On the Meaning of Nuclear and Prenuclear Accents

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Outline

- Background: The status of nuclear and prenuclear accents
- Previous studies on the prominence and meaning of nuclear and prenuclear accents
- A production study on the relation between informativeness and nuclear and prenuclear accents in German

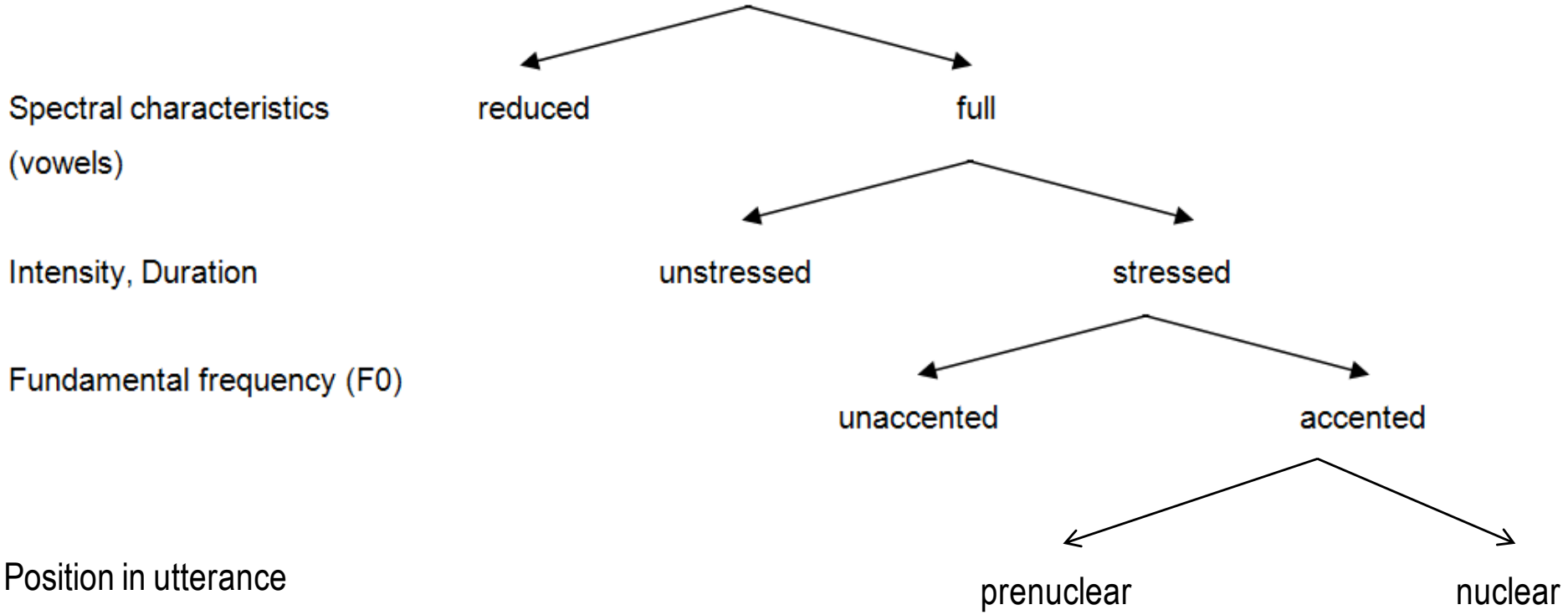
Nuclear and Prenuclear Accents

- West-Germanic languages: pitch accents serve to **highlight** information

JOHN and MAry went to a fanTAStic PARty last night.

Nuclear and Prenuclear Accents

- Which (phonetic) parameters bring about different levels of highlighting?

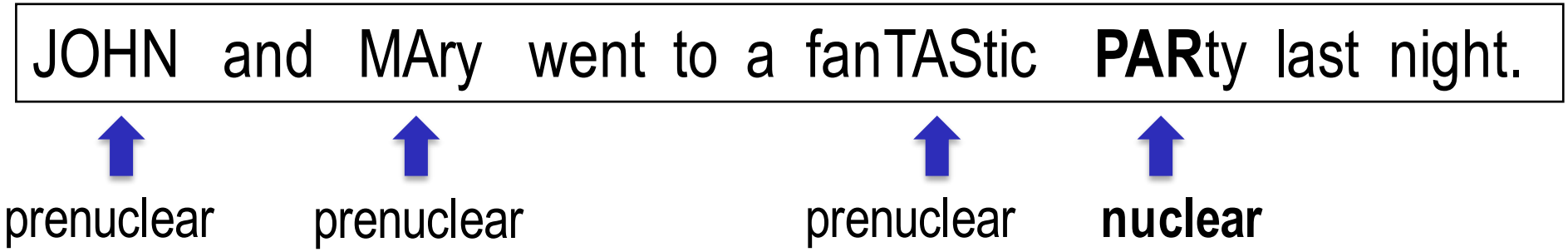


(adapted from Terken & Hermes 2000)

Nuclear and Prenuclear Accents

- **Nuclear accent** = last pitch accent in an intonation unit (only obligatory accent)
- **Prenuclear accent** = pitch accent that occurs *before* the nucleus within the same intonation unit

  = strictly positional definition



Nuclear and Prenuclear Accents

More importantly: Difference in **status**

- **Nuclear accent** = structural head of an intonation unit (➔ prosodic hierarchy)
- Decisive for the interpretation (of the pragmatic meaning/ information structure) of an utterance
- But not necessarily most prominent phonetically!

Nuclear and Prenuclear Accents

David only wears a bow tie when teaching.

a) *David only wears a bow tie when TEAching.*

(Teaching is the only situation in which he wears a bow tie...)

b) *David only wears a BOW tie when teaching.*

(He wears nothing but a bow tie...)

(Beaver & Clark 2008)

Nuclear and Prenuclear Accents

- Misinterpretations arising from wrong assumptions about prosody of written language

Sign in the London underground (Halliday 1970):

Two possible prosodic structures:

a) *Dogs must be CARried.*
b) *DOGS must be carried.*

Two different interpretations:

a) If you have a dog, you have to carry it.
b) Everybody has to carry a dog.

Nuclear and Prenuclear Accents

- Position of nuclear accent indicates
  - whether broad focus reading (focus projection) is possible

[I'm going to BerLIN tomorrow.]F — broad (accent on last argument)

vs.

I'm going to Berlin [toMORrow.]F — narrow

Nuclear and Prenuclear Accents

- Position of nuclear accent indicates
  - whether all-new reading is possible in broad focus

John has an old COTtage.

a) Last summer he reconSTRUCted the shed.

(shed = cottage) given information = coreference

b) Last summer he reconstructed the SHED.

(shed ≠ cottage) new information = no coreference

Nuclear and Prenuclear Accents

- Status of **prenuclear accents** is unclear
- Previous studies draw inconsistent conclusions

1) Prenuclear accents are **optional** (Gussenhoven 2015) – or *ornamental* – on prefocal (= non F-marked) elements (Büring 2007)

   – Who did Gus vote for?
   GUS VOTED [for a friend of his neighbors from LITtleville]$_F$

Prenuclear accents may be used due to general principles of **rhythmic** organization and do not reliably mark information structural distinctions (Calhoun 2010)

Nuclear and Prenuclear Accents

2) **Lower inter-transcriber agreement** for prenuclear accents (Ladd 2008)

3) **Low listener sensitivity** (and longer RTs) of prenuclear accents: (acoustically identical) weak accents not perceived as accents in prenuclear but in nuclear position (Jagdfeld & Baumann 2011)

➔ supports claim that prenuclear accents are perceived as less prominent

Prominence of Pitch Accents

- What do untrained (= theory-unbiased) listeners do when asked to annotate connected speech?

- Method: *Rapid Prosody Transcription* (RPT)

Signal-based and expectation-based factors in the perception of prosodic prominence

JENNIFER COLE, YOONSOOK MO, MARK HASEGAWA-JOHNSON

University of Illinois

(2010)

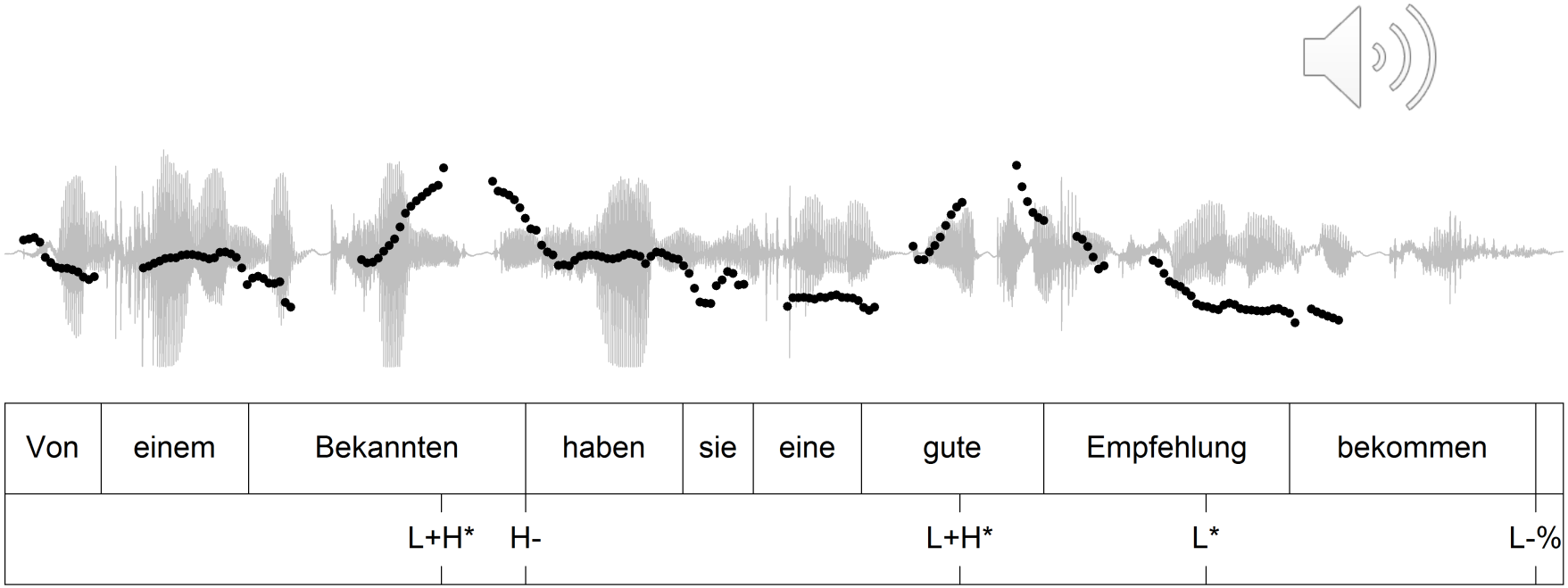
Prominence of Pitch Accents

- 60 read German sentences from various databases (different focus structures and information status categories)
- 28 untrained native speakers of German
- Instruction on paper (translated):
  “your task is to underline all words you perceive as **stressed / highlighted / important** on the transcript”

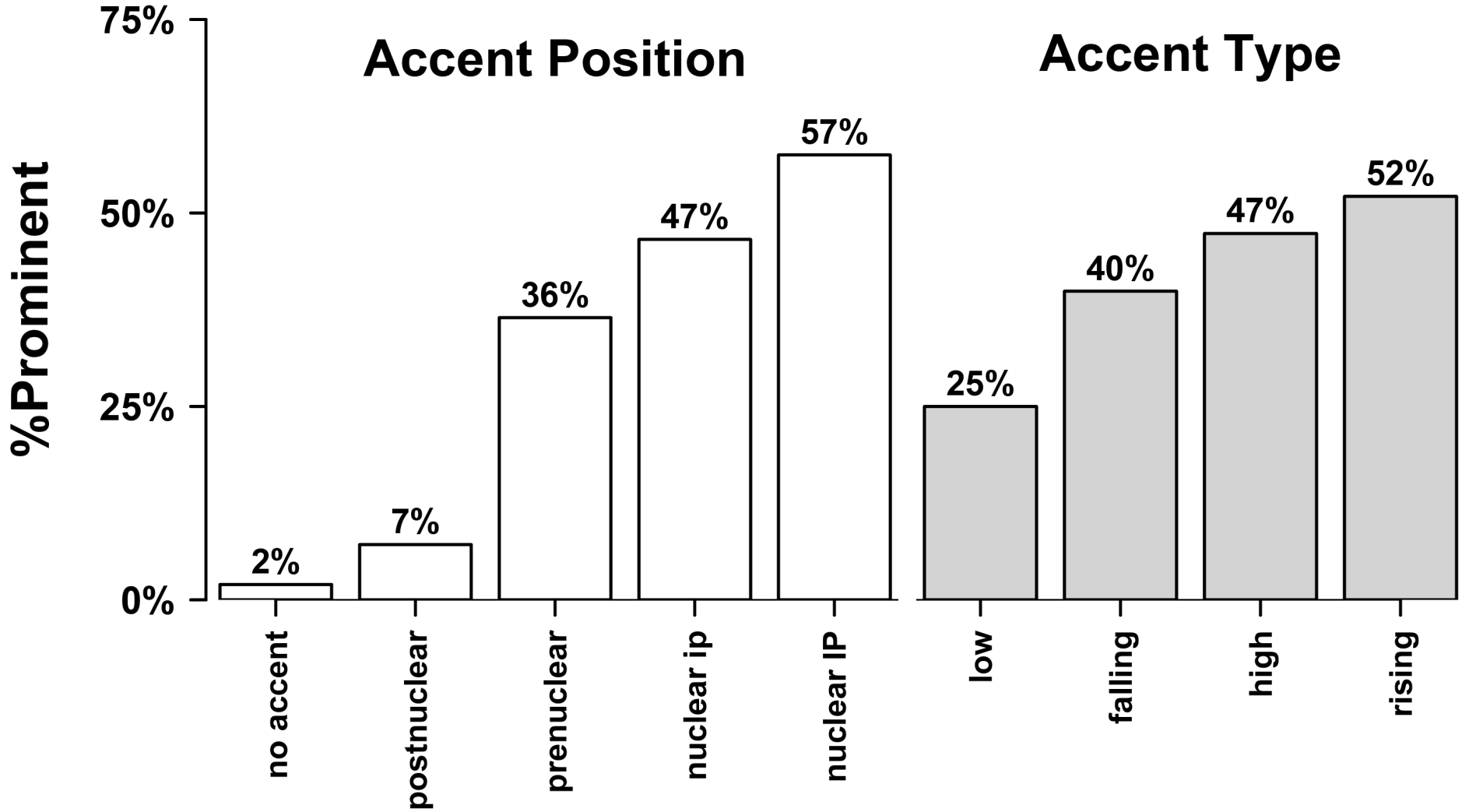
word word word

Prominence of Pitch Accents

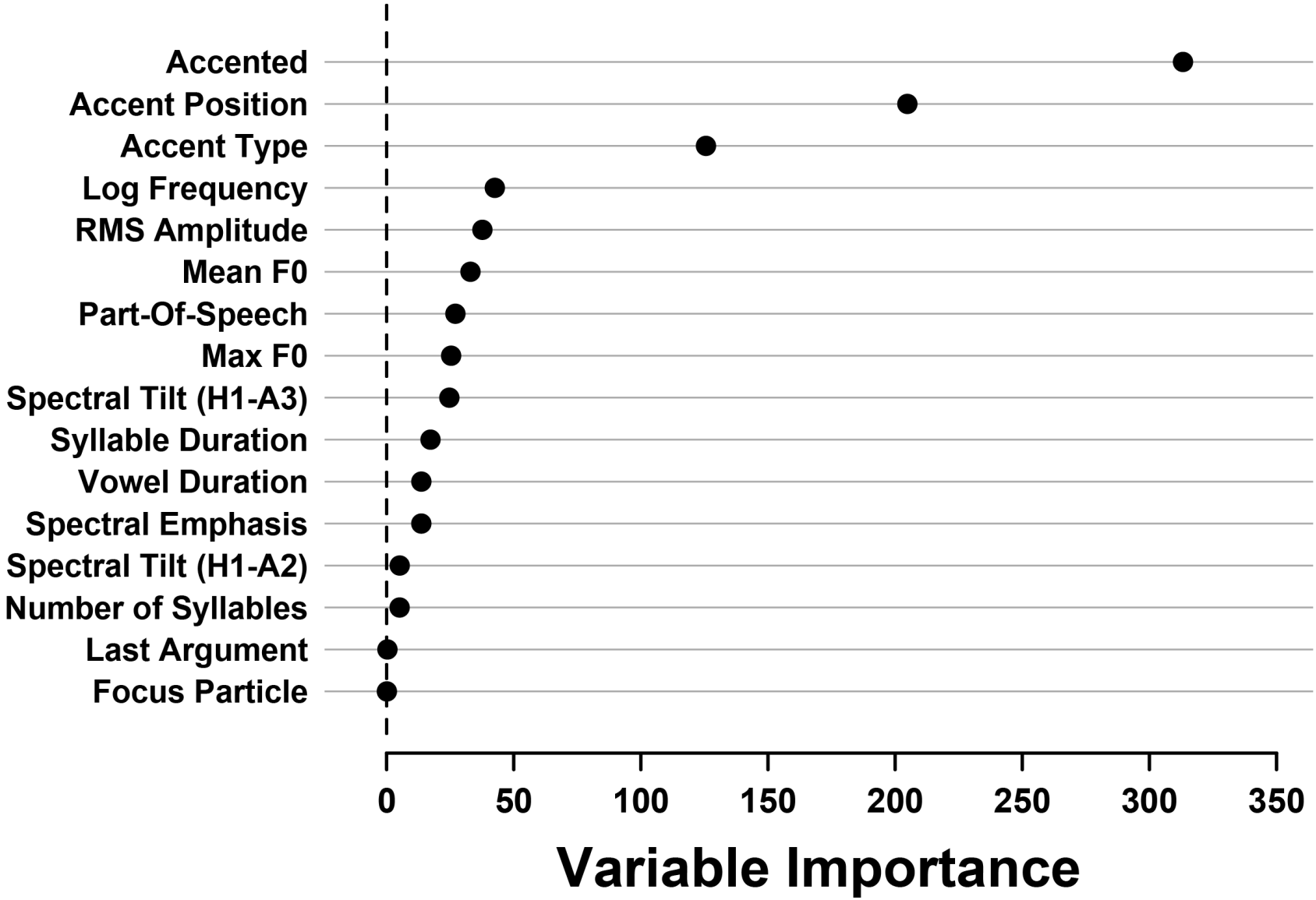
- Only declaratives with a low boundary tone



Prominence of Accents: Position and Type



Prominence of Accents: *Random Forests*

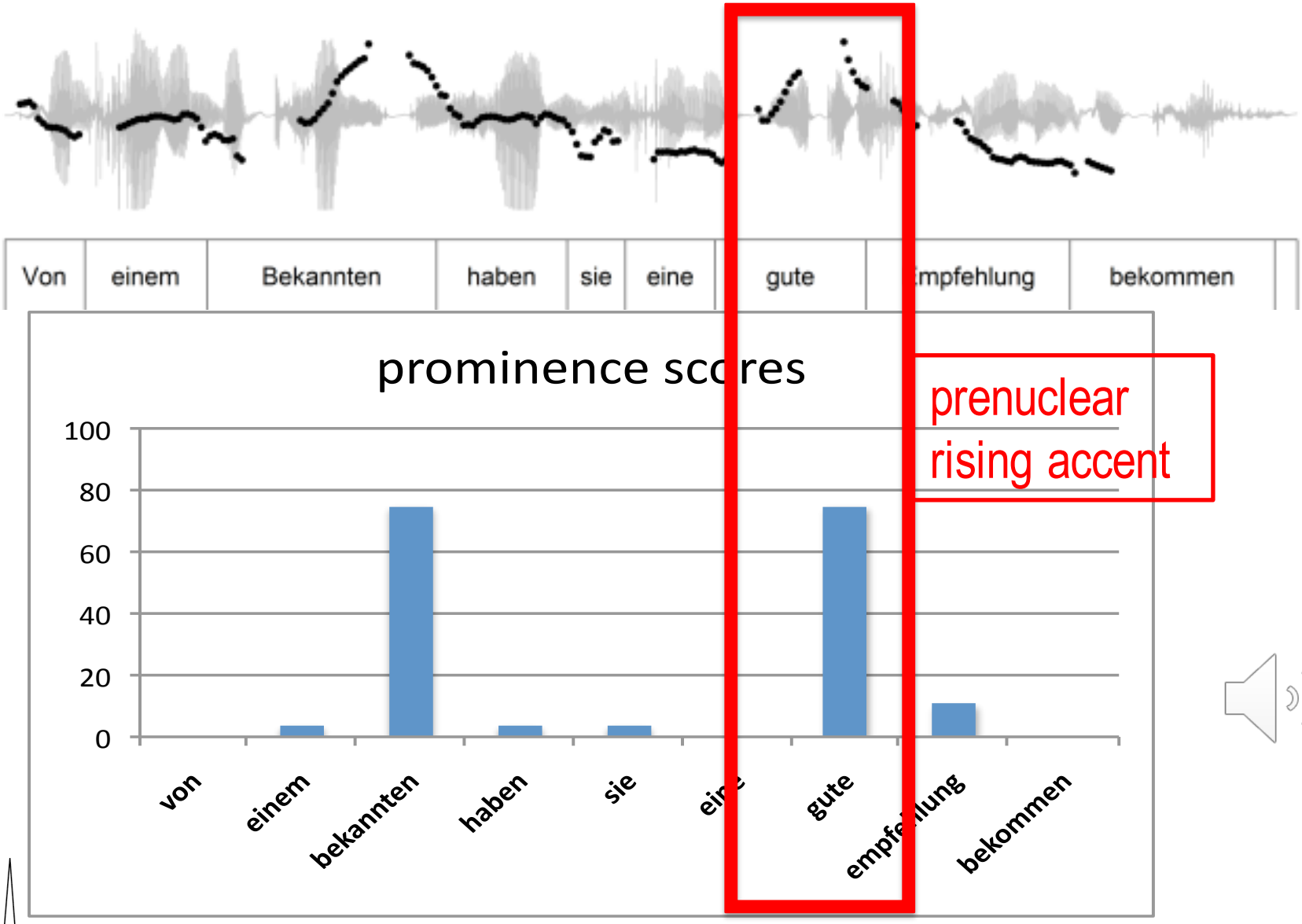


Prominence of Pitch Accents

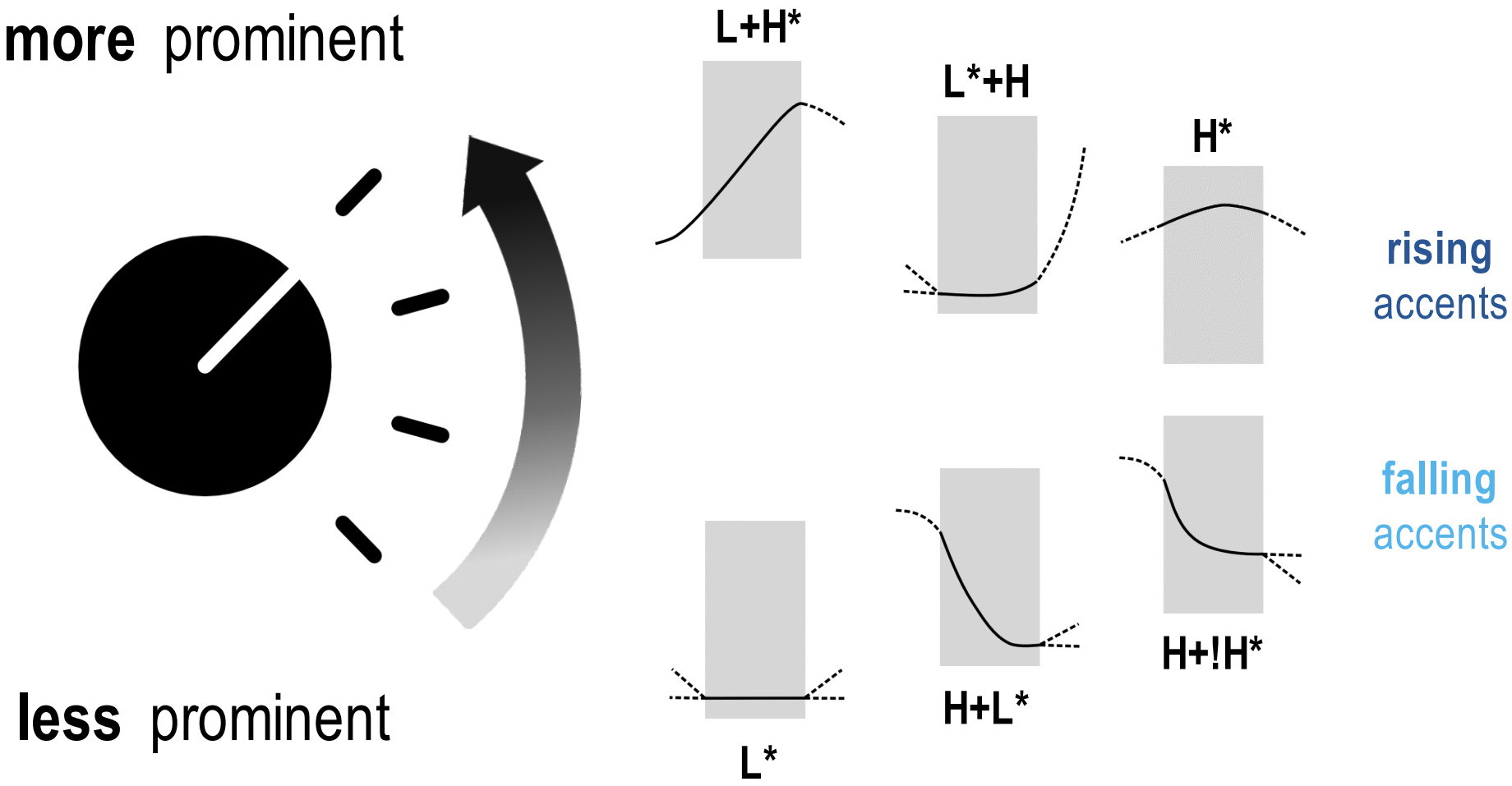
- Importance of ACCENT POSITION confirms the **structural prominence of the nucleus** – also for untrained listeners

- However: Sometimes the ACCENT TYPE is more important for prominence perception

Prominence of Pitch Accents



Prominence of Pitch Accents



Baumann & Röhr (2015)

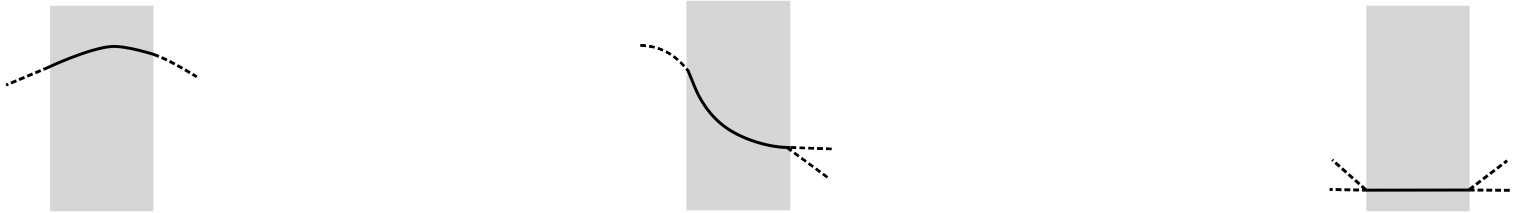
GToBI: Grice et al. (2005)

Accent Type and Meaning: Information Status

- Pierrehumbert & Hirschberg (1990, Am. Engl.)
  - Meanings of starred tones are shared among different accent types (decreasing prominence):

new ➔ accessible ➔ given

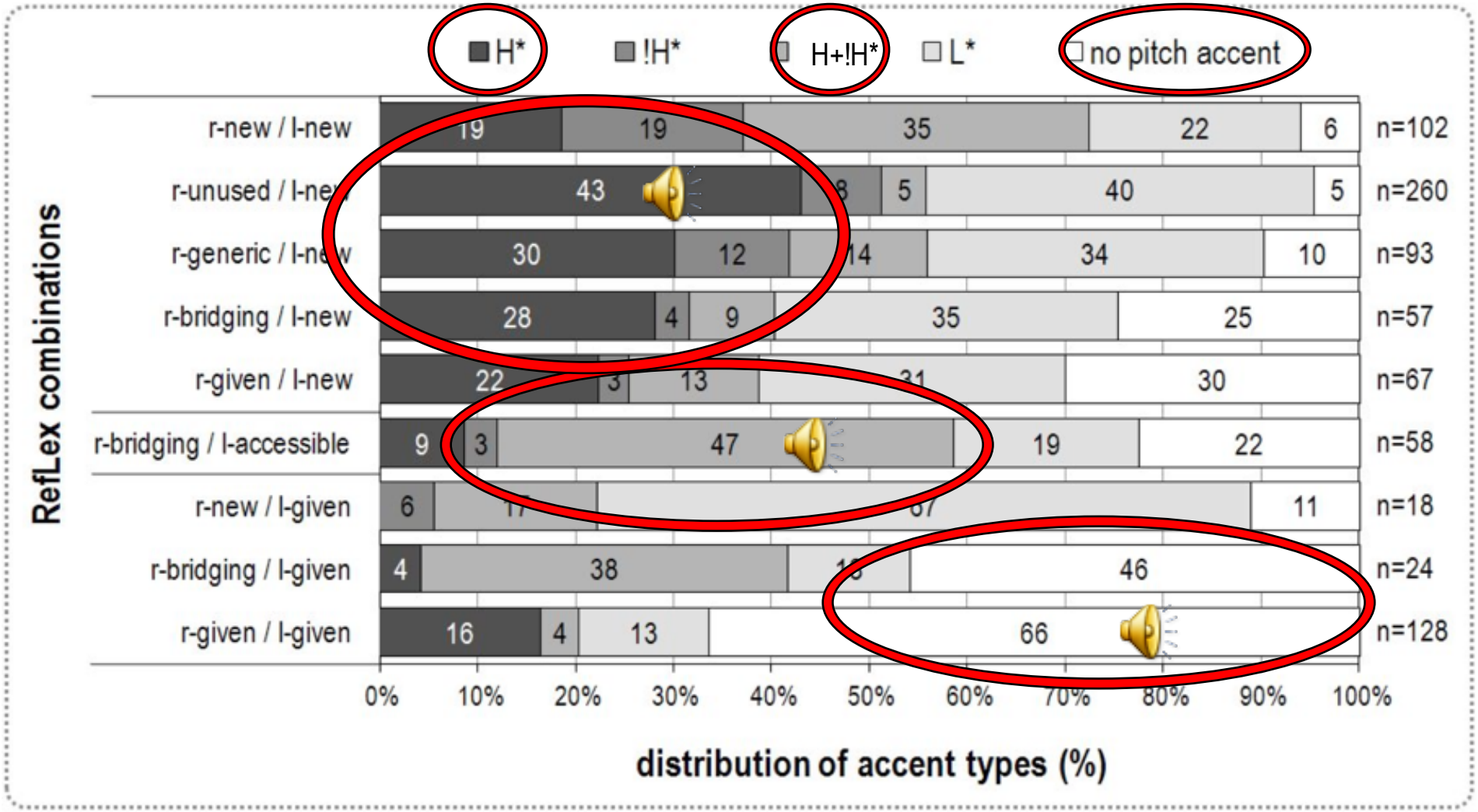
H* !H* L*



H* H+!H* L*

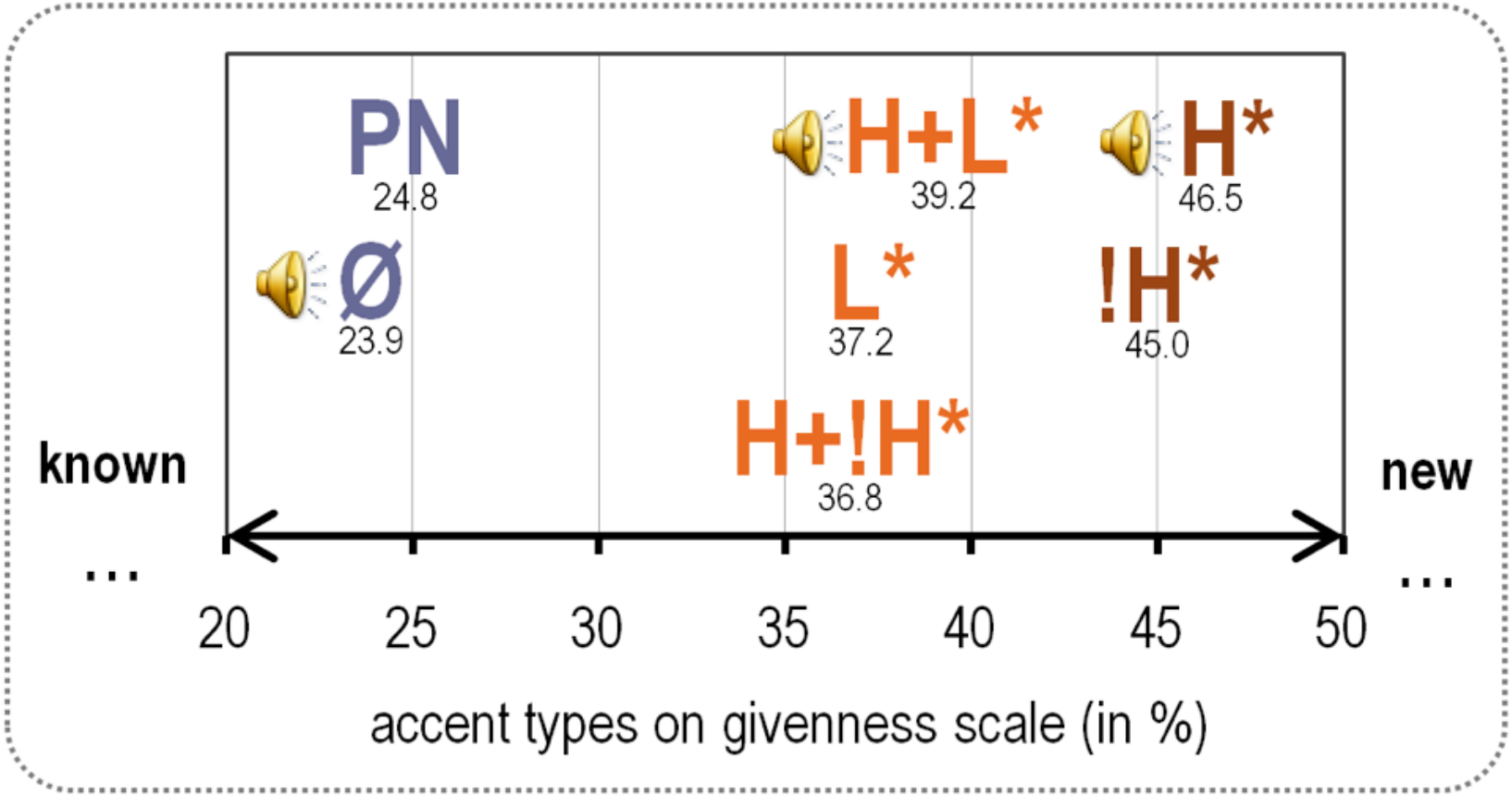
Accent Type and Meaning: Information Status

- Baumann & Riester (2013): Corpus study, probab. distribution of ATs



Accent Type and Meaning: Information Status

- Similar result in perception study on German (Röhr & Baumann 2011): Task to judge an item's **degree of givenness**



Accent Type and Meaning: Focus

Production

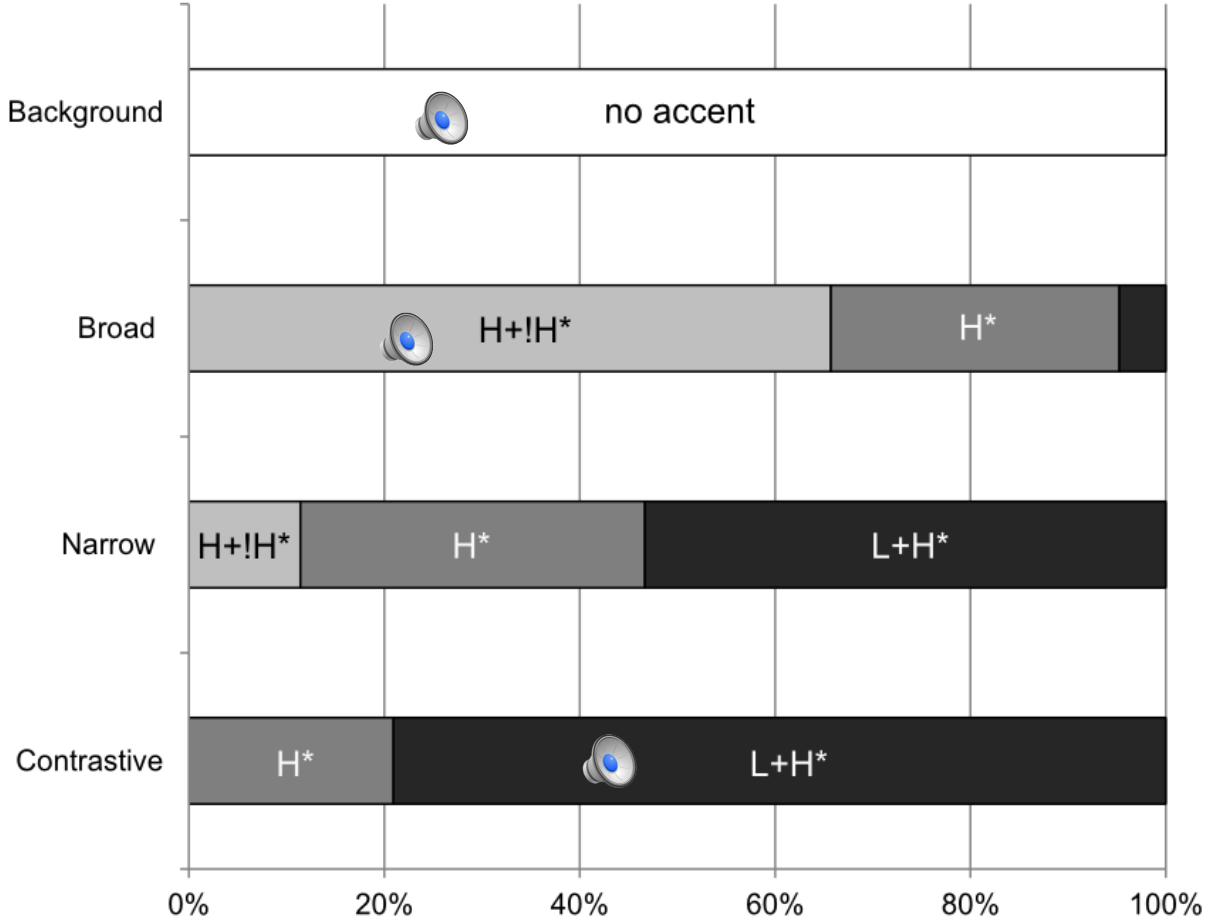
	Questions:
1.	Will Norbert Dr. Bahber treffen? *Does Norbert want to meet Dr. Bahber?*
2.	Was gibt's Neues? *What's new?*
3.	Wen will Melanie treffen? *Whom does Melanie want to meet?*
4.	Will Melanie Dr. Werner treffen? *Does Melanie want to meet Dr. Werner?*

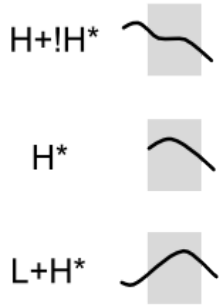
	Answers:	**target word in:**
	Melanie will Dr. Bahber treffen.	
1.	[ ]$_{focus}$	background
2.	[ ]$_{focus}$	broad focus
3.	[ ]$_{focus}$	narrow focus
4.	[ ]$_{focus}$	contrastive focus
	(lit.: *Melanie wants Dr. Bahber to-meet*)	

Mücke & Grice (2014)

Accent Type and Meaning: Focus

- Production experiment with different sizes of focus domain in German (Mücke & Grice 2014)





Falling vs. rising onglide

(Krüger 2009, Ritter & Grice 2015)

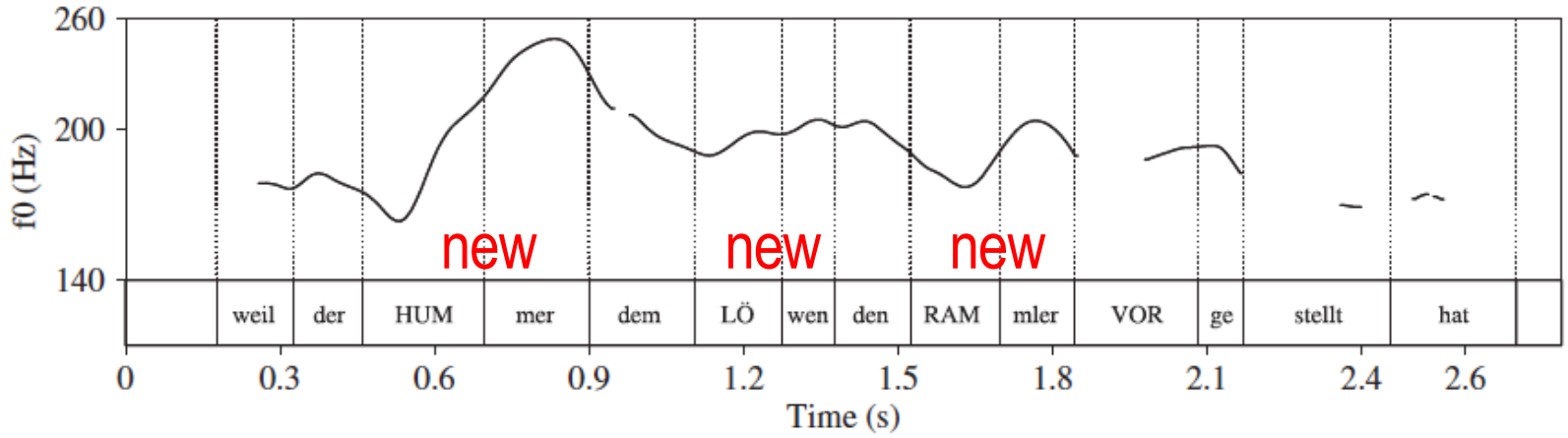
Prenuclear Accents and Meaning

- Common opinion: Optionality of prenuclear accents in German and English: *ornamental* accents (Büring 2007)
- Some studies show that prenuclear accents are **placed consistently**, irrespective of information status
  - Textually given information in narrow focus contexts (Baumann et al. 2007, Féry & Kügler 2008)
  - Topics in topic-comment structures (Braun 2006)
- However, accents displayed subtle changes in peak scaling or peak alignment, which expressed meaning differences (Braun 2006, Féry & Kügler 2008)

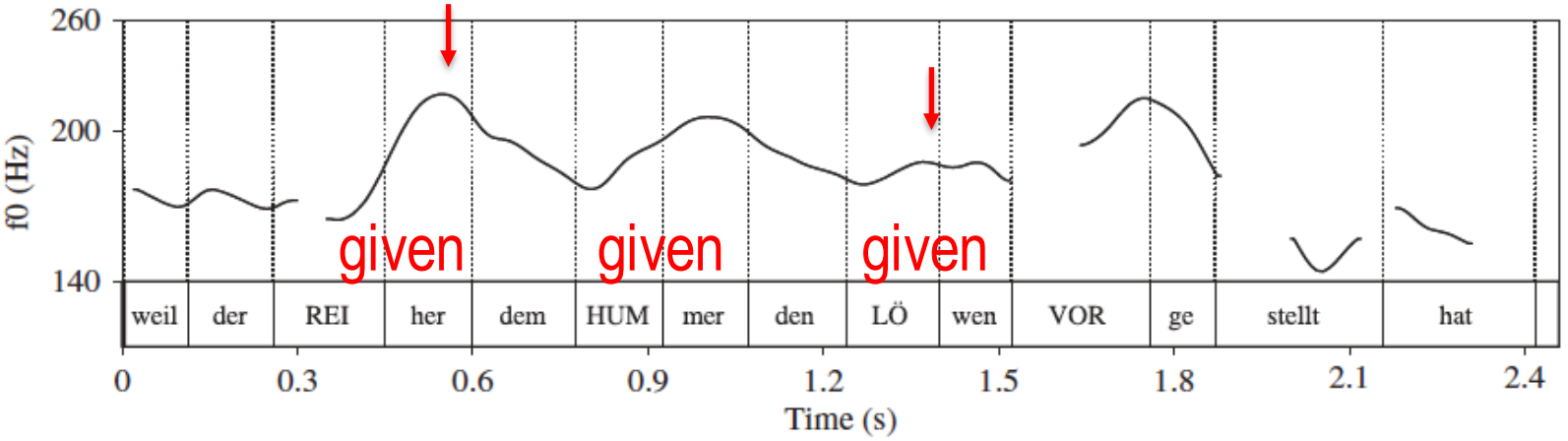
Prenuclear Accents and Meaning

- Givenness slightly lowers prenuclear accents in comparison with accents on new information (Féry & Kügler 2008)

broad focus



narrow focus



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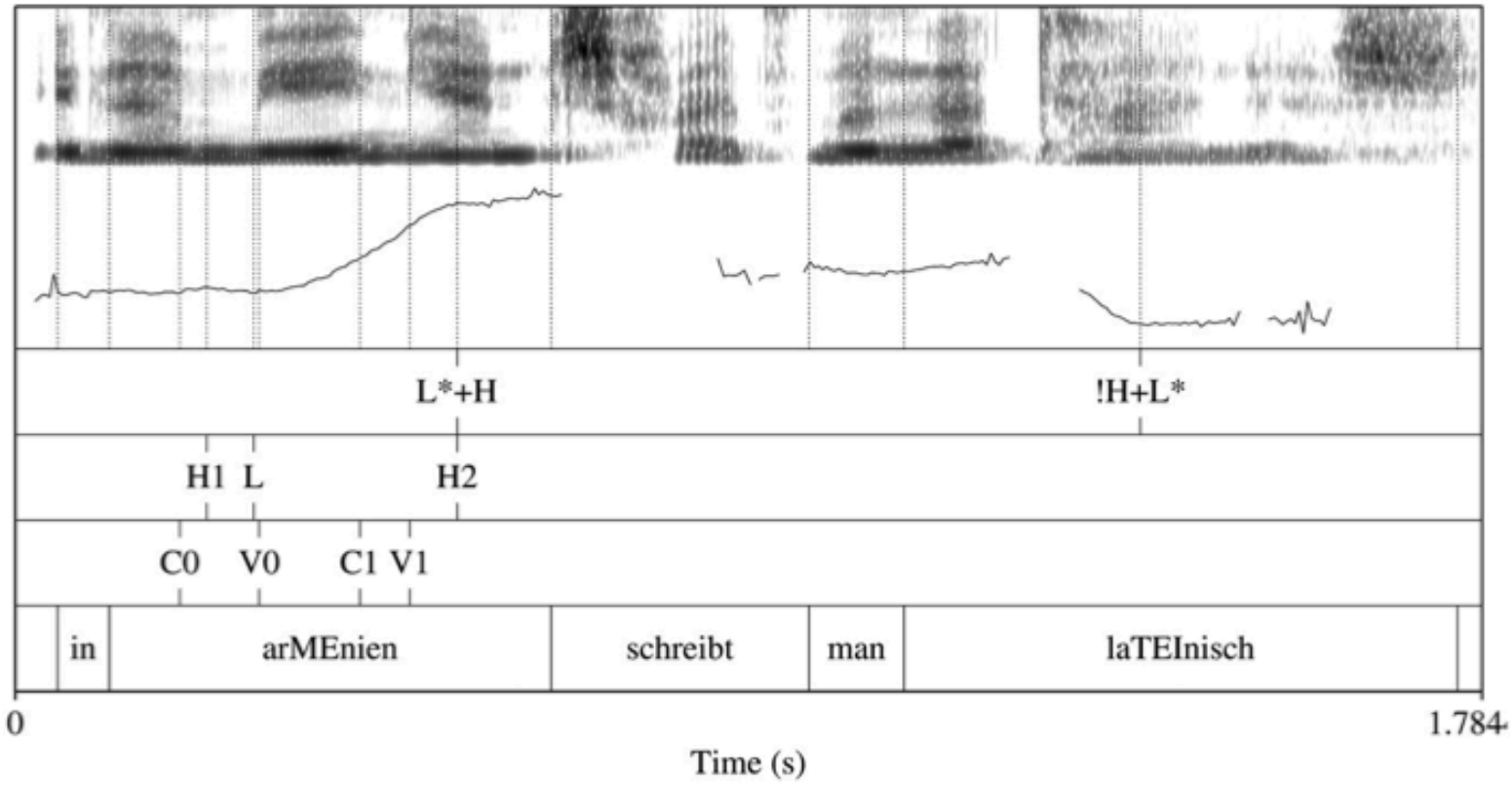
Prenuclear Accents and Meaning

E.g. higher and later F0 peaks in contrastive prenuclear accents vs. non-contrastive prenuclear accents (Braun 2006)

Contrastive:

[...] *Die Georgier hingegen besitzen sogar eine eigene Schrift.*

('The Georgians, however, even have their own writing system.')



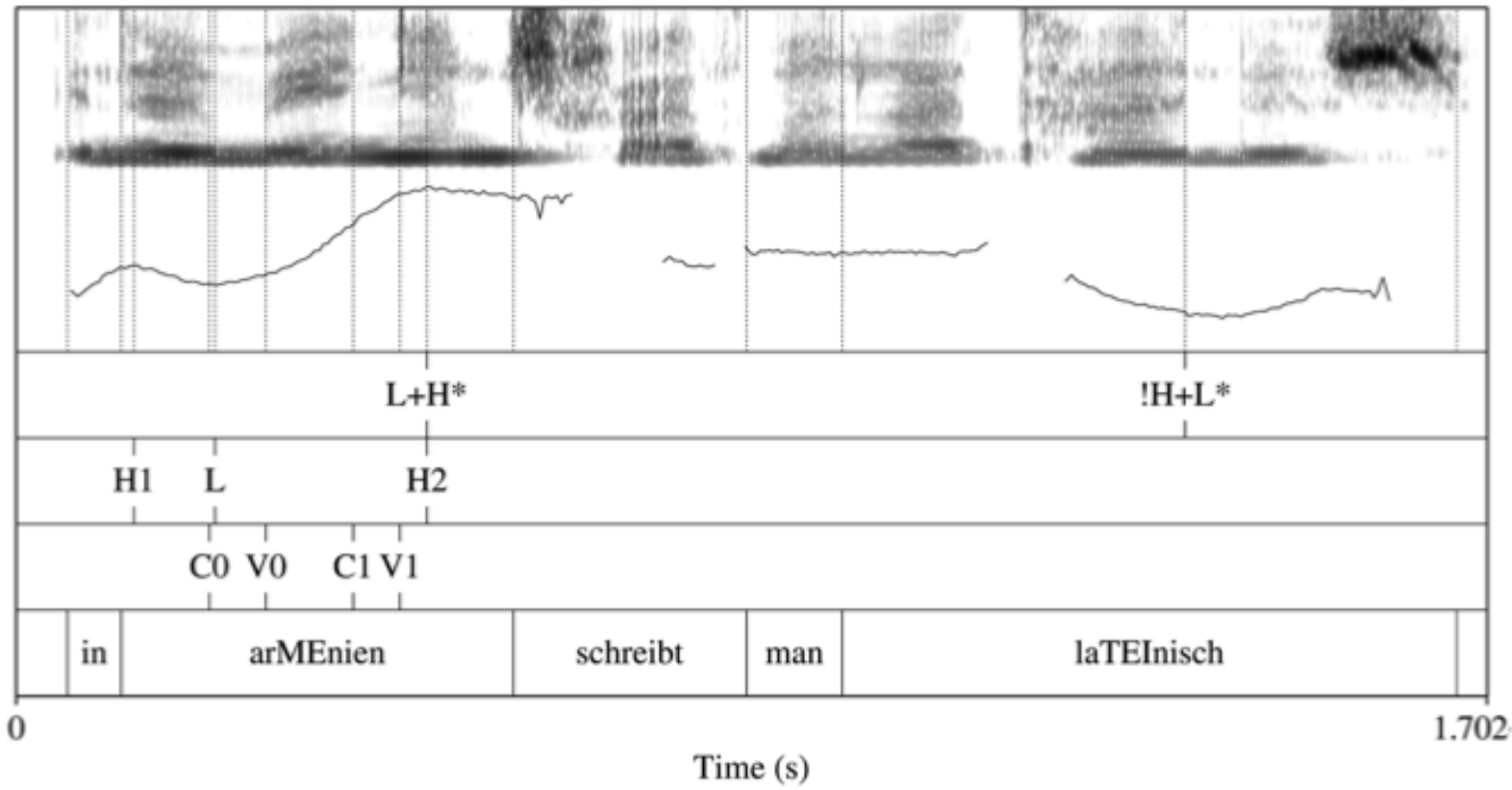
('In Armenia, the Latin alphabet is used')

Prenuclear Accents and Meaning

Non-contrastive:

[...] *Ungefähr 80% der Bevölkerung sind Christen.*

('About 80% of the population are Christians.')



('In Armenia, the Latin alphabet is used')

New Production Study

- **Motivation**: Inconsistent results of (the few) previous studies on the relation between form and function of prenuclear accents in German – plus comparison with nuclear accents in the same setup

- **Testbed**: Find out whether differences in the **information status of a sentence-initial argument (prenuclear) and a sentence-final argument (nuclear)** influence their prosodic realisation

- **Hypothesis**: Positive correlation between informativeness and prosodic prominence

Method – Nuclear Accents

- 28 native German speakers (23f, 5m), aged 19-58
- Presentation of 20 different mini-stories on a computer screen (*PsychoPy*)
- Task: Read out the story at a natural but swift speech rate (‘tell the story to a friend’)
- After each story, subjects had to answer a content question

Method – Nuclear Accents

- Target words: Three-syllable nouns with stress on the first syllable, mostly sonorous material

  e.g. *Mandelbaum, Regenwurm, Bauernhof, Wiegenlied* (‚almond tree', ‚earthworm', ‚farm', ‚lullaby')

- Last argument (object) in the sentence

Method – Nuclear Accents

Nach dem langen Winter freuten sich alle auf ein paar sonnige Stunden im Freien.

Im Klostergarten blühten die ersten Pflanzen.

Die Nonne hat den Mandelbaum gegossen.

Method – Nuclear Accents

Context 1	Nach dem langen Winter freuten sich alle auf ein paar sonnige Stunden im Freien.
Context 2a ***given***	Im Klostergarten blühte der erste *Mandelbaum*.
Context 2b ***accessible***	Im Klostergarten blühten die ersten *Pflanzen*.
Context 2c ***new***	Die Sonne schien schon den ganzen Tag und der Schnee war endlich geschmolzen.
Context 2d ***contrastive***	Der Mönch hat einen *Brombeerstrauch* gegossen.
Target	**Die Nonne hat den/einen Mandelbaum gegossen.**

Method – Nuclear Accents

- Each participant (28) read only one condition per story (20), resulting in five realisations of each condition per speaker

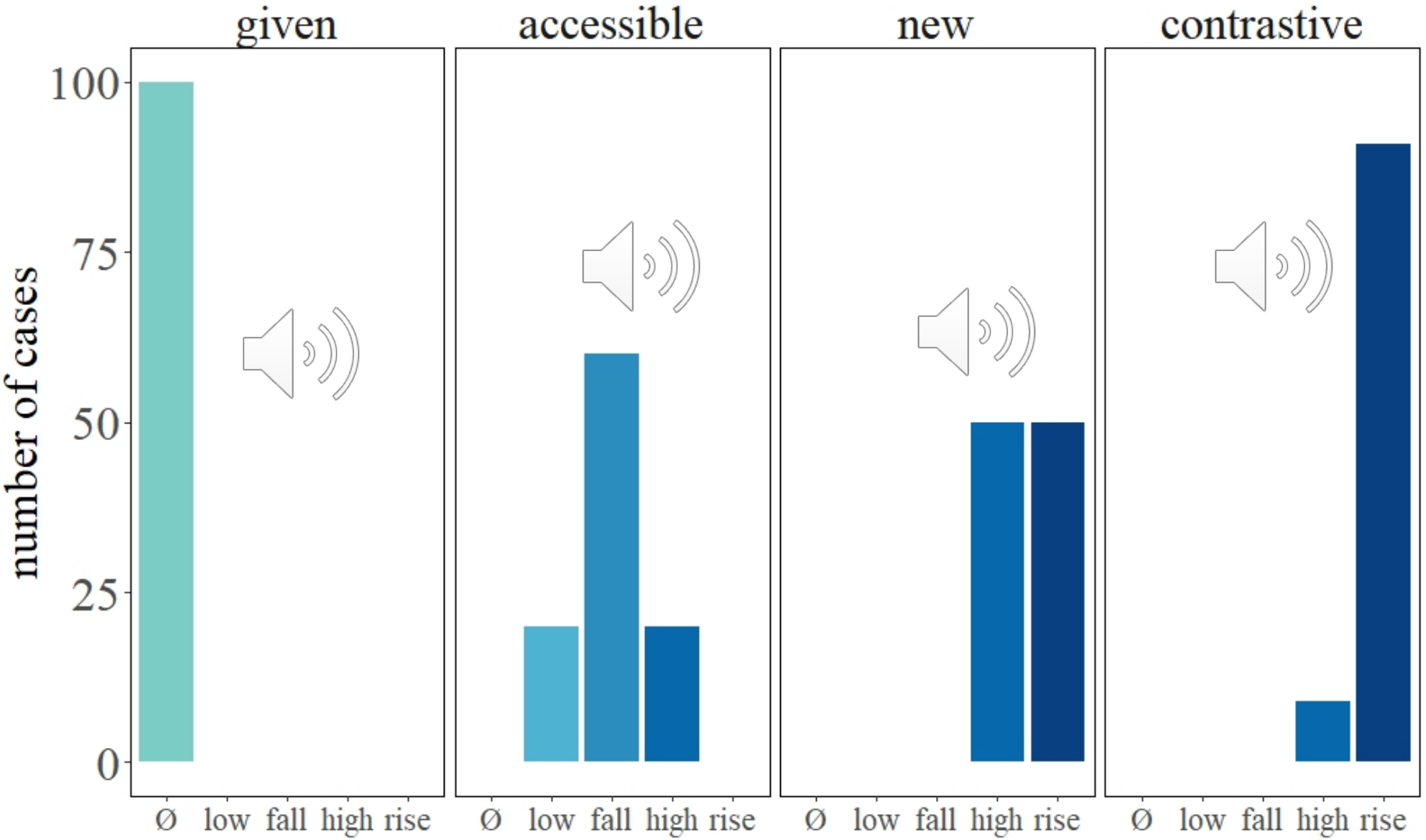
  = 560 utterances in total

  14 utterances (2.5%) excluded due to hesitations or creak in target word = **546 utterances** entered the analysis

Method: Analysis

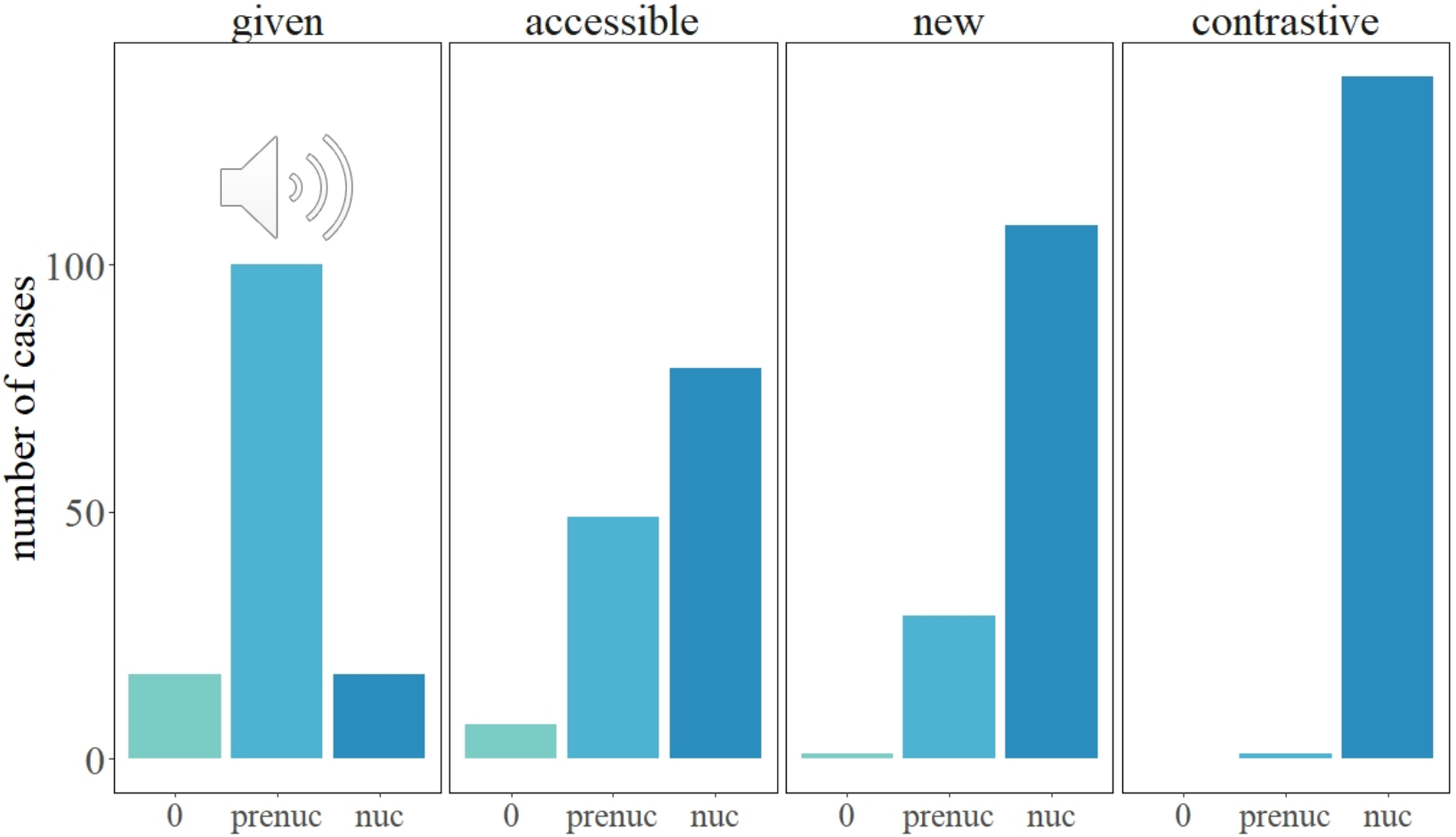
- Annotation: Accent types on target words
- Measurements:
  - DURATION of target WORDS
  - DURATION of stressed SYLLABLES
  - RMS amplitude of stressed syllables (INTENSITY)
  - F0 SLOPE (st/ms) and RANGE (st) of accented target words
  - TONAL CENTER OF GRAVITY (alignment and scaling) (Barnes et al.2012)

Hypothesis: Nuclear Accent Types



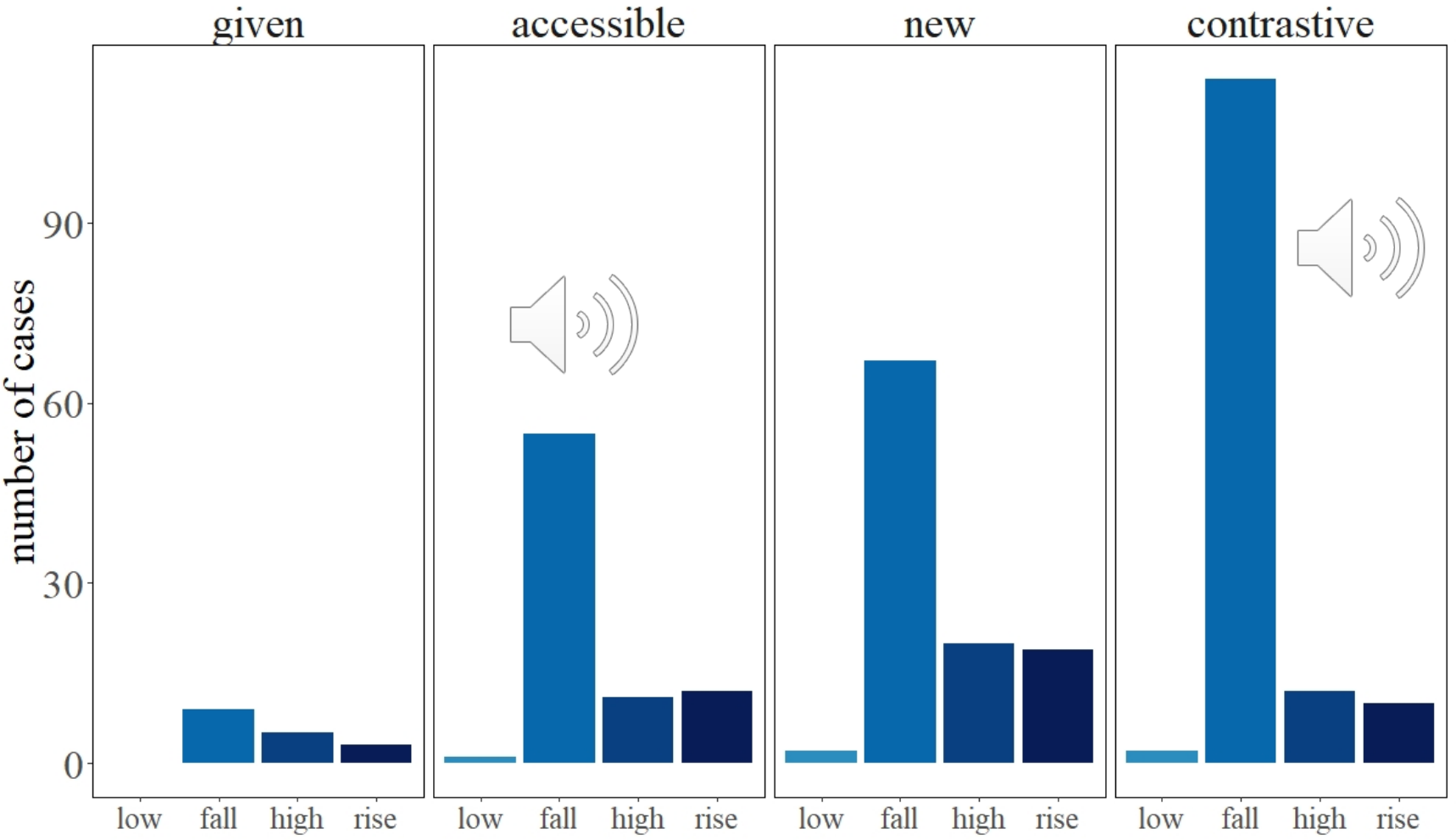
Results – Accent Position

- Info status has highly significant influence on ACCENT POSITION
- More accents on given than expected - but prenuclear



Results – Nuclear Accent Type

- Surprisingly large number of falls on new and contrastive items



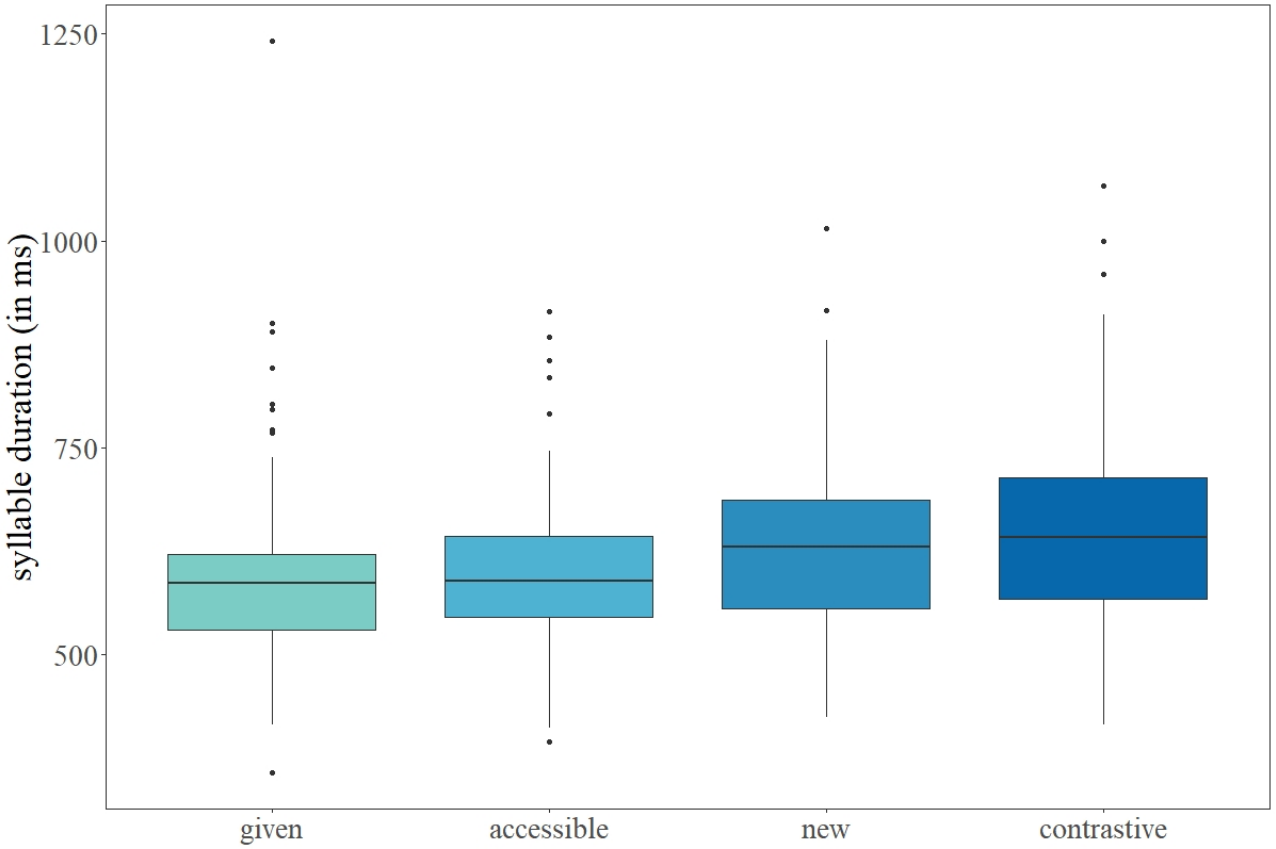
Results – Phonetic parameters

- Main effect of information structure on

- SYLLABLE DURATION

- WORD DURATION

- INTENSITY



but *contrastive* significantly lower

Method – Prenuclear Accents

- Target words: Two-syllable nouns with stress on the first syllable, mostly sonorous material

  e.g. *Nonne, Maler, Junge, Lehrer*
  (‚nun', ‚painter', ‚boy', ‚teacher')

- First argument (subject) in the sentence

Method – Prenuclear Accents

Context 1	Nach dem langen Winter freuten sich alle auf ein paar sonnige Stunden im Freien.
Context 2a ***given***	Die *Nonne* kümmerte sich um den Klostergarten.
Context 2b ***accessible***	Im *Klostergarten* blühten die ersten Pflanzen.
Context 2c ***new***	Die Sonne schien schon den ganzen Tag und der Schnee war endlich geschmolzen.
Context 2d ***contrastive***	Der *Mönch* hat einen Brombeerstrauch gegossen.
Target	**Die Nonne hat einen Mandelbaum gegossen.**

Method – Prenuclear Accents

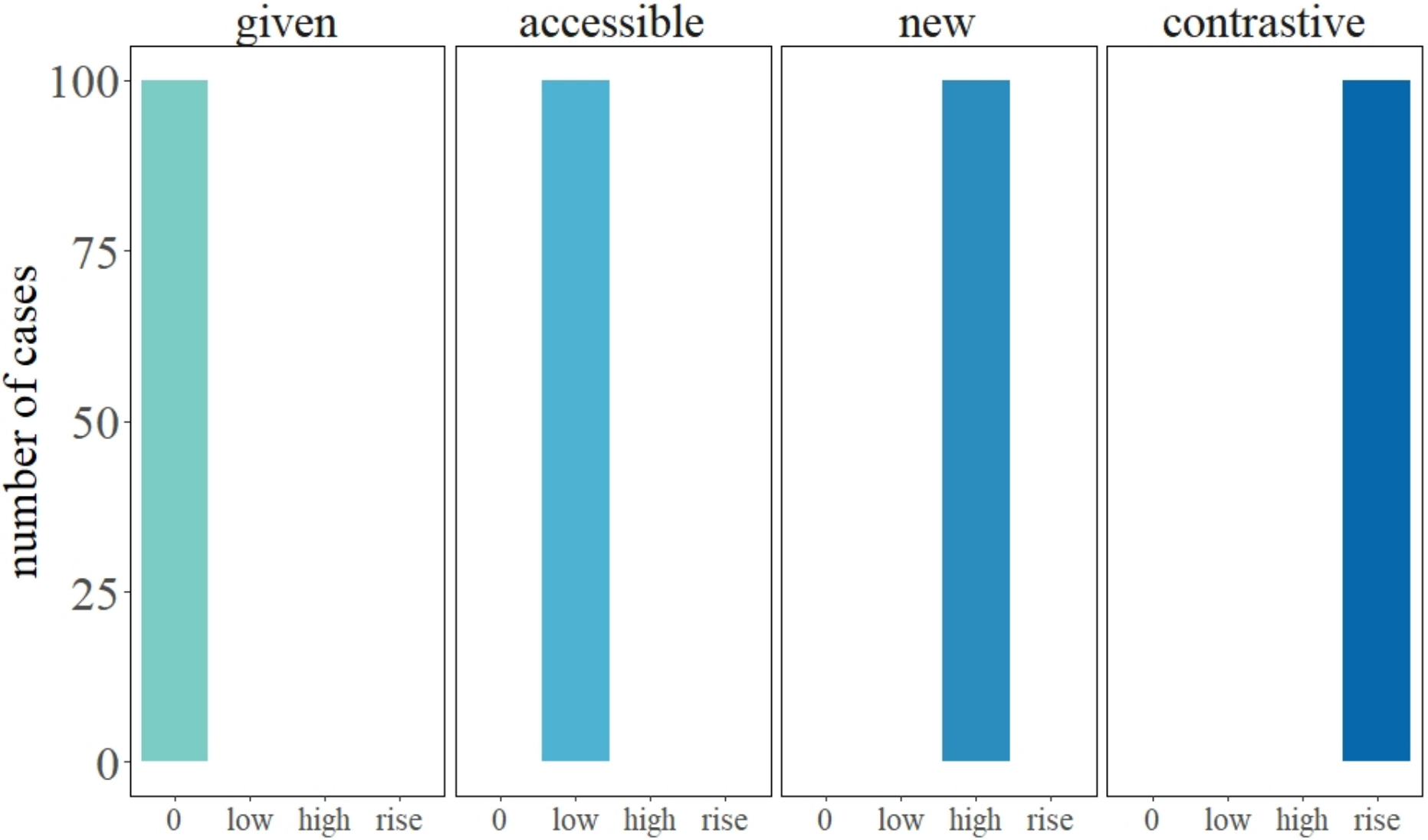
- 29 native German speakers (21f, 8m), aged 19-30
- 580 utterances in total

  12 utterances (2.1%) excluded due to hesitations or creak in target word

  75 utterance (12.9%) excluded due to **phrase breaks** after target word, turning prenuclear accents into nuclear accents

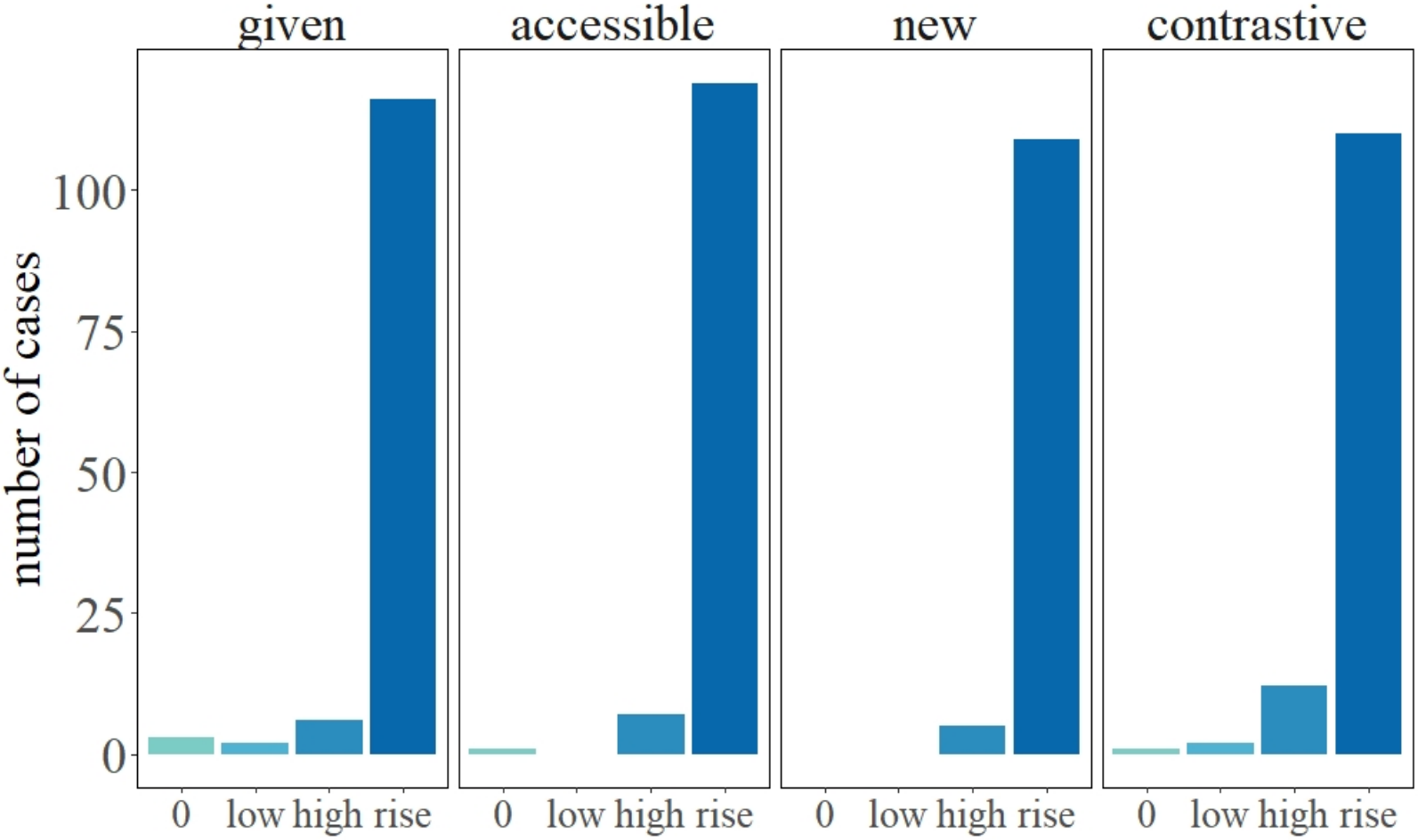
  = **493 utterances** entered the analysis

Hypothesis: Prenuclear Accent Types



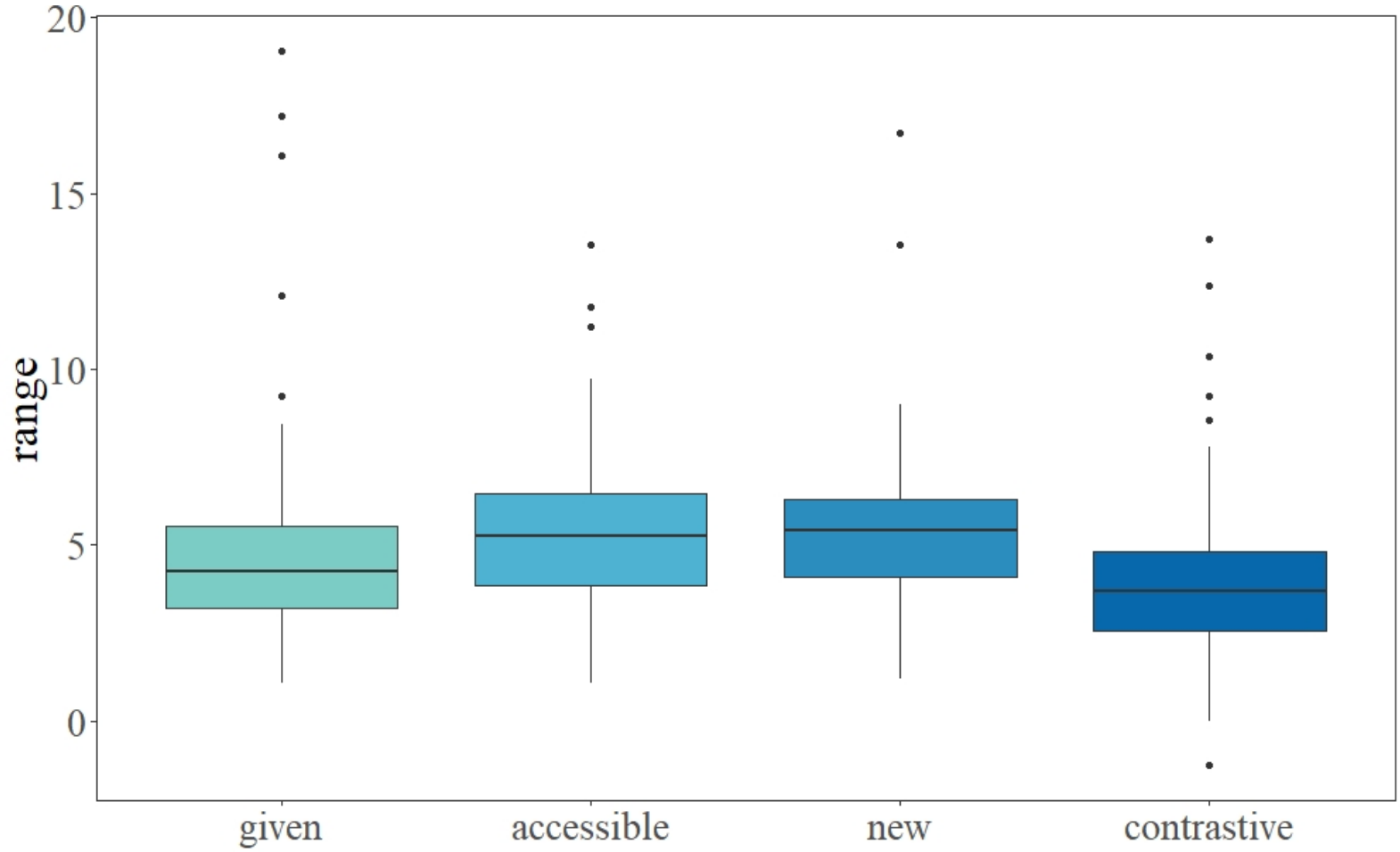
Results – Accent Type

- Info status has no influence on ACCENT TYPE (and POSITION)
- Hardly any cases of deaccentuation but 92% rises



Results – Range

- Main effect of info structure on RANGE (and SLOPE)
- Significant increase from *given* to *new* – vs. *contrastive*



Results – Phonetic parameters

- Main effect of information structure on
  - TCoG (SCALING) but *contrastive* significantly lower
  - WORD DURATION
  - INTENSITY but *contrastive* significantly lower

Conclusions

- Hypothesis „positive correlation between informativeness and prosodic prominence“ only partly confirmed:
- Informativeness strongy influences the prosody of **final arguments**
  - Increase of nuclear accents from given to contrastive (different distribution of ACCENT POSITION)
  - But less deaccentuations on *given* items than expected
  - Only subtle differences in ACCENT TYPE

  = Speakers make systematic use of **nuclear accents** to **express meaning differences**

Conclusions

- Only subtle influence of informativeness on **initial arguments**
  - Consistent marking by rising prenuclear accents (no deaccentuations of *given* items)
  - For rhythmic reasons after all (Bolinger's *accent of power*)?
  - But effects of RANGE and SLOPE: the *newer* an item the steeper the rise (= the higher its prosodic prominence)

  = In this respect, **prenuclear accents are not just 'ornamental'**

Conclusions

- Surprising but stable result for contrastive (double focus) structures:
- Flat hat pattern = prosodically non-prominent prenuclear and nuclear accents
- Possible reason: contrast already expressed by parallel syntactic structure

Outlook

- **Typological comparison** with prenuclear (and nuclear) accents in American English (J. Cole) and Spanish (J. Hualde)

- Furthermore: to what extent does the speaking style (neutral vs. lively) affect the prosodic marking?

Thank you for your attention!

Additional Slides

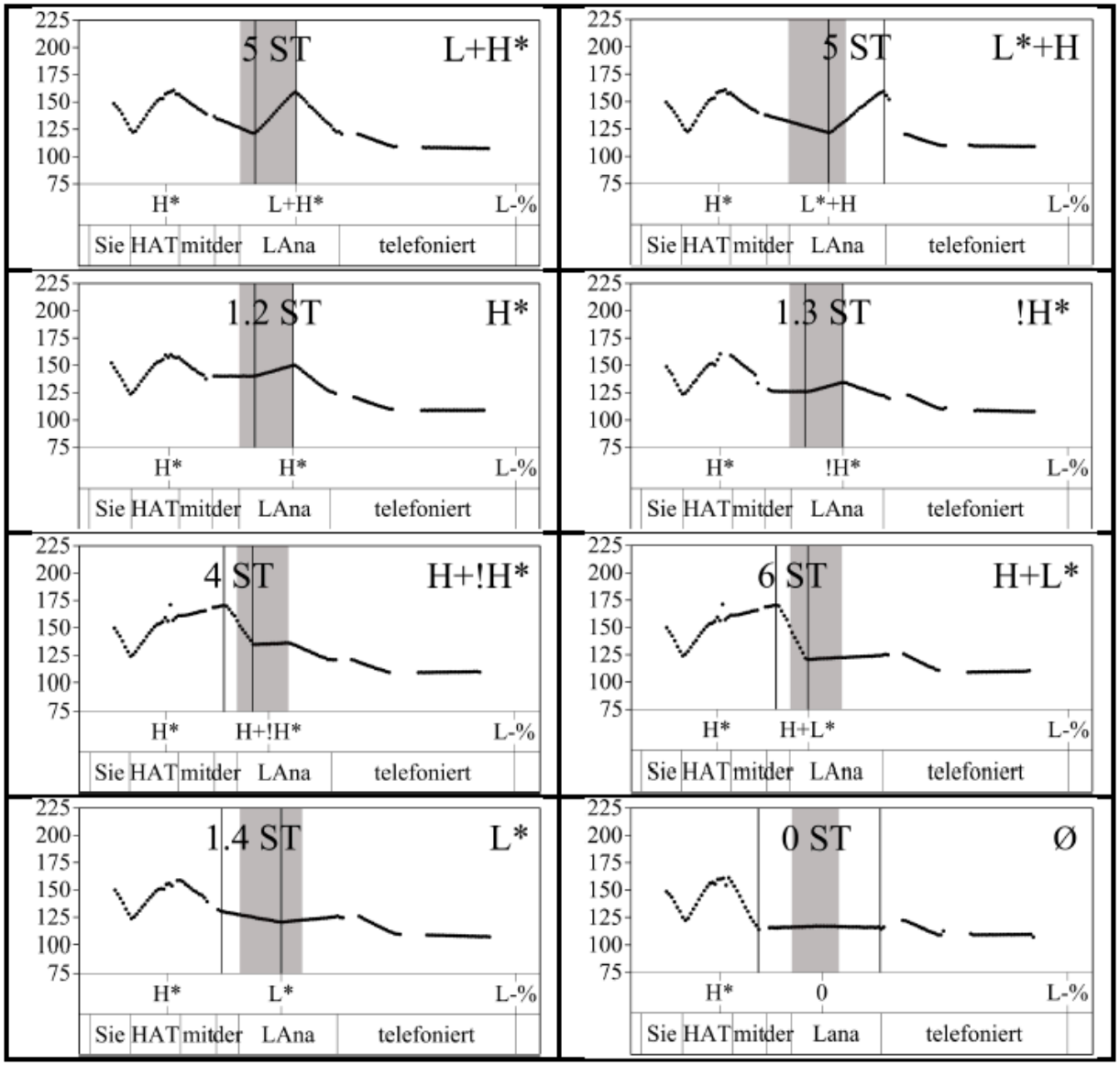
Prominence of Accent Types

- Perception experiment: Do German nuclear pitch accent types (plus deaccentuation) differ with respect to their perceived prominence?

- Three relevant tonal dimensions

  1. Direction of pitch movement (rises > falls)
  2. Degree of pitch excursion (steep > shallow)
  3. Height of the starred tone (H > !H > L)

Prominence of Accent Types: Stimuli



Baumann & Röhr (2015)

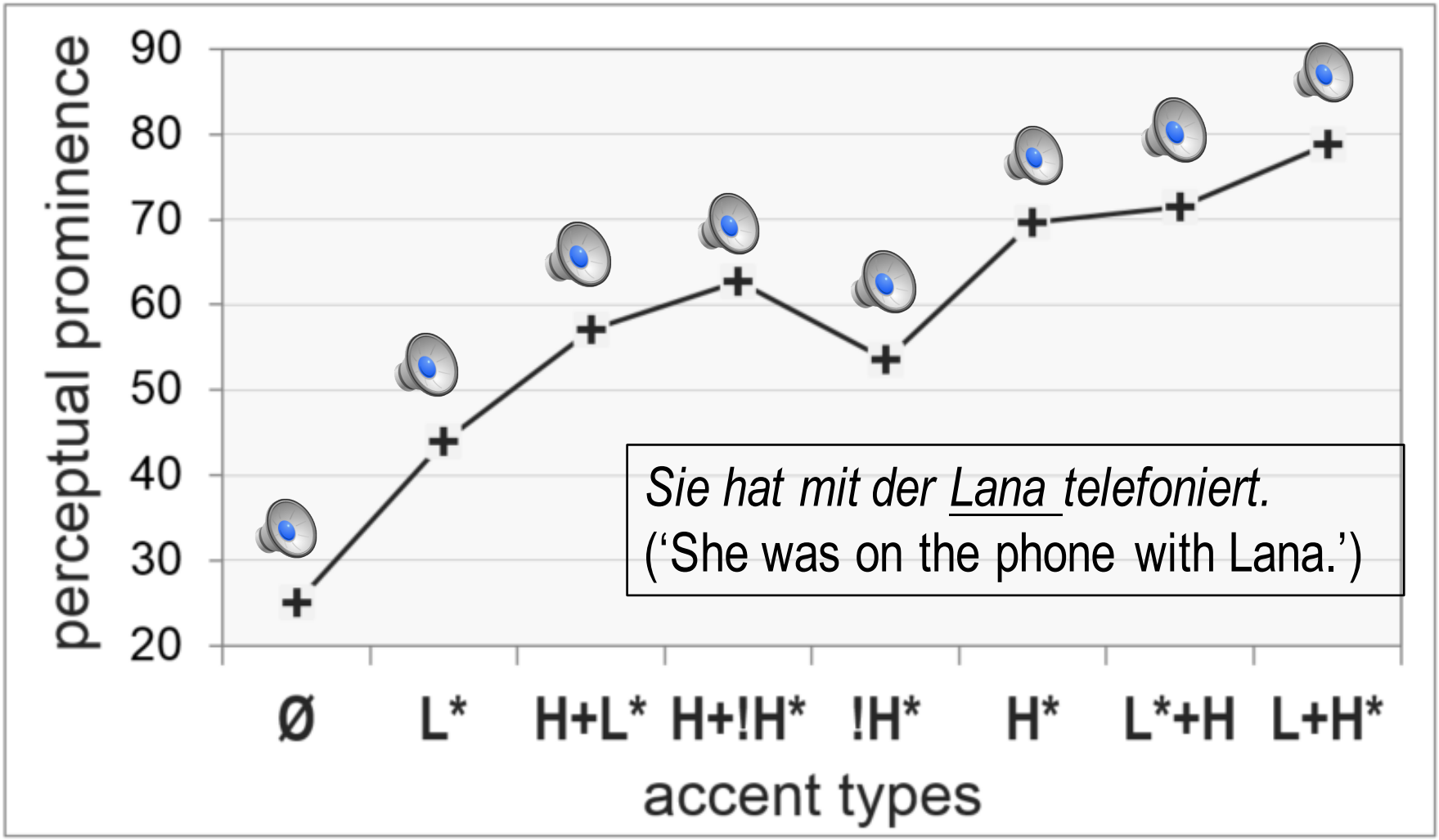
Prominence of Accent Types: Procedure

- 68 native German listeners
- Web-based questionnaire
- Task: Evaluate on a Visual Analogue Scale (0-100%)

“How highlighted does the name in the following utterance sound?”

Sie hat mit der Lana telefoniert.
(‘She was on the phone with Lana.’)

Prominence of Accent Types: Results



Baumann & Röhr (2015)

Accent Type and Meaning: Information Status

- Schumacher & Baumann (2010): neurolinguistic perception study
- Cognitive processing of semantically accessible information (part-whole relation)
- Measurement of event-related potentials (ERPs) while listening to stimuli (24 subjects, 90 stimulus sets)

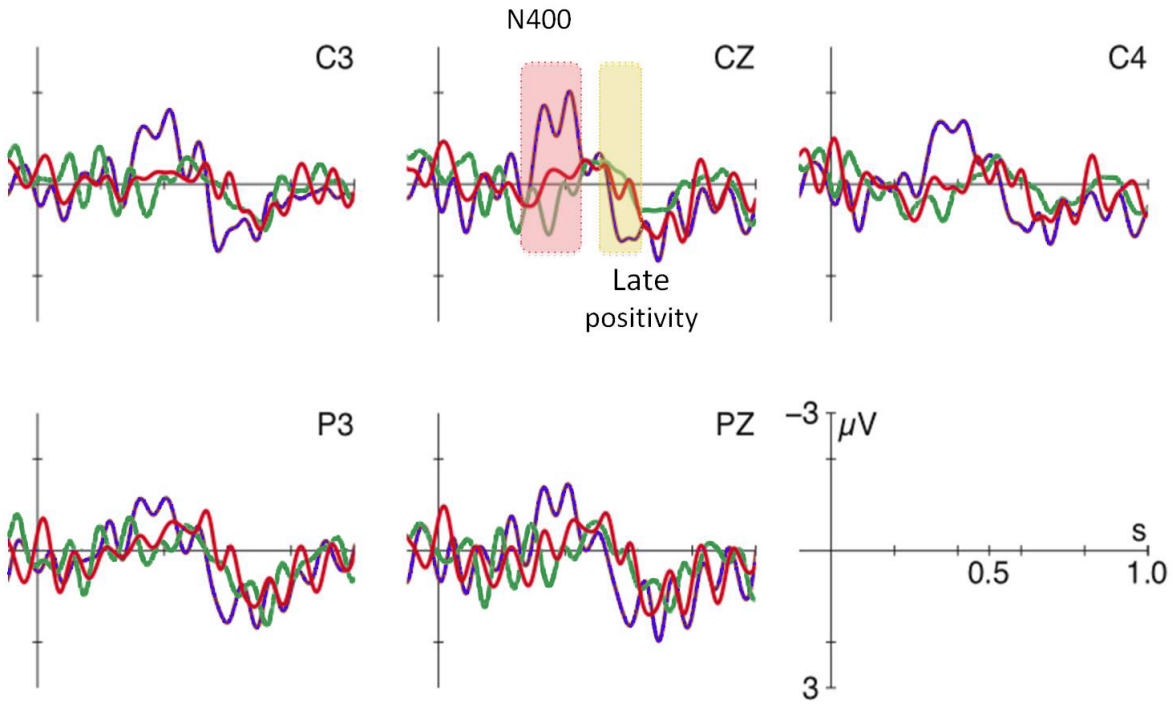
Context: *Sabine repariert einen alten Schuh*. (= holonym)

Target Sentence: *Dabei zerschneidet sie die Sohle*. (= meronym; accessible)

H* H+L* Ø

Accent Type and Meaning: Information Status

- Significant three-way difference in processing effort:
  - N400: Ø > H* > H+L*
- Least integration costs for 'secondary accent' H+L* as marker of 'secondarily given' referents



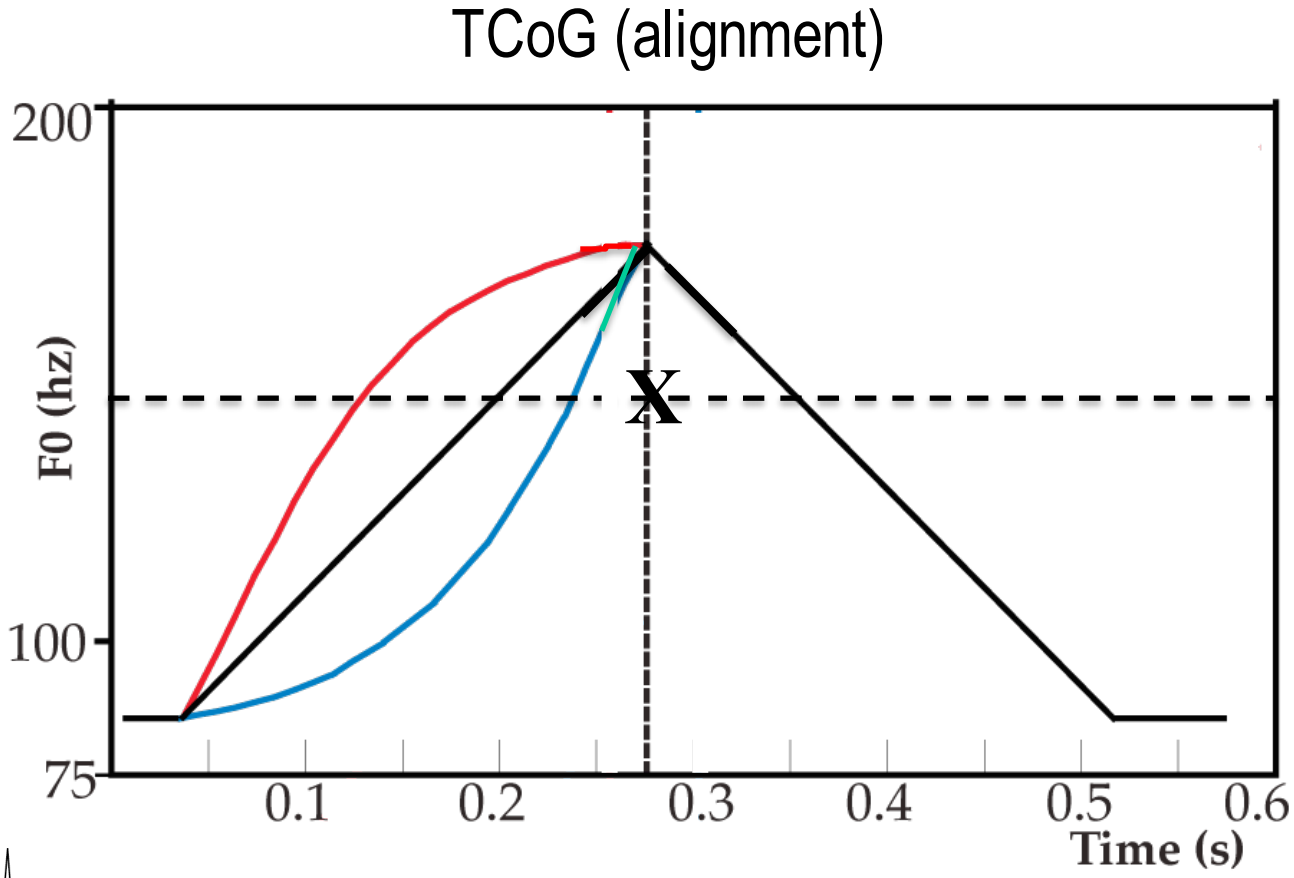
GIVENNESS (deaccented)
ACCESSIBILITY (H+L*)
NEWNESS (H*)

Tonal Center of Gravity (TCoG)

- Holistic measure that incorporates contour shape and alignment or scaling of turning points (Barnes et al. 2012)
- Reflects either a temporal value (TCoG alignment) or a pitch level (TCoG scaling) within the sampled F0 region that represents the balancing point of the **area under the curve**

TCoG in Two Dimensions

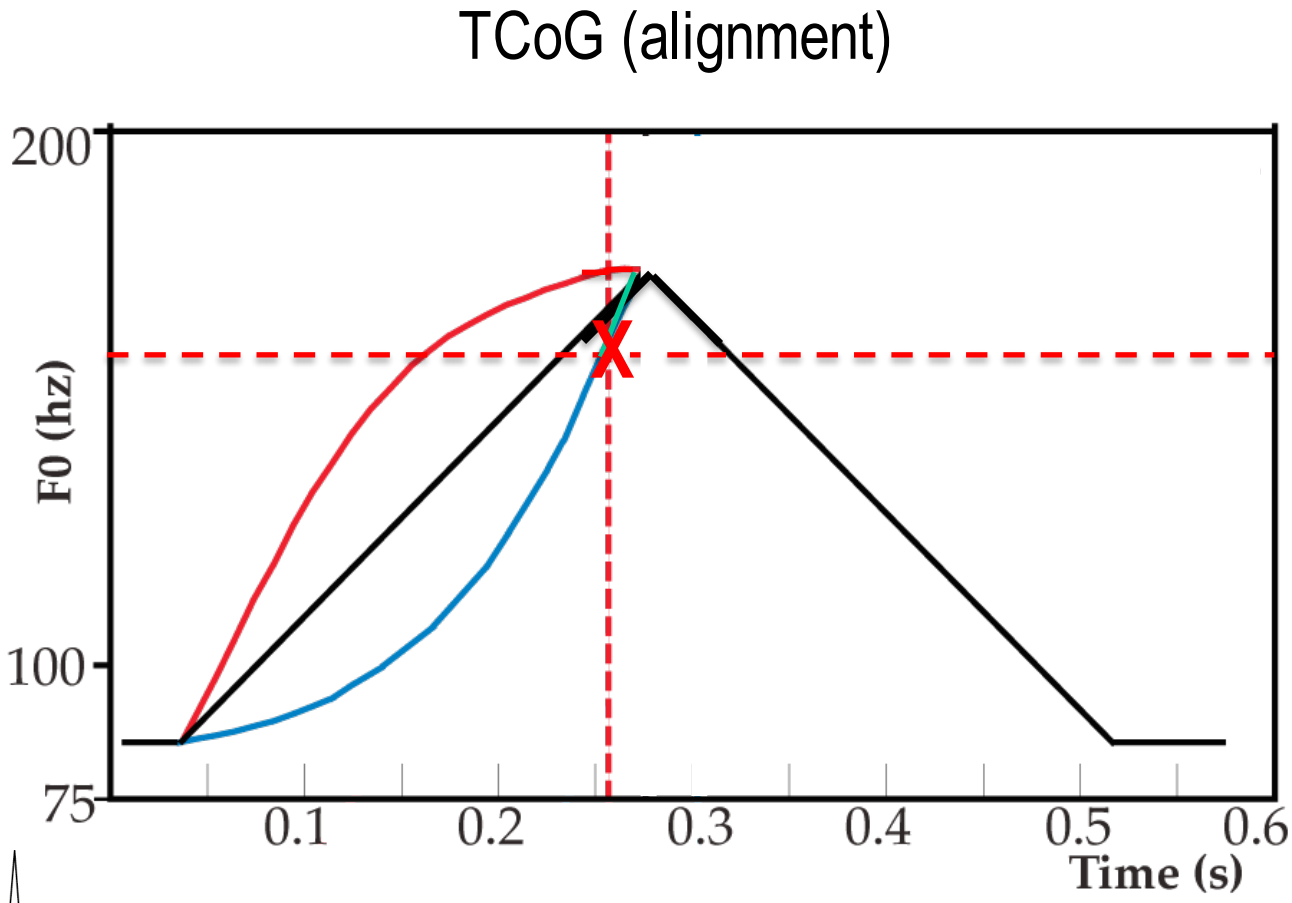
- The same shape differences simultaneously affect the location of TCoG for timing and scaling



Slides adopted from Barnes (2017) PaPE

TCoG in Two Dimensions

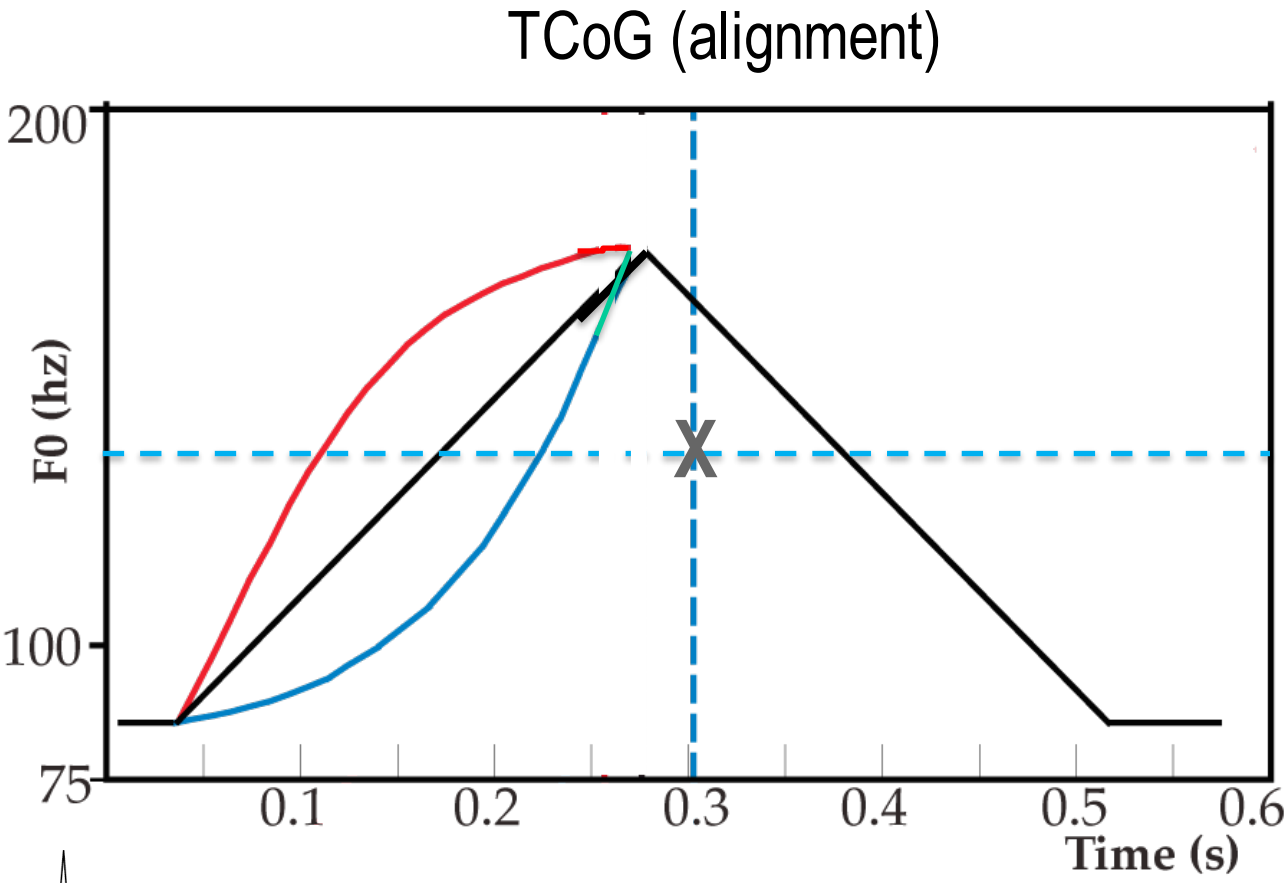
- Doomed rise: Accents sound earlier and higher



Slides adopted from Barnes (2017) PaPE

TCoG in Two Dimensions

- Scooped rise: Accents sound later and lower

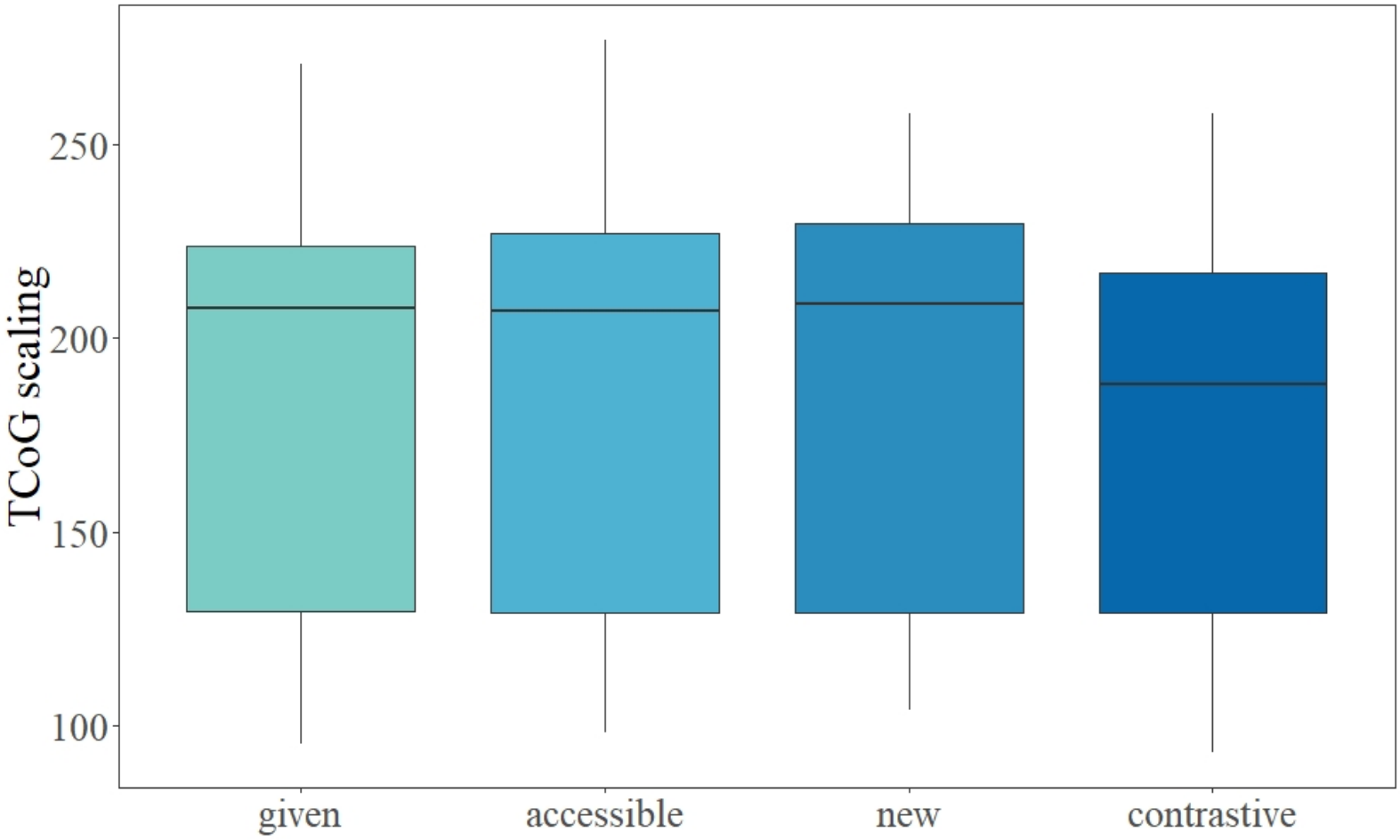


TCoG (scaling)

Slides adopted from Barnes (2017) PaPE

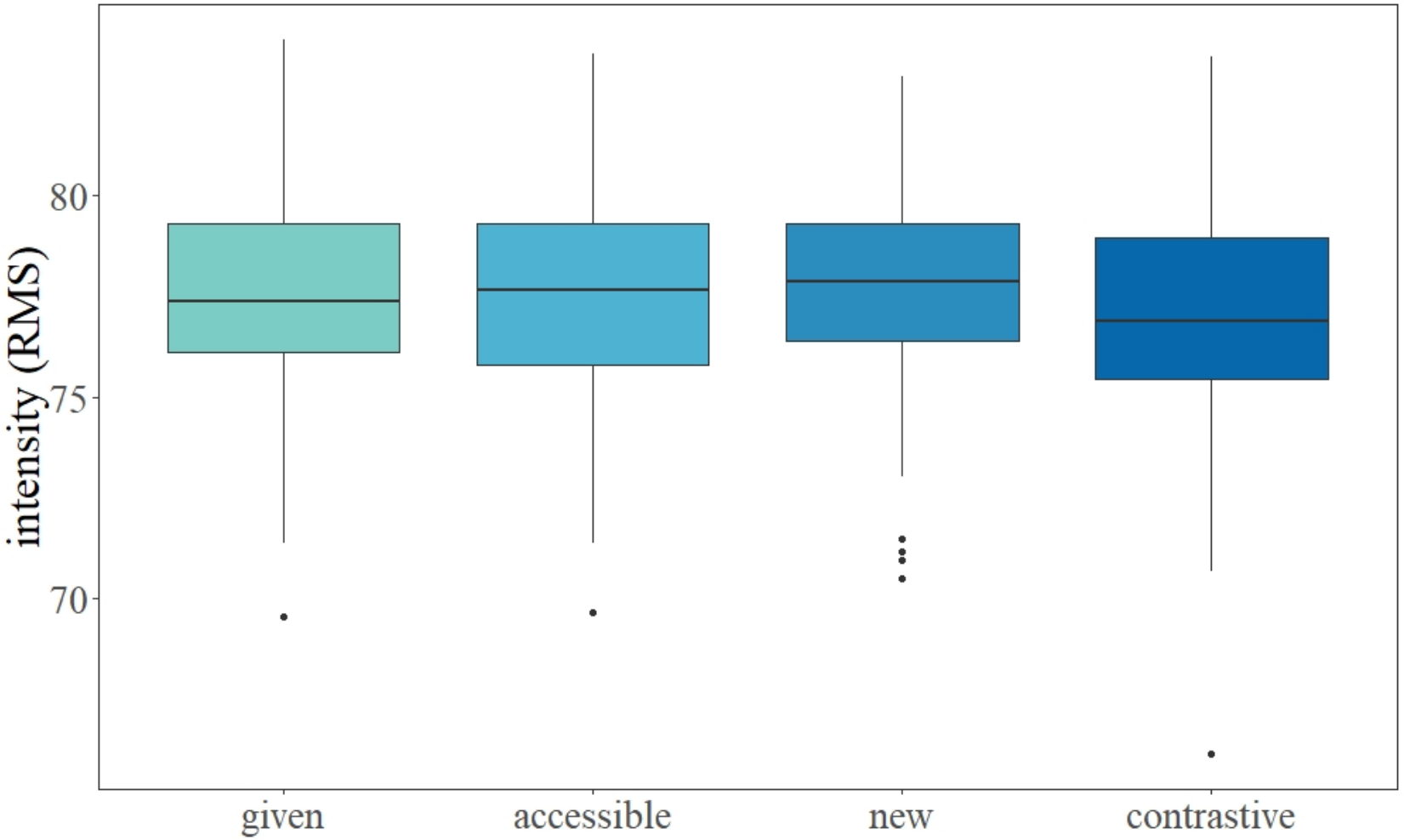
Results – TCoG (Scaling)

- Main effect of info structure on TCoG (SCALING)
- *Contrastive* significantly lower



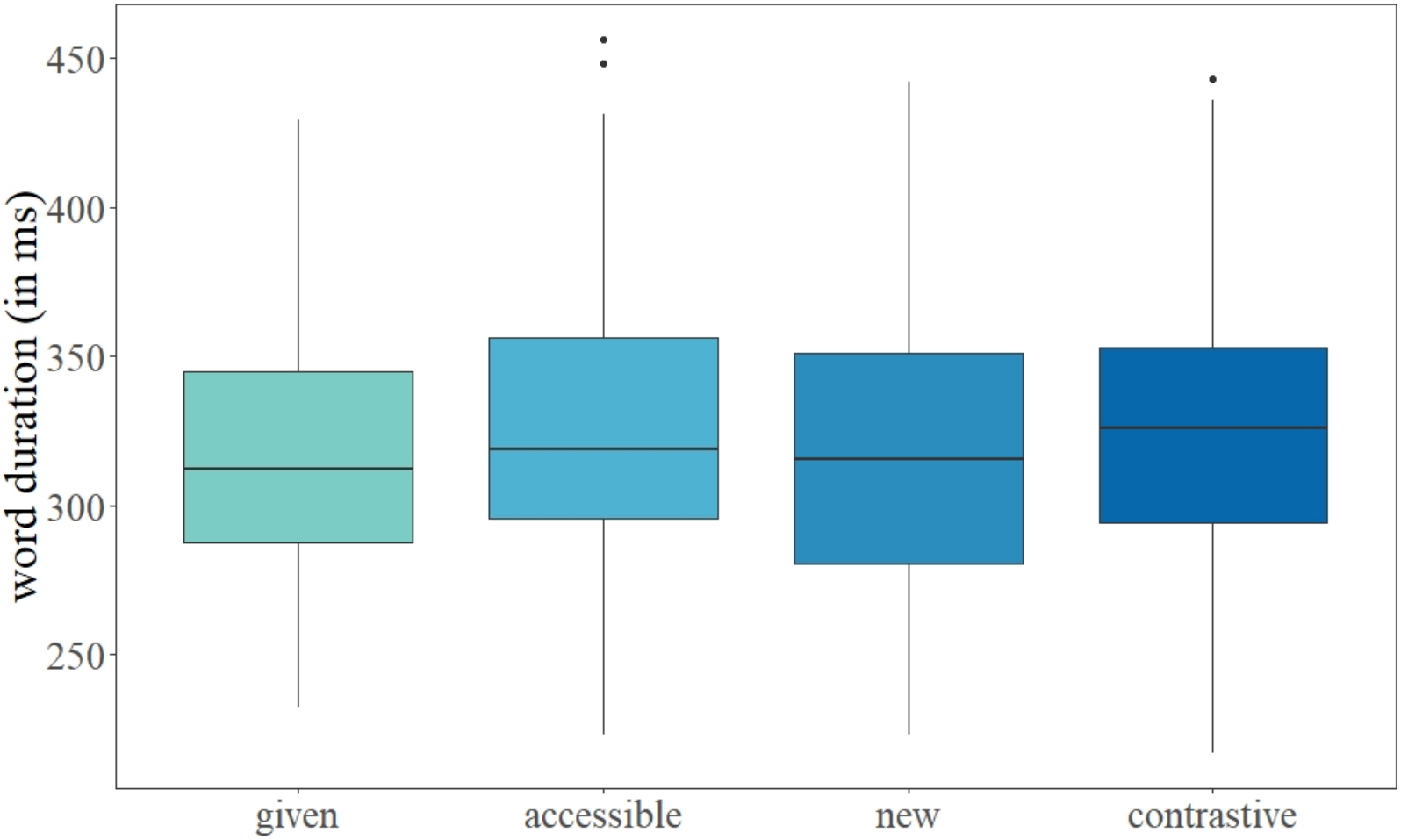
Results – Intensity

- Main effect of info structure on INTENSITY
- *Contrastive* significantly lower

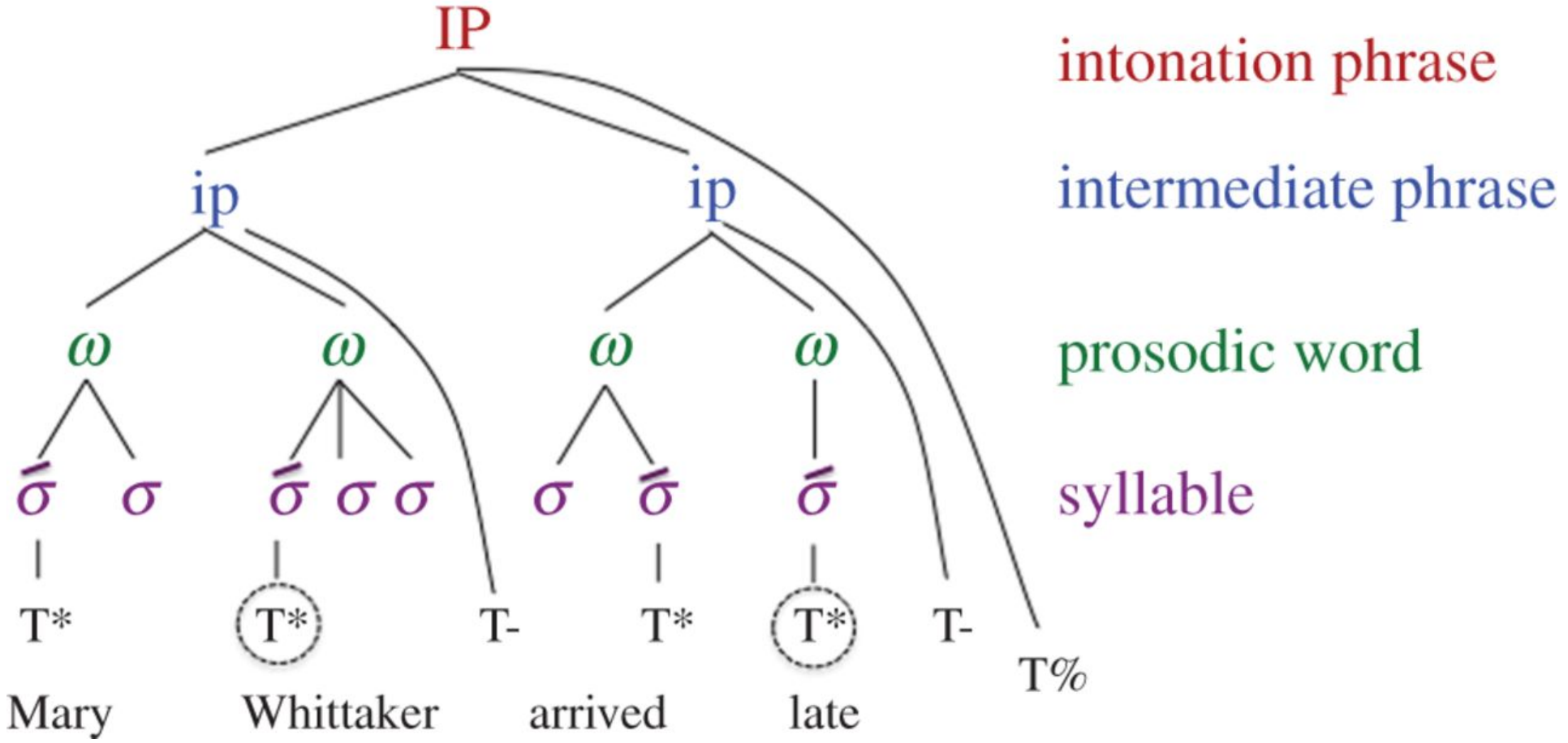


Results – Word Duration

- Main effect of info structure on WORD DURATION
- *Contrastive* significantly longer than *given*



Background: Prosodic Hierarchy



(from Krivokapić 2014)

Some References

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