Local and Global Acoustic Correlates of Information Structure in Bulgarian

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Background

- three elements of information structure:
  - topic (the subject matter, on which new information is to be offered)
  - focus (the new information offered)
  - given information (information given previously or assumed to be known)
- focus types:
  - broad focus
  - narrow focus (contrastive vs. non-contrastive)
- acoustic correlates:
  - duration
  - energy
  - fundamental frequency
  - spectral properties

Background

- Important factors in the realization of the information structure in Bulgarian utterances are:
  - *word order*, flexible and discourse conditioned, as in all Slavic languages
  - *morphological category of definiteness*, unusual in the Slavic language family
  - *clitic replication* of nominal material
  - *intonation*

Research questions

- Does Standard Bulgarian distinguish between different types of focus?
  a) non-contrastive and contrastive narrow focus
  b) broad and narrow focus

- What are the acoustic features associated with these different aspects of information structure in Bulgarian?

Material and Method

- existing speech corpus consisting of read speech for several languages
- 6 sentences
  subject < verb < direct object < indirect object < oblique
- 2 critical words (one early and one late in the sentence)
- different focus on critical words (CWs) elicited by questions:
  - broad
  - narrow non-contrastive (early or late)
  - narrow contrastive (early or late)
- 6 speakers of Contemporary Standard Bulgarian (3m/3f)
- 1080 sentences in total (6 speakers x 6 sentences x 5 focus conditions x 6 repetitions)

Local Measurements

Duration	• Duration (ms) of stressed vowels, stressed syllables
F_0	• Mean F_0 (Hz) across stressed vowel of CW
	• peak alignment (ms from the F_0 peak to rhyme onset)
Energy	• Mean intensity (dB) of stressed vowel in CW
	• Spectral balance = difference between 70-1000 Hz band and 1200-5000 Hz band in stressed vowel of CW

Normalized relative to mean across corresponding units in sentence

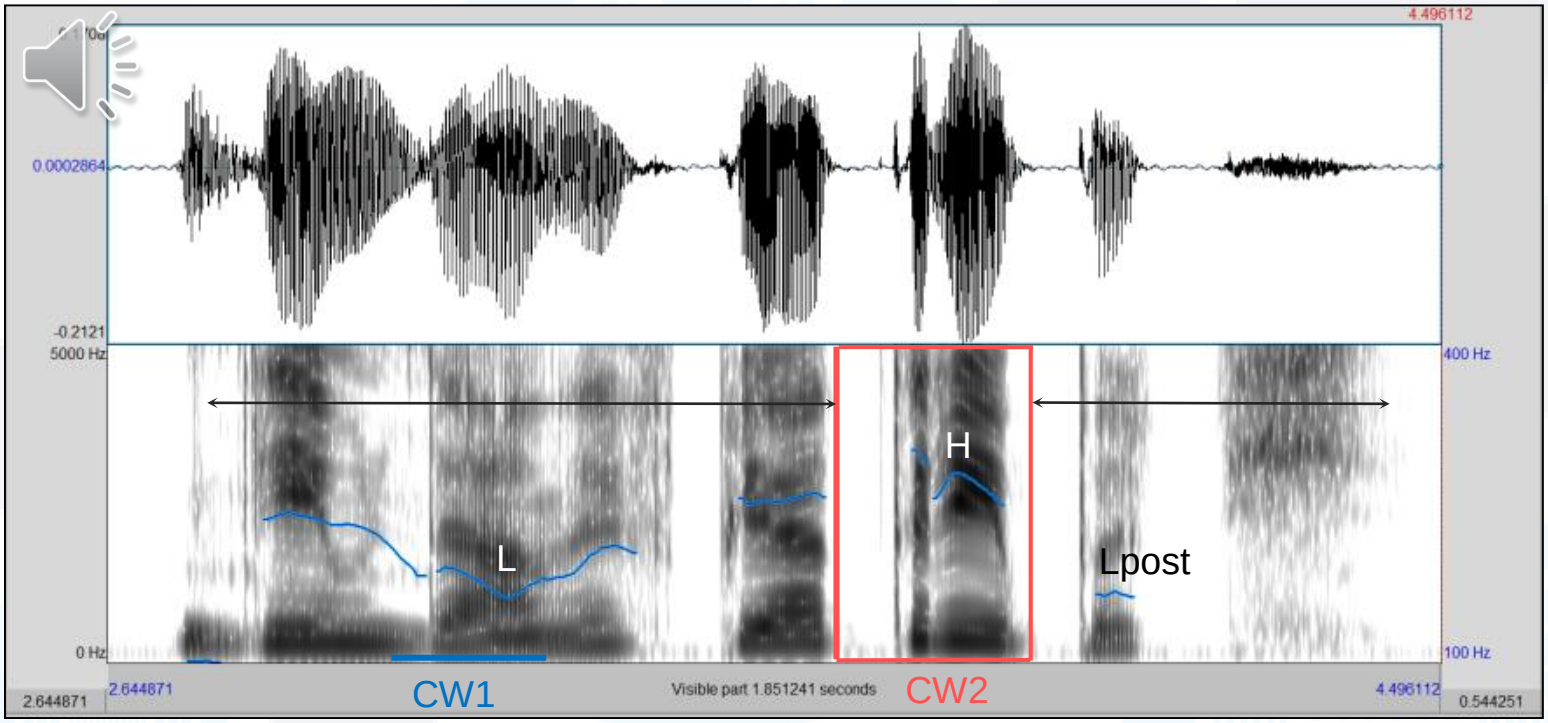
Global Measurements

Duration	• Duration and tempo (ms) of pre-nuclear and post-nuclear interval
F_0	• minimum F_0 value (Hz) preceding (L) and following the peak (Lpost)
	• pitch excursion (s.t.) between the preceding F_0 minimum and the peak (LH) and between the peak and the following F_0 minimum (HLpost)
	• Mean F_0 (Hz) across pre- and post-nuclear interval
Intensity	• Mean intensity (dB) across pre- and post-nuclear interval

Normalized relative to mean across corresponding units in sentence

Measurements

narrow non-contr.



Statistical analysis

- One-Way Repeated Measures ANOVA for CW1 and CW2 separately

  with dependent variables:
  - parameter for local and global measures

  with within-subjects variable:
  - focus condition (broad, early narrow, late narrow, contr. early narrow, contr. late narrow)

  with between-subjects factor:
  - subjects

Results: Pitch Accents

broad focus: H+!H*/L*

narrow focus: H* (except by SP5 and SP6)

focus on CW1: H close to end of accented syllable (93 %)

focus on CW2: H close to beginning of accented syllable (85%)

Speakers vary as to preferred accent types and phonetic realization:

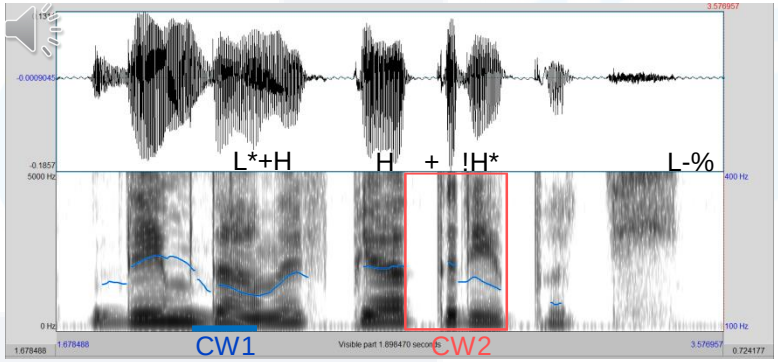
- SP5: exclusively H+!H* in narrow focus regardless of position within the sentence
- SP6: strong preference for H+!H* in the narrow focus condition on CW2
- SP1, 2, 4 and 6: preference for late peak alignment in the contrastive focus on CW1.

Results: broad vs. narrow (nucl. accent on CW2)

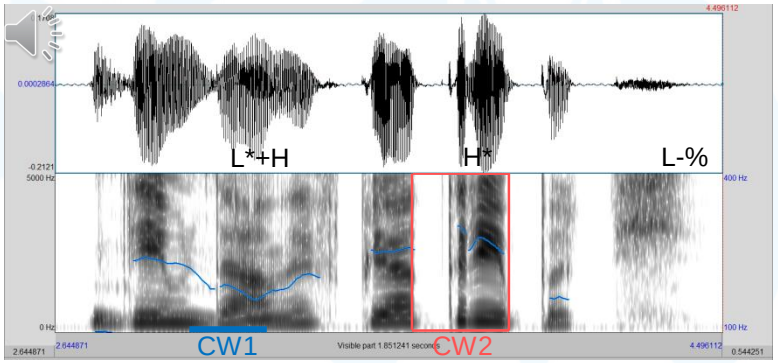
- local acoustic cues

parameter	focus	subject	interaction
peak alignment	***	***	***
syll. duration	***	n.s.	n.s.
vowel intensity	***	***	***
vowel SpecTilt	***	***	***
vowel F_0 mean	***	***	***

broad

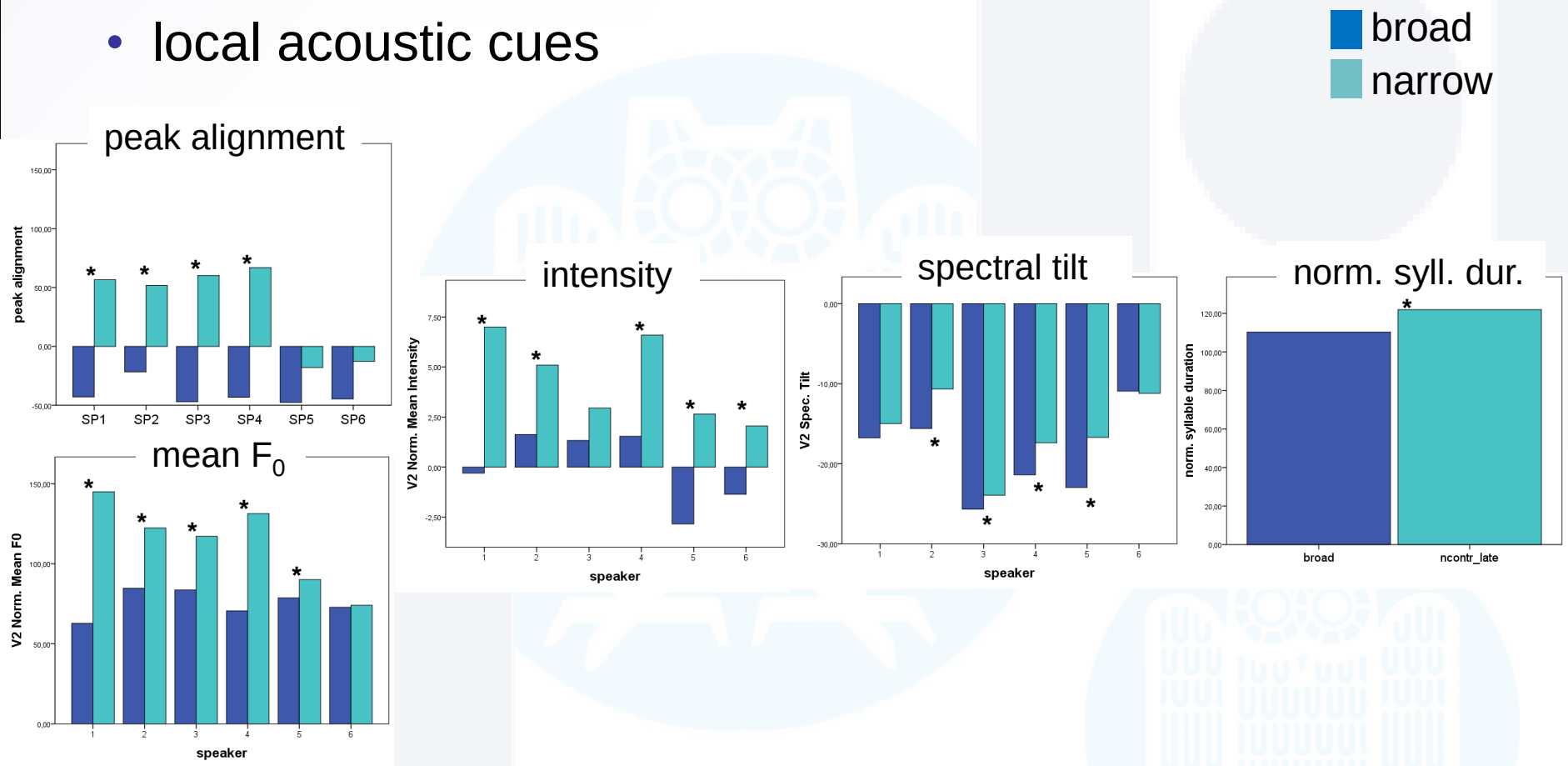


narrow non-contr.



Results: broad vs. narrow (nucl. accent on CW2)

- local acoustic cues



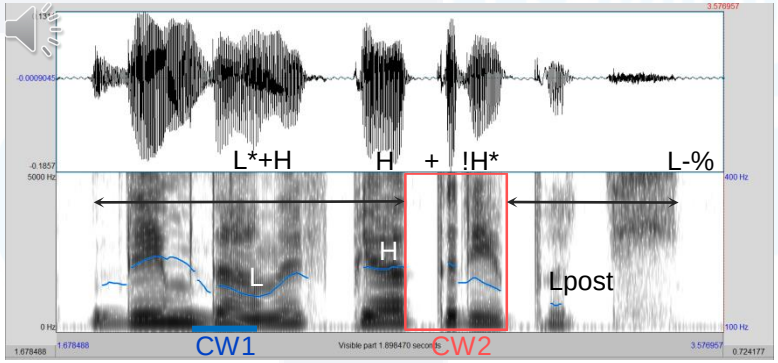
- broad focus: earlier peak alignment, lower F_0 in the vowel, lower vowel intensity, greater spectal tilt, shorter syllable durations

Results: broad vs. narrow (nucl. accent on CW2)

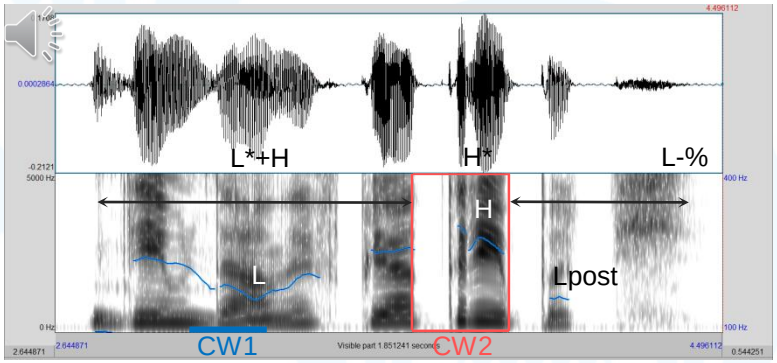
- global acoustic cues

parameter	focus	subject	interaction
excursion LH	***	***	***
excursion HLpost	***	***	***
tempo pre-nucl.	***	***	n.s.
intensity pre-nucl.	***	***	***
intensity post-nucl.	***	***	n.s.

broad

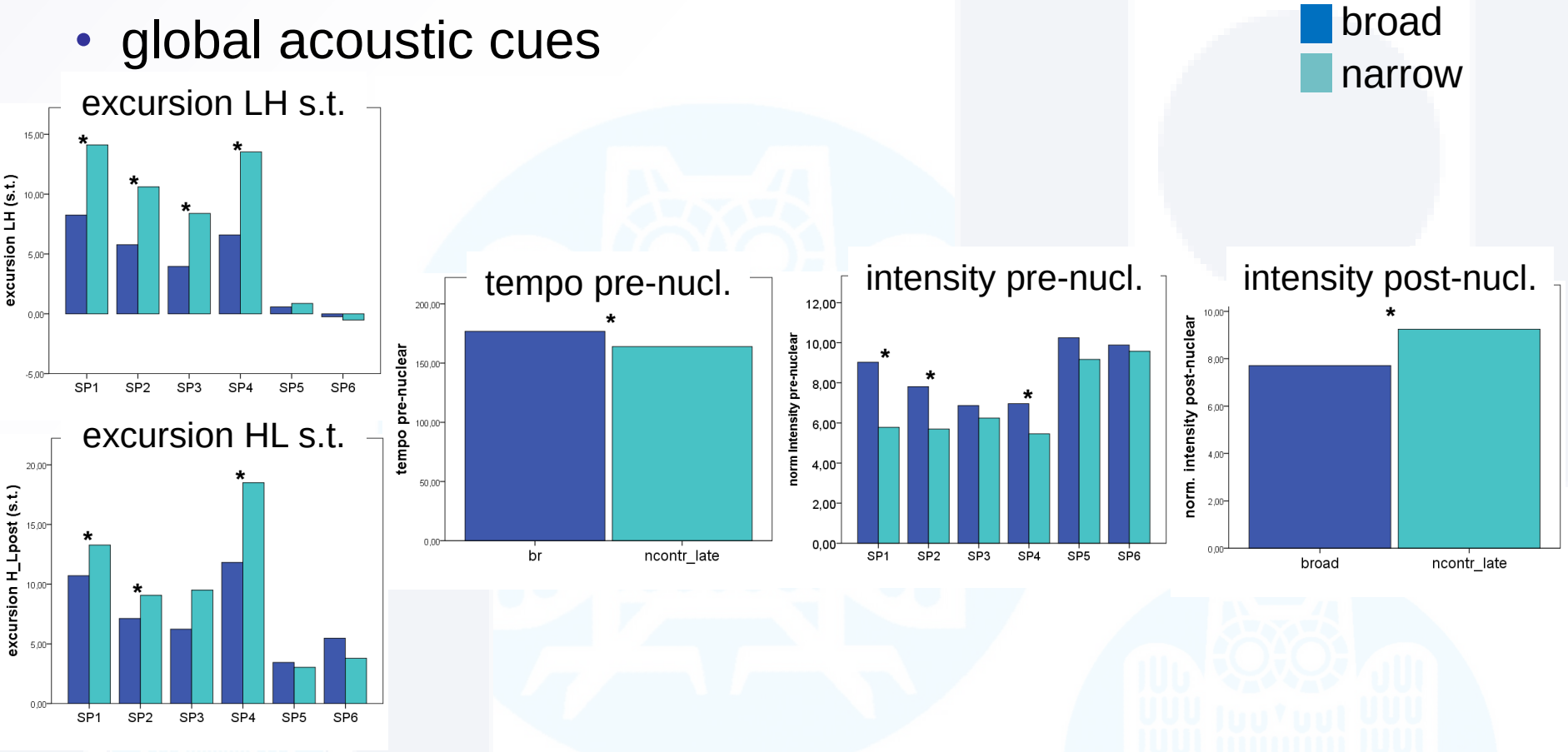


narrow non-contr.



Results: broad vs. narrow (nucl. accent on CW2)

- global acoustic cues

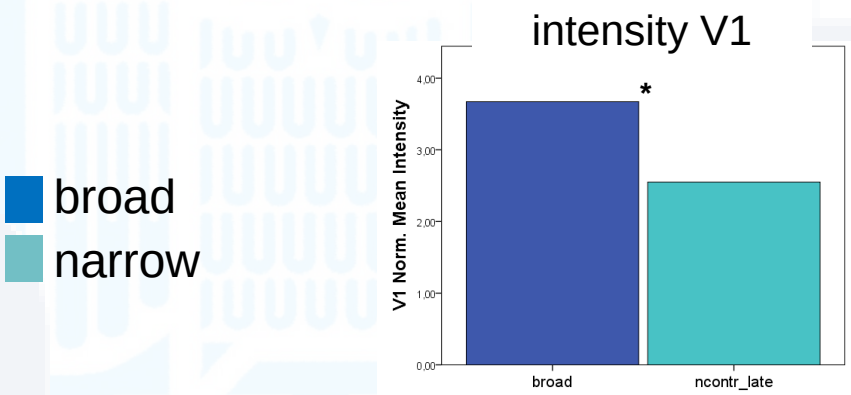


- broad focus: lower pitch excursion, lower tempo and higher intensity in the pre-nuclear interval, lower intensity for the post-nuclear interval

Results: broad vs. narrow (nucl. accent on CW1)

- global acoustic cues

parameter	focus	subject	interaction
vowel intensity	***	n.s.	n.s.



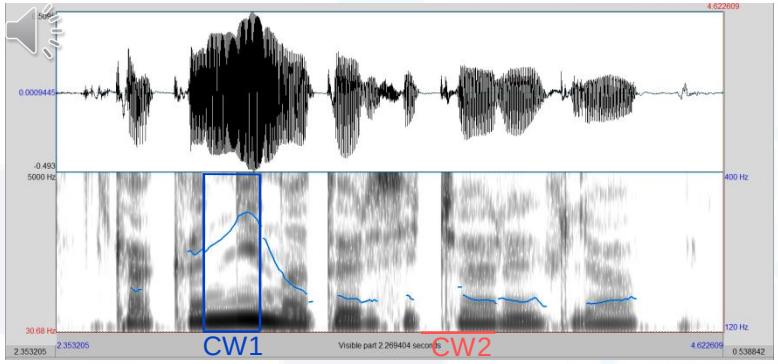
- broad focus: higher vowel intensity
- CW1 not de-accented in narrow focus
- L*+H pitch accents in broad and narrow focus

Results: contr. vs. non-contr. (nucl. acc. on CW1)

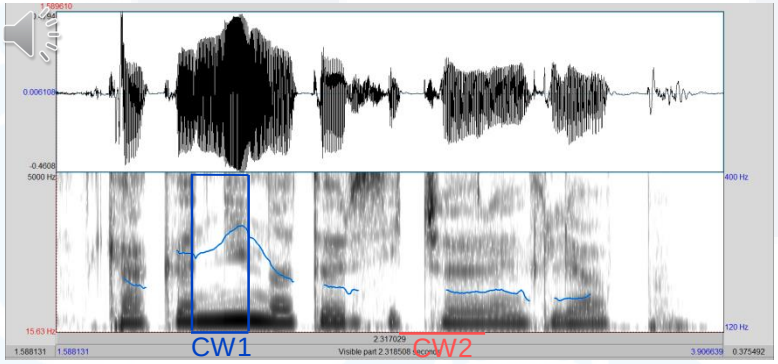
- local acoustic cues

parameter	focus	subject	interaction
vowel duration	***	n.s.	n.s.
syll. duration	***	n.s.	n.s.

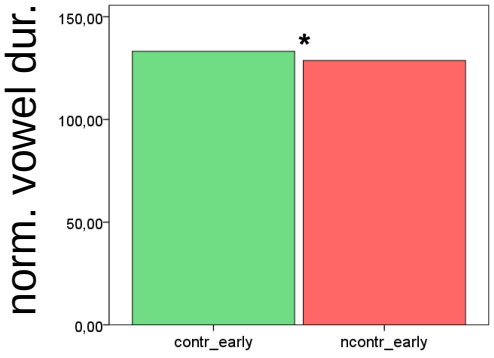
contrastive

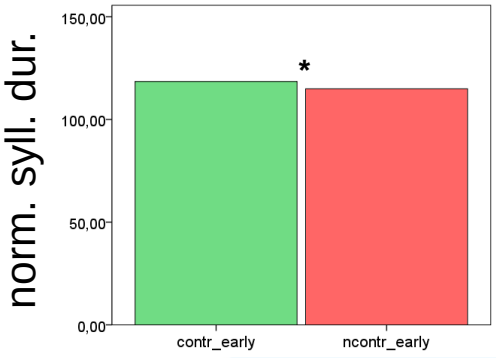


non-contrastive



contr.
non-contr.





Results: contr. vs. non-contr. (nucl. acc. on CW2)

- local acoustic cues

No differences were found between the local measurements for contrast versus non-contrast.

Results: contr. vs. non-contr.

- global acoustic cues

No differences were found between the global measurements for contrast versus non-contrast, independent of the position of the nuclear accent.

Summary of the Results

- Speakers vary as to preferred accent types and phonetic realization
- contrastive vs. non-contrastive focus on CW1:

  local: longer vowel and syllable duration for contr.

- broad vs. narrow focus on CW2:

  local: different pitch accent types (H* vs. H+!H*/L*)
  longer duration
  later peak alignment (but still early in the syllable),
  greater F_0 excursions
  higher energy

  global: same pitch accent type (L*+H) on CW1, but higher vowel intensity for broad
  longer duration and higher intensity in the pre-nuclear interval for broad
  lower intensity in the post-nuclear interval for broad

Conclusion

- The all-important function of intonation, namely to transmit the relative weighting of information in speech communication, cannot be captured by a purely phonological description of realized accent types.

- The IS-related patterns of phonetic prominence show a complex interplay between phonological categories and the local and global phonetic signal properties.

Thank you for your attention!

Благодаря Ви за вниманието!