

# The interplay of prominence and boundary strength: a comparative study

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## Abstract

Hungarian is a language with left-headed head-/edge-prominence. Our goal was to investigate if prominence in Hungarian can be increased by inserting or strengthening phrase boundaries before emphasised words. German, being a right-headed head-prominence language was the basis for the comparison. Since prominence marking in Hungarian is highly dependent on syntax, a list of fruits differing in size was used. Participants were asked to utter fruit names so that someone else can guess if a fruit was small or large. We hypothesised that Hungarian speakers would use boundary signals *preceding* a large fruit, whereas Germans would either insert boundaries *after* a large fruit or not make use of final lengthening and pauses. Results show that Hungarians use more pauses than Germans in all positions, and the occurrence of pauses is used to enhance prominence. While pre-boundary lengthening was only observed preceding a large fruit in Hungarian, it was present for speakers of both languages in the final syllable of the large fruit itself. Pause occurrences after a large fruit did not depend on fruit size in any of the languages.

**Index Terms:** prosodic boundary, prosodic prominence, final lengthening, Hungarian, German

## 1. Introduction

Prosodic prominence can be marked in various ways depending on the prosodic typology of the language: it can be marked by prominence cues on the head or phrase, by the edge of a phrase, or by a combination of the two [1]. Head-prominence languages can have lexically distinctive tones (Mandarin, Swedish) or lexical stress (German, English). Edge-prominence languages, on the other hand, lack word- or phrase-level heads and use phrase boundary signals to mark prominence (Korean, certain Japanese and Mongolian dialects). In head/edge-prominence languages, prominence is marked by both the head and the edge (French, Japanese). These languages have postlexical (i.e. lexically non-distinctive) stress and accentual phrases (AP) with a uniform tonal pattern (rising, falling or rising-falling) [2].

Hungarian is a language with left-headed prosody both on the word and the sentence level. Word-level stress is fixed to the word-initial syllable and is thus fully predictable. Sentences that contain a narrow or contrastive focus are structured according to their information structure, and the strongest pitch accent falls to the left edge of the logical predicate of the sentence [3]. However, prosodic headedness is difficult to apply to broad focus sentences, since accent strength is described to be roughly equivalent throughout the intonation phrase [4, p. 131].

Recent studies on Hungarian have shown that the left-headed structure is also present in accentual phrases of Hungarian. Their tonal pattern is falling and can be described as H\* La

[5]. Another characteristics of languages with APs is that two adjacent content words forming a single syntactic unit tend to form one AP, whereas longer or more complex syntactic phrases contain more APs [2]. Evidence for this was found by [6]. Regressive voicing assimilation that applies over word boundaries in Hungarian was found to be weaker over AP boundaries by [7]. Unlike in Korean, pitch accents in Hungarian cannot be predicted based on the tonal pattern of the AP they initiate, thus the language shows a head/edge-prominence marking pattern.

In an experiment in which contrastive emphasis was elicited in read dialogues, it was observed that Hungarian speakers often inserted pauses before emphasised words [8]. This strategy might be used by speakers to enhance the prominence of a word by inserting a prosodic boundary before it, since the initial word of an AP automatically receives prominence due to the language's left-headed structure. In this study,

In the present study, the realisation of emphasis in Hungarian is compared to German that is prosodically right-headed on the IP level, but has no APs [9]. It is hypothesised that Hungarian speakers use edge-marking cues *before* an emphasised target to enhance its prominence, whereas Germans primarily make use of head prominence and potentially of the right-headed structure by inserting boundaries *after* a large fruit.

Hungarian is a so-called discourse-configurational language in which word order is highly dependent on pragmatic factors such as information structure [3]. This means that prominence is primarily expressed by syntax. It has been shown that prosodic cues do not play a crucial role of prominence production and perception in syntactically well-formed sentences [10]. Thus, in order to investigate prosodic cues of prominence marking, it was essential to create material that does not contain syntactic information.

## 2. Materials and methods

Participants saw two baskets containing altogether five fruits on a computer screen. The fruits and their order were identical throughout the experiment, whereas the size of the baskets (3+2 vs. 2+3) and the size of the fruits (small vs. large) varied. Participants were asked to name fruits and to indicate (1) whether the fruits are small or large and (2) whether the basket includes two or three fruits. The experiment was preceded by a training phase. Participants were shown a small and a large fruit with their names written in lower case and in capital letters, and they were asked to indicate the difference. They were not provided by any auditory material to avoid a bias due to priming. The training phase included a familiarisation session with the sequence of the fruits in order to make the naming task as fluent as possible.

Stimuli in the Hungarian material contained the fruits

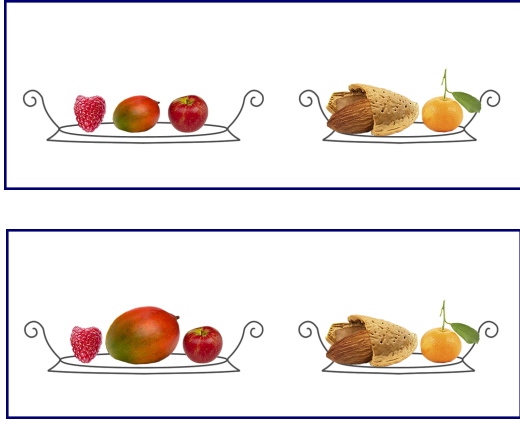


Figure 1: Examples of fruit sequences in Hungarian. Analysis was based on the first unit, i.e. the first basket.

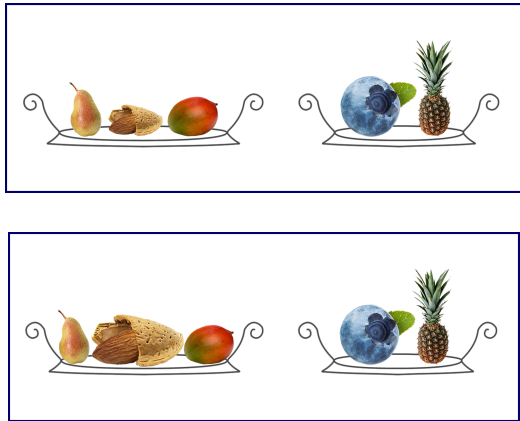


Figure 2: Examples of fruit sequences in German. Analysis was based on the first unit, i.e. the first basket.

*málna mangó alma mandula mandarin* ‘raspberry mango apple almond mandarin’. German stimuli were *Birne Mandel Mango Blaubeere Ananas* ‘pear almond mango blueberry ananas’. Stress was initial in all words.

Analysis was based on sequences in which the first basket contained three fruits which were either [small small small] or [small LARGE small] (the size of fruits in the second basket being [small LARGE] or [LARGE small], but the latter did not undergo further analysis), see Figure 2. The following parameters were used for analysis:

1. Pause **occurrence** before and after the second fruit.
2. Pause **duration** before and after the second fruit (if present).
3. Lengthening: duration of final syllable **before** the second fruit.
4. Lengthening: duration of the final syllable **in** the second fruit.
5. Accent: duration of the **initial** stressed syllable of the second fruit.

Speech samples were recorded in a sound-proof room with 10 Hungarian native speakers in Budapest and with 8 German native speakers in Munich, all being female students. The data set contained 432 realisations (4 sequences  $\times$  6 repetitions  $\times$  18 speakers). Linear mixed effect models were computed for each language separately with the size of the second fruit in the first basket as fixed effect, participant, repetition and the size of the fourth and fifth fruit in the second basket as random effects.  $\chi^2$  tests were used for the distribution of pauses if applicable.

The following hypotheses were tested:

- Hypothesis 1: Boundaries are likely to occur before each accented word in Hungarian.
- Hypothesis 2: Hungarian speakers mark the prominence of a large second fruit by a **preceding** prosodic boundary.
- Hypothesis 3: German speakers will mark a large second fruit either by a boundary **following** it, or by no boundary.

### 3. Results

#### 3.1. Occurrence and duration of pauses

All fruits carried a pitch accent in both languages irrespectably of their size. Thus, the target of the subsequent analysis is not to compare accentuation with deaccentuation, but higher emphasis with lower prominence.

Table 1 presents the number of pauses before and after the second fruit in the two languages.

Table 1: This is an example of a table.

	before 2nd fruit		after 2nd fruit	
	small	big	small	big
<b>Hungarian</b>	59	92	83	103
<b>German</b>	0	7	5	34

Hungarian speakers produced a substantially higher number of pauses in all positions which is interpreted as a consequence of the presence of lower-level, i.e. AP boundaries before each pitch-accented fruit. According to  $\chi^2$  tests, the occurrence of pauses in the production of Hungarian speakers was significantly more frequent before a large second fruit ( $\chi^2 = 7.21, df = 1, p = 0.007$ ), but not after it ( $\chi^2 = 2.15, df = 1, p = 0.14$ ). At the same time, German speakers produced significantly more pauses after a large second fruit ( $\chi^2 = 21.56, df = 1, p < 0.001$ ). (Due to the overall low number of pauses produced by German speakers before the second fruit, the test was not applicable.)

Pause durations in Hungarian showed the expected tendency before the second fruit being significantly longer if it was large ( $t = 9.2, p < 0.001$ ), but the same tendency was found for the right boundary following a large fruit ( $t = 10.7, p < 0.001$ ). Pause durations did not differ for German speakers in either position.

#### 3.2. Pre-boundary lengthening

The last syllable of the first fruit (that was small throughout the experiment) showed substantial lengthening preceding a large fruit in Hungarian, ( $t = 4.16, p < 0.001$ ), but not in German ( $t = 1.4, p < 0.16$ ), see Figure 3. However, the final syllable of the second fruit was lengthened in both languages due to a larger

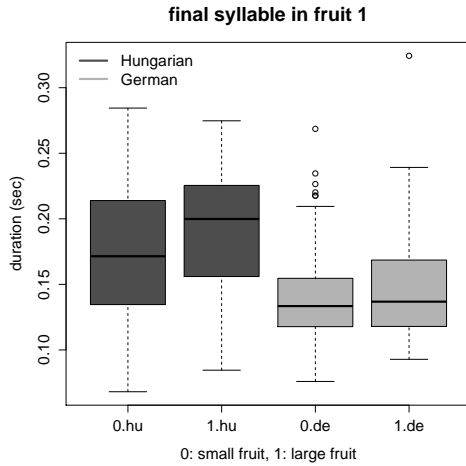


Figure 3: Duration of the final syllable preceding the emphasised word and a potential pause.

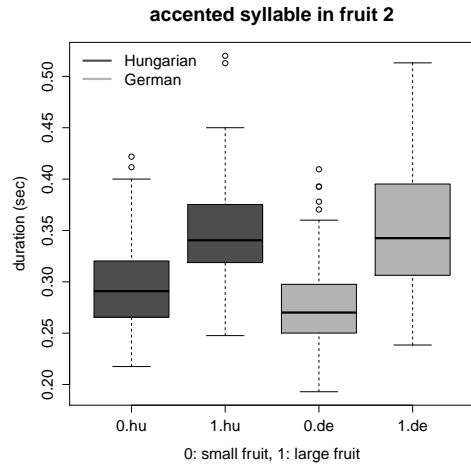


Figure 5: Duration of the stressed syllable of the emphasised word.

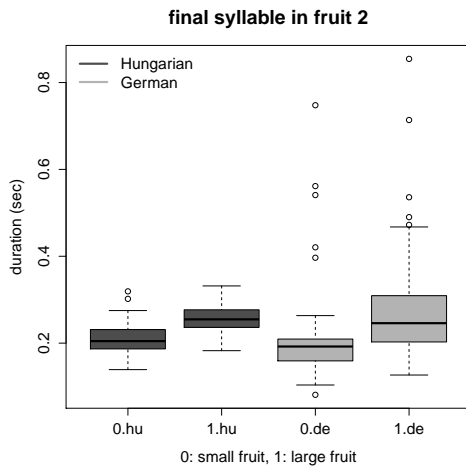


Figure 4: Duration of the final syllable preceding the emphasised word and a potential pause.

emphasis on the fruit as a unit ( $t = 12.5$  for Hungarian,  $t = 6.0$  for German, both  $p < 0.001$ ), see Figure 4. The interpretation of the latter findings is problematic, because final lengthening *within* an emphasised word can both signalise head prominence, i.e. a carryover effect of the previous stressed syllable [11] and a boundary effect due to the following pause.

The assumption of a carryover effect is based on [11, 12] who found evidence that accentual lengthening is not limited just to the syllable carrying the word stress but also affects adjacent syllables. Thus the locus of domain-head and -edge effects [13], the stretch of speech over which the effects are manifested, can span more than one syllable.

A domain-head effect in terms of longer duration on the stressed syllable of the large second fruit was found in both languages ( $t = 11.2$  for Hungarian,  $t = 12.5$  for German, both  $p < 0.001$ ), see Figure 5.

#### 4. Discussion and conclusions

The results show that Hungarian and German speakers utilise different prosodic means to mark emphasis if syntax cannot be used. The frequent occurrence of pauses between any two fruits in the production of Hungarian speakers signalises that accented words are preceded by lower-level boundaries, which is not the case in German (evidence for Hypothesis 1). Both the more frequent occurrence of pauses and their longer durations at the left edge of the emphasised word provide evidence that higher prominence is connected with stronger boundaries in Hungarian (evidence for Hypothesis 2). German speakers did not make use of boundary strength on the left edge.

Although the utilisation of boundaries for prominence marking is characteristic of edge-prominence and head/edge-prominence languages that contain accentual phrases, it is not clear if the prominence-effect of the preceding final syllable was found [14]. Thus it could be argued that boundaries between the first and the second fruit in Hungarian do not demarcate AP, but an IP boundary. However, the amount of lengthening in the final syllable of the third fruit (being the last one in the first basket) is larger, thus it cannot be excluded that Hungarian differs from Korean and utilises higher-level boundary markers to mark lower-level boundaries.

It is not clear how lengthening of the final syllable of large fruits can be interpreted in the two languages. Longer durations of non-stressed syllables of accented words have been shown before [15]. At the same time, they can alternatively or parallelly signalise pre-boundary lengthening following the second word. Since pauses were frequent after the second fruit in both languages, this possibility cannot be excluded at present.

As was mentioned in the Introduction, complex syntactic units tend to form several APs in Hungarian. In fact, adverb+adjective+noun sequences investigated in [6] tended to be divided in two APs rather than to bear a single pitch accent. Thus, it is possible that Hungarian speakers tend to split longer sequences into more accentual phrases – this would explain the overall higher number of pauses between the second and the

third fruit.

Based on the findings, it can be concluded that in Hungarian, boundaries at the left edge of a prominent word (here: the large fruit), both in terms of pauses and their durations and of pre-boundary lengthening are utilised for prominence strengthening. In German, lower-level boundaries do not seem to play a role in prominence marking.

## 5. Acknowledgements

This work was funded by the researchers' exchange grant *Form and function of prosodic structure in Hungarian and in German* between IPS LMU Munich and RIL HAS Budapest funded by DAAD (Germany) and MÖB (Hungary). Many thanks to the further participants of the projects: Susanne Beinrucker, Andrea Deme, Kristóf Galla, Anna Kohári, Nele Salveste, Balázs Surányi for data processing and discussions.

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