Teasing apart lexical stress and sentence accent in Hungarian and German

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Abstract

This study compares the strategies to mark lexical stress and sentence-level accent in Hungarian and in German by employing two production experiments of comparable designs. The experimental conditions elicited target segments in +/– stressed and +/– accented conditions. The results indicated that while German, a language with variable lexical stress placement, clearly marks both stress and accent with a number of phonetic parameters, Hungarian, a language with fixed word-level stress placement marks accents, but not stress.

Index Terms: lexical stress, accent, Hungarian, German, prominence marking

1. Introduction

Lexical stress and sentence accent are marked on the same segments (syllables), however they are associated with different levels of prosodic structure. The parameters (e.g. intensity, duration) that are available for a language for prominence marking apply to both prominence levels, therefore it can be assumed that there is some degree of difference in the quantity of these parameters when they are employed to mark lexical stress and sentence accent. This difference might be linked to the prosodic system of a given language, where redundancies and marking necessities might play an important role in influencing what categories receive marking and to what degree. The present study aims to answer this question by comparing acoustic cues of stress and accent in Hungarian and German, two languages with different prosodic systems.

1.1. Hungarian and German stress and accent systems

Word-level stress in Hungarian is highly predictable: stress is always assigned to the initial syllable of a prosodic word. There is no evidence for secondary stress [1]. Stress has been shown to effect intensity [2], but it has not been shown to have a considerable effect on lengthening [2, 3, 4]. The lack of a lengthening effect might be due to the presence of a vowel quantity distinction in the language. While word-level stress shift is possible, it is linked to very specific conditions: the segment where stress is shifted to needs to be contrasted.

German behaves differently from Hungarian in this respect. Lexical stress is not strictly assigned to a given syllable, instead, it is restricted to a 3-syllable window (e.g. **Li**.ba.non 'Libanon', Ba.**na**.ne 'banana', E.le.**fant** 'elephant') [5]. Word-level stress placement is marginally contrastive, a property that was exploited in the creation of the target stimuli as shown in (1) to (4), showing how stress placement differentiates between the name ***Au****gust* and the month *Au****gust***.

Prominence is associated with sentence-level (i. e. pitch) accents in Hungarian broad focus sentences on each content word or syntactic constituent, while in sentences containing a narrow focus, the focused item receives the highest prominence while the following items are deaccented. The focus occurs in a specific syntactic position. The degree to which the accent manifested on the focus is more prominent than non-focus accents in broad focus sentences has been debated with some evidence suggesting larger f0 range [6], with other studies not finding significant differences [7].

German has a large variety of pitch accents as well as a nuclear accent [8], where the focused item usually co-occurs with the nuclear accent. In these cases there is post-focal compression. Different accent shapes might be associated with different levels of prominence [9].

1.2. Motivation and goals

The present study aims to differentiate lexical stress and sentence accent marking in Hungarian and German. By working with comparable experimental paradigms in the two languages, it is also our aim to show what, if any, differences exist in the prominence marking of these languages with different prosodic systems.

2. Methods and materials

A production experiment was conducted to elicit target syllables that varied in their assignment of lexical stress and accent. In German the following four combinations of +/– stress and +/– accent conditions were created:

+lexical stress, +sentence accent

(1) Um den Garten wird sich der alte ***Au***gust kümmern.
'The garden will be taken care of by old August.'

+lexical stress, –sentence accent

(2) Um den Hund wird sich **nicht** der alte *Au*gust kümmern.
'The dog will not be taken care of by old August'

–lexical stress, +sentence accent

(3) Zurück werde ich wohl Mitte **Au*gust*** kommen.
'I will probably come back by Mid-August.'

–lexical stress, –sentence accent

(4) Vielleicht werde ich aber auch erst **Ende** Au*gust* kommen.
'Perhaps I will come back no earlier than end of August.'

In the above example the target syllable is underlined, the position of lexical stress is indicated by *italics* and the position of sentence-level accent is in **bold**. The +/- stress conditions were created by making use of different stress placements on the words *August*, the name, and *August*, the month, to modify the placement of lexical stress. In the case of sentence accents, the -conditions were created by placing the target syllable under the scope of negation as in (2), or by shifting focus to a preceding word as in (4).

In Hungarian not all possible variations of factors is possible due to syntactic reasons, thus, only three conditions could be created:

+lexical stress, +sentence accent

(5) **Jól** ***lo***csold meg a **mus**kátlit.
'Water the geraniums well.'

+lexical stress, –sentence accent

(6) **Sem**miképp **ne** *lo*csold meg a **kak**tuszt.
'In no way should you water the cactus.'

–lexical stress, +sentence accent

(7) **Ne**hogy **meglocsold** az **or**chideát.
'Don't water the orchid ever.'

The target syllable and the placement of stress and accent are indicated as above. The target syllable was always the first syllable of a verb. In Hungarian neutral clauses the verb is most often the first element of a syntactic unit which coincides with a prosodic phrase, its first syllable therefore receives a pitch accent by default. Other pitch accents that are present in the sentence are also indicated. These are usually assigned to syntactic phrases. In the sentence (7) a verbal modifier is placed in front of the verb, forming one prosodic unit with it. In this configuration lexical stress is assigned to the verbal modifier as it now contains the first syllable. The presence of sentence-level accents was manipulated by placing the verb under the scope of negation as in (6). In this sentence the pitch accent is shifted from the verb to the negation word.

The experimental paradigm aimed to introduce a degree of communication between the two participants. They were asked to imagine a scenario where one of them is going on holiday, and the other will stay in the apartment. The task involved giving instructions to the friend on what to do and what not to do in the flat. Participants were presented with slides containing images and unconjugated/morphologically unmarked words that formed the target sentences as in Figure 1 with two examples from the German stimuli. Participants were then asked to say aloud the instructions, while the dialogue partner was asked to remember as many of the instructions as possible.

Recordings were made in sound-proof rooms in Budapest and in Bielefeld, using SpeechRecorder [10] and head-mounted microphones. For both languages there were 7 target words with 2 factors (accent and stress). Stimuli were presented in randomized order together with filler sentences. There were two repetitions for each item. 30 German and 12 Hungarian native speakers participated in the experiment.

The following parameters based on the target vowel were investigated: duration, intensity, spectral balance, and f0 maximum.

Results were analyzed using linear mixed effect models with stress and accent as fixed effects and speaker and item as random effects. In order to account for the unbalanced design of the Hungarian data, tests were run separately for all conditions, i.e. the comparison between stressed and unstressed syllables in accented words was separated from the comparison between stressed and unstressed syllables in deaccented words.

Figure 1: *Stimuli to elicit the sentences given in (1) (top) and (3) (bottom).*

3. Results

3.1. Duration

Duration was measured on the vowel of the target syllable fore each language. The results are presented in Figures 2 and 3.

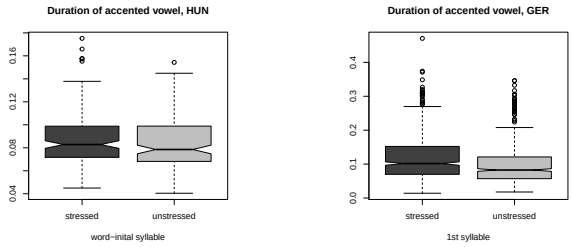

Figure 2: *The effect of stress on the duration of the accented vowel in Hungarian (left) and in German (right).*

The statistical analysis revealed that duration was significantly effected by word-level stress placement and by accent placement on the target syllable in both languages.

3.2. Intensity and spectral balance

The analysis of intensity was done on maximum intensity values extracted from the vowel in the target syllable. The results are presented in Figures 4 and 5.

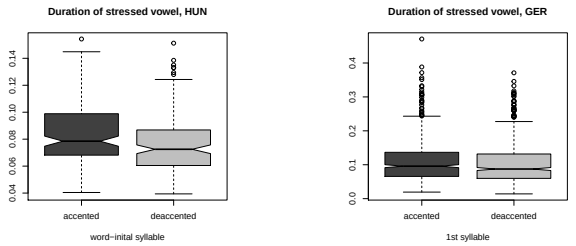

Figure 3: *The effect of stress on the duration of the stressed syllable in Hungarian (left) and in German (right).*

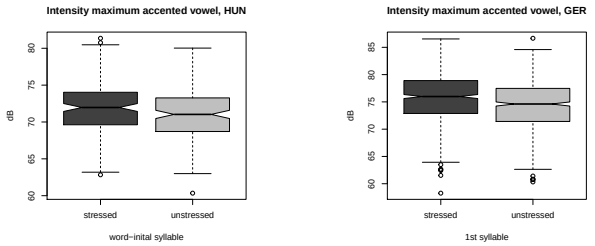

Figure 4: *The effect of lexical stress on the intensity maximum on the accented syllable in Hungarian (left) and in German (right).*

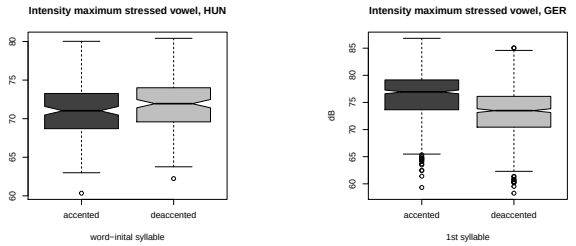

Figure 5: *The effect of accent on the intensity maximum on stressed syllable in Hungarian (left) and in German (right).*

Statistical analysis revealed that intensity was significantly different in the case of German for both stress and accent factors. In the case of Hungarian only accent lead to significantly different intensity levels, but not stress.

Another parameter investigated was spectral balance. Spectral balance (SPLH–SPL) is calculated by subtracting the sound pressure level (SPL) from the sound pressure level at high frequencies (SPLH) of the same segment. This parameter has been shown to be a good indicator of vocal quality and prominence [11]. The plots below show the results of the SPLH-SPL data in Figures 6 and 7. s

Statistical analysis revealed that differences were significant for German both for the effects of stress and accent. However, in Hungarian only the effect of accent showed significant differences, lexical stress did not, as in the case of intensity maximum.

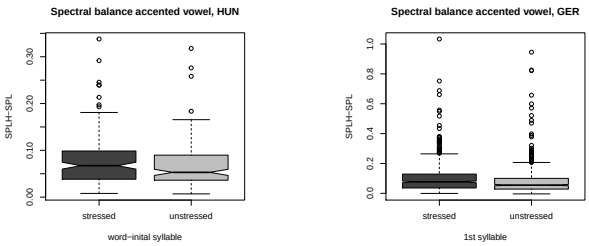

Figure 6: *The effect of lexical stress on spectral balance on accented syllable in Hungarian (left) and in German (right).*

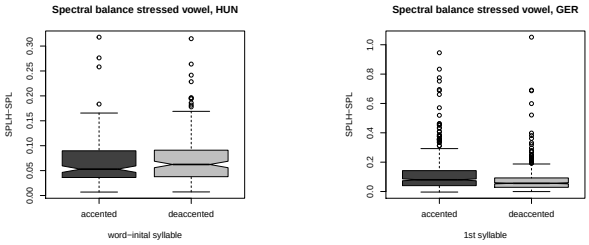

Figure 7: *The effect of accent on spectral balance on stressed syllable in Hungarian (left) and in German (right).*

3.3. F0 maximum

F0 maximum Hz values were extracted from the sound files, and values where converted to semitones using speaker specific median values as baselines. The results are presented in Figures 8 and 9.

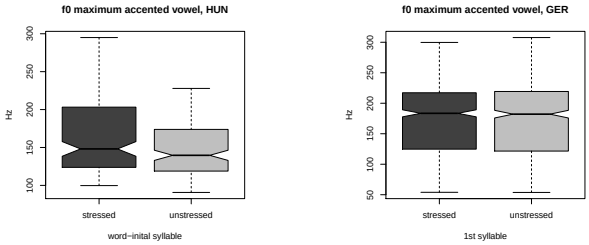

Figure 8: *The effect of stress on the f0 maximum on accented syllable in Hungarian (left) and in German (right).*

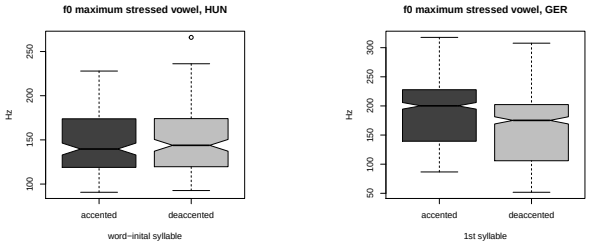

Figure 9: *the effect of accent on the f0 maximum on stressed syllable in Hungarian (left) and in German (right).*

As in the case of intensity maximum and spectral balance, German showed significant effects for both stress and accent while Hungarian only showed them for accent. It should be noted that for 1st syllable target syllables in German the factor lexical stress did not show a significant difference for f0, however it did for syllables in the second position.

4. Discussion and conclusions

We have shown that German and Hungarian mark lexical stress and sentence accent in different ways. Higher-level prominence marking by pitch accents is present in both languages. German also marks lexical stress across all parameters observed in this study, while Hungarian does not. We did find a difference in duration as an effect of lexical stress, however, this might be due to the necessity of moving the accented syllable from the initial to a word-medial position. We assume that these results originate from the prosodic systems of the two languages, namely that German lexical stress marking is not predictable, while Hungarian stress marking is highly predictable. Therefore marking differences in prominence in German is a necessity on both levels examined in this study, while for Hungarian it is a redundancy on the level of lexical stress but not when it comes to sentence-level accents.

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