

# Prosodic prominence in Hungarian and German: same, same, but different

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9th of February 2017

Experiments based on two researchers' exchange projects:

the Alexander von Humboldt Foundation by the institute partnership grant *Grammar and pragmatics* to RIL HAS and University of Bielefeld (Beáta Gyuris and Marcus Kracht).

Collaborators: Petra Wagner and Andreas Windmann.

*Form and function of prosodic structure in Hungarian and in German* between LMU Munich and RIL HAS Budapest funded by DAAD (Germany) and MÖB (Hungary).

Collaborators: Susanne Beinrucker, Andrea Deme, Kristóf Galla, Felicitas Kleber, Anna Kohári, Uwe Reichel, Nele Salveste, and Balázs Surányi.

Imagine a thirsty animal. Imagine a river with clear and fresh water. How does the animal get to the river?



There are many ways of moving.

Imagine listening to this dialogue:

„What did you get for your birthday?”

„The new Harry Potter book, a ticket for the zoo, and – just imagine – a golden retriever.”

Imagine listening to this dialogue:

„What did you get for your birthday?”

„The new Harry Potter book, a ticket for the zoo, and – just imagine – a golden retriever.”

**There are many ways of highlighting a phrase.**

# Measuring stress

Means to express unexpected or in whatever way emphatic information, traditionally called stress (see Fónagy 1958):

## Articulatory features:

- higher physical effort,
- higher force of exhalation,
- higher muscular activity, etc.

## Acoustic features:

- energy,
- pitch,
- stress (i.e. pressure), etc.

# Problems with measuring stress

Various difficulties were recognised already around 1900:

- higher muscular activity for voiced sounds ↔ lower amount of exhaled air (Jespersen 1904),
- intensity is dependent on frequency, i.e. the amplitude of the sound wave does not serve as a direct marker of stress (Schwan 1890),
- the human ear does not transform intensity into loudness in a linear way (first results by Helmholtz 1857),
- amount of relevant intensity difference is dependent on vowel quality (first mentioned by the Greek Dionysios Halikarnasseus), /a/ having the highest intrinsic intensity,
- effect of melody (pitch curve) on prominence perception (Scott 1939),
- impact of duration (Rosengren 1903),
- all measures of stress are relative,
- language-dependency.



## Different levels of prominence

Cruttenden (1986), in accordance with previous literature (e.g. Jones 1950 etc.) suggests two levels of prominence:

- 1 **Stress** that distinguishes between different lexical meanings on the **word level**, e.g. *récord* – *recórd*.  
(Potential) acoustic correlates:
  - higher intensity,
  - longer duration,
  - segmental strengthening (e.g. aspiration, full vowels etc.).
- 2 **Accent** refers to emphasis on the **sentence level**, e.g. *it's NOT my FAULT* – *it's not MY fault*.  
Acoustic correlates:
  - potentially all correlates of stress,
  - + pitch → pitch accent.

Stressed syllables have the potential for bearing a pitch accent.

Problem: the function of (word-)stress is highly language-dependent:

- lexically distinctive in the Germanic languages,
- mostly predictable in e.g. Spanish,
- fully predictable in Hungarian, Slovak, Polish etc.,
- absent in e.g. Seoul Korean, West Greenlandic, some Japanese and Mongolian dialects.

Consequence: languages make use of prominence marking cues to various extents.

Remember: all animals can move, but not all of them can or prefer to walk.

# Prosodic typology: prominence type, word prosody, and macro-rhythm

Jun 2014:

- 1 Head-prominence languages mark phrase-level prominence by the phrase head, i.e. by a lexical (Swedish) or a postlexical (English, Dutch, German) pitch accent.
- 2 Head/edge-prominence languages mark prominence both by head and the edge of the phrase, i.e. they have both lexical/postlexical stress and tonal marking of an accentual phrase (French, Georgian, Tokyo Japanese, Basque).
- 3 Edge-prominence languages have no lexical stress, prominence is only marked by the edge of a word or phrase (Seoul Korean, West Greenlandic, accentless dialects of Japanese).

German is a head-prominence language, while Hungarian has been shown to be a head/edge prominence language (e.g. Beňuš, Reichel & Mády 2014).

Research questions:

- 1 Which acoustic cues are used to mark word-level stress in German where it is lexically distinctive and in Hungarian where it is predictable?
- 2 Is edge prominence used in Hungarian for prominence marking by inserting prosodic boundaries?

# Experiment 1

# Motivation

Several studies on prominence in German (Kohler 1987, Kleber & Klippfahn 2006, Schneider & Möbius 2007 etc.), but often no dissociation between word- and sentence-level prominence.

Exceptions: Dogil & Williams 1999, Samlowski et al. 2014.

Little is known about prominence realisation in Hungarian (Fónagy 1958 on stress in general, Genzel et al. 2014 and Mády 2015 on focus prosody).

Hardly any cross-linguistic comparisons (Cambier-Langeveld & Turk 1999).

## German: word-level stress and sentence accent

- Lexical stress is not fixed and not fully predictable.
- Lexical stress placement is marginally contrastive: *Part.tie* vs. **Par.ty**, **Konstanz** vs. Kon.**stanz**.
- Sentence prominence is carried by the placement of pitch accents and the nuclear accent (Féry & Kügler 2008).
- Accents: noticeable pitch excursions of variable shapes, connected to different prosodic functions, e.g. contrast, novelty (Baumann & Riester 2012).

# Hungarian: word-level stress and sentence accent

- Word-level stress is fixed to the word-initial syllable, e.g. **ba**.nán, **szo**.lá.ri.um, **pro**.zó.dí.a ‘banana, solarium, prosody’ → fully predictable, thus postlexical rather than lexical.
- No consistent lengthening due to stress (Fónagy 1958, Kassai 1978, Mády et al. 2008) – possibly because of phonemic vowel quantity distinction.
- Sentence-level prominence is primarily expressed by word order, whereas prosodic cues are optional both in production and perception (Mády 2015).
- Both word-level and sentence-level prosody are left-headed.



# Established cues to lexical and sentence prominence

- Pitch accents (presence, height, shape, excursion, slope).
- Duration/lengthening.
- Overall intensity.
- Spectral tilt, open quotient (“laryngeal effort”).
- Hyper-/hypoarticulation, reduction, centralisation (“articulatory effort”).
- Cues are used in a language-specific fashion and interact heavily (e.g. Tamburini & Wagner 2003, Barry et al. 2003, Samlowski et al. 2014).
- For German, all above cues have shown to play a role across various studies. Few investigations on Hungarian.

# Materials

**Problem:** How to measure the same syllable with different levels of prominence?

**German:** Find minimal pairs with different stress patterns.

**Hungarian:** Move the target syllable to different prominence positions.

# Materials: German

Lexical stress:

August = name

August = month

Target syllable: 'au', condition: +/- lexical stress:

- (1) Um den Garten wird sich der alte August kümmern.  
'The garden will be taken care of by old August'
- (2) Zurück werde ich wohl Mitte August kommen.  
'I will probably come back by mid August.'

# Materials: German

Sentence accent: sentential accent falls on negation.

Target syllable: 'au', condition: +/- **Sentence accent:**

- (3) Um den Garden wird sich der alte **August** kümmern.  
'The garden will be taken care of by old August'
- (4) Um den Hund wird sich **nicht** der alte **August** kümmern.  
'The dog will not be taken care of by old August.'

## Materials: German +/- stress and +/- accent

+lexical stress, +sentence accent

Um den Garten wird sich der alte **August** kümmern.

'The garden will be taken care of by old August.'

+lexical stress, -sentence accent

Um den Hund wird sich **nicht** der alte August kümmern.

'The dog will not be taken care of by old August'

-lexical stress, +sentence accent

Zurück werde ich wohl Mitte August kommen.

'I will probably come back by Mid August.'

-lexical stress, -sentence accent

Vielleicht werde ich aber auch erst **Ende** August kommen.

'Perhaps I will come back no earlier than the end of August.'

Target syllable: **red**, accent: **bold**, stress: underlined.

# Materials: Hungarian

Lexical stress: always on first syllable

locsold (verb)

meglocsold (PRT+verb)

Target syllable 'lo' condition: +/- lexical stress

- (5) Jól locsold meg a muskátlit.  
'Water the geraniums well'
- (6) Nehogy meglocsold az orchideát.  
'Don't water the orchid'

# Materials: Hungarian

Sentence accent: There is deaccentuation after negation.

**Locsold.**

**Ne locsold.**

Target syllable 'lo' condition: +/- sentence accent.

(7) Jól **lo**csold meg a muskátlit.

'Water the geraniums well'

(8) Semmiképp **ne lo**csold meg a kaktuszt.

'Under no condition should you water the cactus.'

## Materials: Hungarian +/- stress +/- accent

+lexical stress, +sentence accent

Jól locsold meg a muskátlit.

'Water the geraniums well.'

+lexical stress, -sentence accent

Semmiképp **ne lo**csold meg a kaktuszt.

'In no way should you water the cactus.'

-lexical stress, +sentence accent

Nehogy meglocsold az orchideát.

'Don't water the orchid ever.'

-lexical stress, -sentence accent

Not possible: [negation PRT+verb] not grammatical.

Target syllable: **red**, accent: **bold**, stress: underlined.



# Methods

## Goals

- Have subjects use materials to produce utterances.
- Avoid “read speech” prosody: be as close to natural spoken speech as possible.

## **Solution:** “House Instructions Paradigm”

- Subject instructs listener to do (or not do) certain things in their apartment while they are away.
- Subject shown pictures, dictionary forms of words and has to create sentences on their own.

Target word: August 'male name' vs. August 'the month August'.

Um



der Garten werden sich



der alte August

kümmern

Zurück werden ich wohl



Mitte August

kommen

Target word: *locsol* 'to water' with and without sentence accent.

KÉTNAPONTA



**MEGLOCSOLNI**



**MUSKÁTLI**



**SEMMIKÉPPEN NE MEGLOCSOLNI KAKTUSZ**

# Materials

- 7 target items in both languages
- 2 factors: +/- stress, +/- accent
- 2 repetitions
- German: 30 subjects, Hungarian: 12 subjects
- SpeechRecorder, head mounted microphones, sound-proof recording rooms in Budapest and Bielefeld.

## Results: Analysis

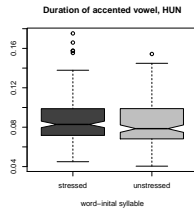
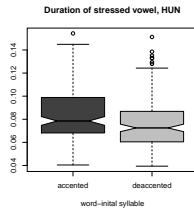
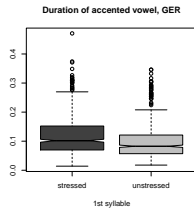
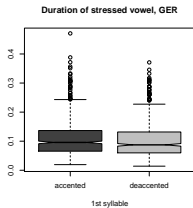
Annotation and data extraction performed with Praat.

- duration
- intensity
- spectral balance (SPLH-SPL)
- f0 maximum
- f0 range

Effects of stress and accent were analysed separately in both languages by linear mixed effects models with random slopes. Fixed effects: accent or stress, random effects: subject, item.

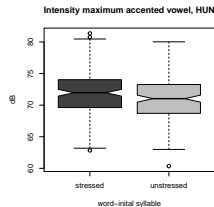
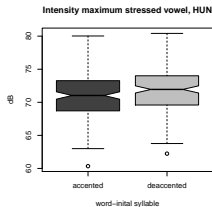
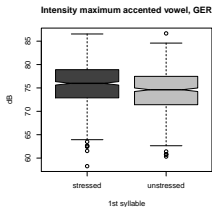
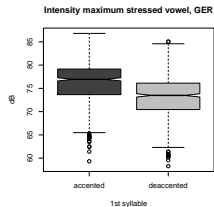
# Duration

Language	German				Hungarian	
Syllable	1st syl		2nd syl		1st syl	
Factor	A	S	A	S	A	S
Dur	✓	✓	✓	✓	✓	✓



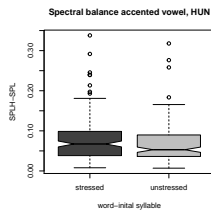
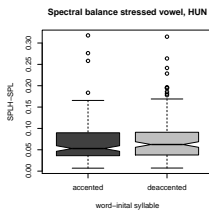
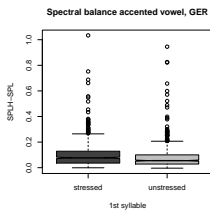
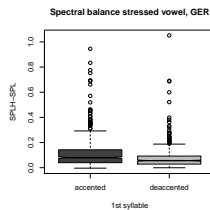
# Intensity

Language	German				Hungarian	
Syllable	1st syl		2nd syl		1st syl	
Factor	A	S	A	S	A	S
max Int	✓	✓	✓	✓	✓	



# Spectral balance

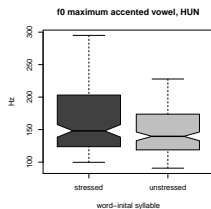
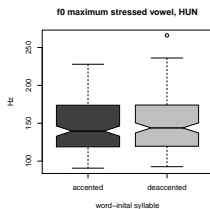
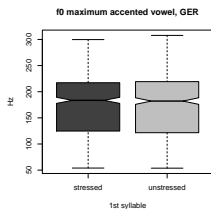
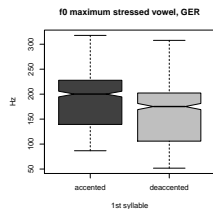
Language	German				Hungarian	
Syllable	1st syl		2nd syl		1st syl	
Factor	A	S	A	S	A	S
SPLH-SPL	✓	✓	✓	✓	✓	





## F0 maximum

Language	German				Hungarian	
Syllable	1st syl		2nd syl		1st syl	
Factor	A	S	A	S	A	S
max f0	✓		✓	✓	✓	



# Summary

Language	German				Hungarian	
	1st syl		2nd syl		1st syl	
Factor	A	S	A	S	A	S
Dur	✓	✓	✓	✓	✓	✓
max Int	✓	✓	✓	✓	✓	
SPLH-SPL	✓	✓	✓	✓	✓	
max f0	✓		✓	✓	✓	
f0 range						

## Position within the accentual phrase

The target syllables in *ne locsold* and *meglocsold* are both in AP-medial position and thus not the head of an AP.

The first syllable carries word stress, the second does not.

Do they differ by any of the acoustic cues?

## Position within the accentual phrase

The target syllables in *ne locsold* and *megllocsold* are both in AP-medial position and thus not the head of an AP.

The first syllable carries word stress, the second does not.

Do they differ by any of the acoustic cues?

Statistics: no difference in intensity, spectral balance or f0. However, the target vowel in *ne locsold* is significantly longer.

Prominence marker or phonotactics?

# Experiment 2

- **German:** variable lexical stress, nuclear accent on the right edge on the sentence along with post-focal compression (Grice, Baumann & Benzmüller 2005)  
→ **right-headed sentence** prosody.
- **Hungarian:** lexical stress fixed to word-initial syllable, heaviest accent on the left edge of the sentence following the topic (É. Kiss 2002), post-focal deaccentuation (Kálmán & Nádasy 1994)  
→ **left-headed word and sentence** prosody.

## Accentual phrases in Hungarian

Unlike German, Hungarian has accentual phrases (AP) with the following characteristics:

- Each pitch accent initiates a new accentual phrase (left-headed structure).
- APs show a regular falling pattern (Beňuš, Reichel & Mády 2014).
- APs are sensitive to syntactic phrasing: simple syntactic units (e. g. adjective + noun) tend to be realised as one AP, more complex ones as more APs (Mády, Szalontai, Deme & Surányi 2013).

Expected consequence according to Jun & Fletcher 2014:

each pitch-accented word is preceded by a lower-level prosodic boundary that is expressed by pre-boundary lengthening and a potential pause.

# Research question

Is edge prominence used in Hungarian for prominence marking by inserting prosodic boundaries?



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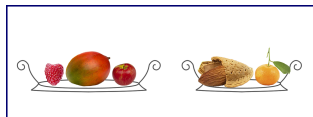
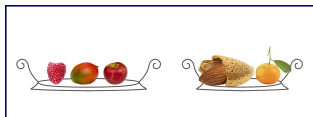
Is edge prominence used in Hungarian for prominence marking by inserting prosodic boundaries?

Problem: prominence is mainly marked by word order in Hungarian. Speakers (and listeners) use syntactic information and postverbal deaccentuation to mark (and identify) focus, not prosodic information (Mády 2015).

## The basket experiment

Workaround: to exclude syntax and force speakers to express prominence purely by prosody.

Task: to name fruits and to indicate (1) whether the fruits are small or large and (2) whether the basket includes two or three fruits.



*málna mangó alma mandula mandarin*

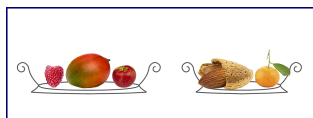
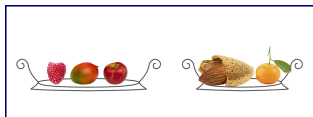
# Experimental design

- Same sequence of 5 fruits throughout the experiment.  
Fruits: small (0) or large (1), baskets: 3+2 or 2+3.
- 2- and 3-syllabic words both in German and in Hungarian with stress on the initial syllable.
- Target of the present analysis: three fruits in the first basket which are [small small small] or [small LARGE small].
- 10 Hungarian and 8 German female speakers.
- 6 repetitions → 432 realisations in total.

## Present analysis

Fixed effect: small or large mango.

Random effects: size of fruits in the second basket (large+small vs. small+large) and repetition.



*málna mangó alma mandula mandarin*

# Parameters

- 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.

Statistics: linear mixed models, fixed effect: size of the second fruit, random effects: participant, repetition and the size of the fruits in the second basket.

$\chi^2$  test for the distribution of pauses.

# Hypotheses

- 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.

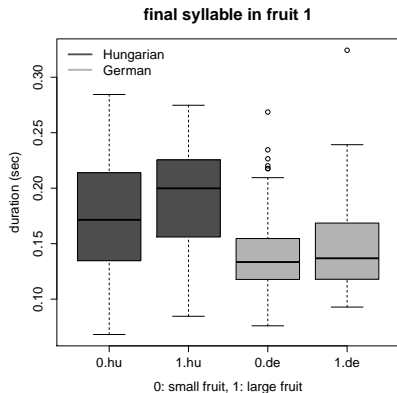
## Results

Number of pauses before and after the 2nd fruit depending on the fruit size in German and Hungarian

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

- An overall higher amount of pauses in Hungarian.
- Significantly more pauses before a large fruit in Hungarian, but not after it.
- Significantly more pauses after a large fruit in German, but not in Hungarian.
- Pause durations are significantly longer before AND after a large second fruit in Hungarian, but not in German.

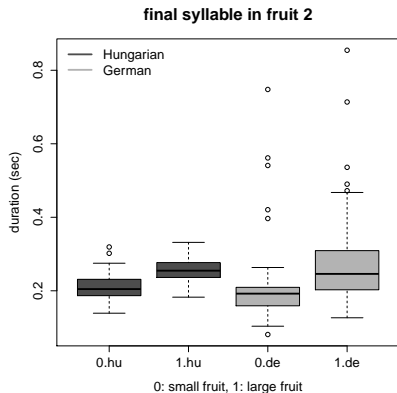
# Lengthening **before** the second fruit



The final syllable preceding the large second fruit is significantly longer in Hungarian, but not in German.

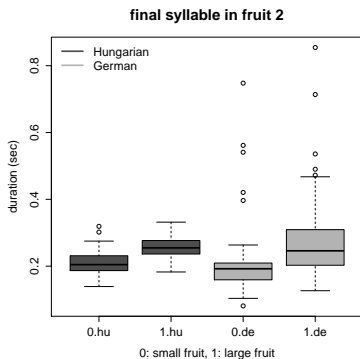
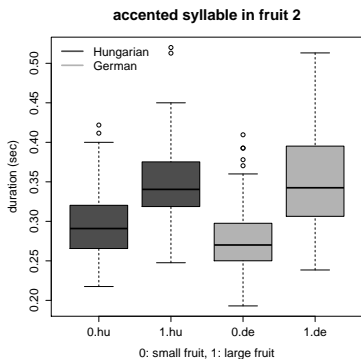


# Lengthening **in** the second fruit



The final syllable of the large second fruit is lengthened in both languages, which is unexpected. Reason?

# Lengthening in the second fruit



Both the initial (= accented) syllable and the word-final one are lengthened in both languages. Open question: is lengthening a boundary signal or an effect of the prominence on the second word?

## Discussion: accent vs. stress

- Acoustic marking in German: lexical stress, sentence accent.
- Acoustic marking in Hungarian: sentence accent only.
- Lengthening in Hungarian possibly due to different syllable positions.
- Syllable position in German may have affected the acoustic correlates of lexical stress in German.
- Predictability of lexical stress in Hungarian: acoustic marking is obviously redundant.
- Hungarian: negation and verb grouped together in one AP.

## Discussion: strengthening by prosodic boundary

- Boundaries are likely to occur before and after each accented word in Hungarian.
- Hungarian speakers insert significantly more pauses before a large second fruit.
- Low overall occurrence of pauses in German, more frequent after the second fruit.
- More lengthening in the final syllable of large second fruits in Hungarian: effect of prominence?

# Conclusions

- Hungarian as a head-/edge-prominence language marks prominence both by accents and by preceding boundaries. Word-level prominence is post-lexical and connected to APs
- German as a head-prominence language marks prominence by accents and stress, but not by boundaries.
- Headedness has more consequences on the segmental level in head-/edge-prominence languages compared to head-prominence languages, the latter relying more on suprasegmental pitch cues.

Thanks to:

the Alexander von Humboldt Foundation by the institute partnership grant *Grammar and pragmatics* to RIL HAS and University of Bielefeld, especially our co-authors Petra Wagner and Andreas Windmann,

the research exchange grant no. 65032 *Form and function of prosodic structure in Hungarian and in German* funded by DAAD and MÖB, especially our co-authors Felicitas Kleber and Uwe Reichel,

and all other participants of these projects.