the type of boundary they precede. Onsets were never significantly influenced by their boundary position.

To find out which of the boundaries contributed to this effect we performed a post-hoc analysis (Tukey's HSD). To avoid large within-group variance we did separate post-hoc tests for long and short vowels. In the four tables below we can see the means for vowels and following consonants, for each segment class. The digits correspond to prosodic boundaries, 1 is the Prosodic Word boundary within composite words, 2 the final Prosodic Word boundary, 3 the Phonological Phrase boundary, 4 the Utterance boundary followed by a second sentence and 5 the Utterance boundary without this sentence. Values that are significantly different from the preceding values are underlined.

Table 2. Means in ms. for target words ending in liquids.

	1	2	3	4	5
ɑ	119	120	122	149	145
r	40	42	44	88	79
a	161	170	163	180	171
r	43	41	45	80	71

Table 3. Means in ms. for target words ending in nasals.

	1	2	3	4	5
ɑ	80	84	96	111	113
n	46	48	51	81	90
a	139	135	153	164	170
n	42	40	47	79	82

Table 4. Means in ms. for target words ending in fricatives.

	1	2	3	4	5
α	97	103	104	133	143
s	67	71	76	145	182
a	160	159	162	185	208
s	66	69	72	117	193

Table 5. Means in ms. for target words ending in stops.

	1	2	3	4	5
α	86	86	85	101	100
t	36	37	41	55	58
a	144	140	133	155	169
t	37	33	41	49	71

Boundaries

Looking at the tables above we find some interesting results. To begin with, we never found a significant difference between boundaries 1 and 2. Since there is no phonological difference between 1 and 2 in the theory of prosodic constituency we adopted, this means that segment durations, in these cases, reflect prosodic structure rather than morpho-syntactic structure. In part, this also holds for boundaries 4 and 5. In most cases there was no difference between segment durations before these two boundaries. The fricatives (and their preceding vowels), however, showed more lengthening in 5 than in 4 and so did the long vowel before the stop. Prosodically, 4 and 5 are identical: they are both Utterance boundaries. But phonetically they differ: in 5 the boundary is 'discourse'-final, whereas in 4 another utterance followed in the same discourse. It is well known that the number of words following a target word has an effect on its duration. It is not clear, however, whether this effect can cross the Utterance boundary. The results described above suggest that it can, especially in cases where extreme lengthening is possible, as is the case with fricatives.

The effect of the Phonological Phrase boundary can only be observed in table 3, showing the words ending in nasals. Vowels that preceded nasals were significantly longer before PPh-boundaries than before word boundaries.

Segments

As has been pointed out in [5], there has been some discussion on the question which part of the syllable is lengthened, and which segments can be lengthened before boundaries. For example, in [6] it is said that most of the syllable lengthening before utterance boundaries is due to lengthening of the vowel. It is also assumed in [6] that only sonorant and continuant segments can be lengthened. In [7], however, it appears that final lengthening largely affects the later part of the syllable. In [5] it was found that stops may show considerable lengthening, even more than the preceding vowel.

When we look at tables 2-5, we see that in our material the largest share of preboundary lengthening is not borne by the vowel but by the following consonant, as was found in [5] and [7]. This was true for all segment classes, including stops. Fricatives were lengthened most (up to 272%), but even stops were lengthened by 192% after long vowels. On the whole, the values for the different classes are not as far apart as might be expected.

CONCLUSION

The experiment we described above shows that higher prosodic boundaries trigger more final lengthening than lower prosodic boundaries. An interesting finding was that compound-internal Prosodic Word boundaries have the same effect as word final ones. This means that segment duration reflects the Prosodic Word boundary instead of the morpho-syntactic word boundary. The effect of the Phonological Phrase boundary could only be observed in words ending in nasals. Thus, at least in some cases, this boundary affects the duration of the segments before it.

We found a difference between a discourse-final Utterance boundary and an Utterance boundary that occurs before another sentence. This suggests that the Utterance boundary may not be the highest boundary that needs to be recognised, or alternatively, that the shortening effect that following words have on the target word may cross Utterance boundaries.

Our experiment confirmes the findings in [5] and [6] that final lengthening affects the vowel as well as the consonant following it, but that it is the latter which is lengthened most, even when this is a stop.

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