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The interpretation of pitch patterns and its effects on accentual prominence in German

Oliver Niebuhr

Presentation at the
TIE 3 Conference, Lisbon
September, 17th, 2008



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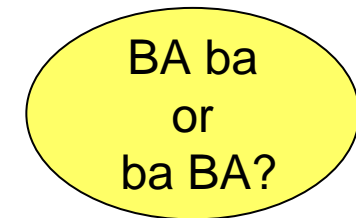
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Introduction

- Perceptual Prominence = how conspicuous a particular entity appears in relation to the surrounding ones
- Concrete gradual property of perceptual entities
- It has a signal-based (i.e. bottom-up) component
 - > F0 movements > perceptual prominence
 - > Durations > perceptual prominence
 - > Intensity / Energie > perceptual prominence
 - Faster changes > perceptual prominence
- In utterance contexts, however, this bottom-up component is complemented by a very influential signal-external top-down component, based on ling. knowledge and/or expectation.





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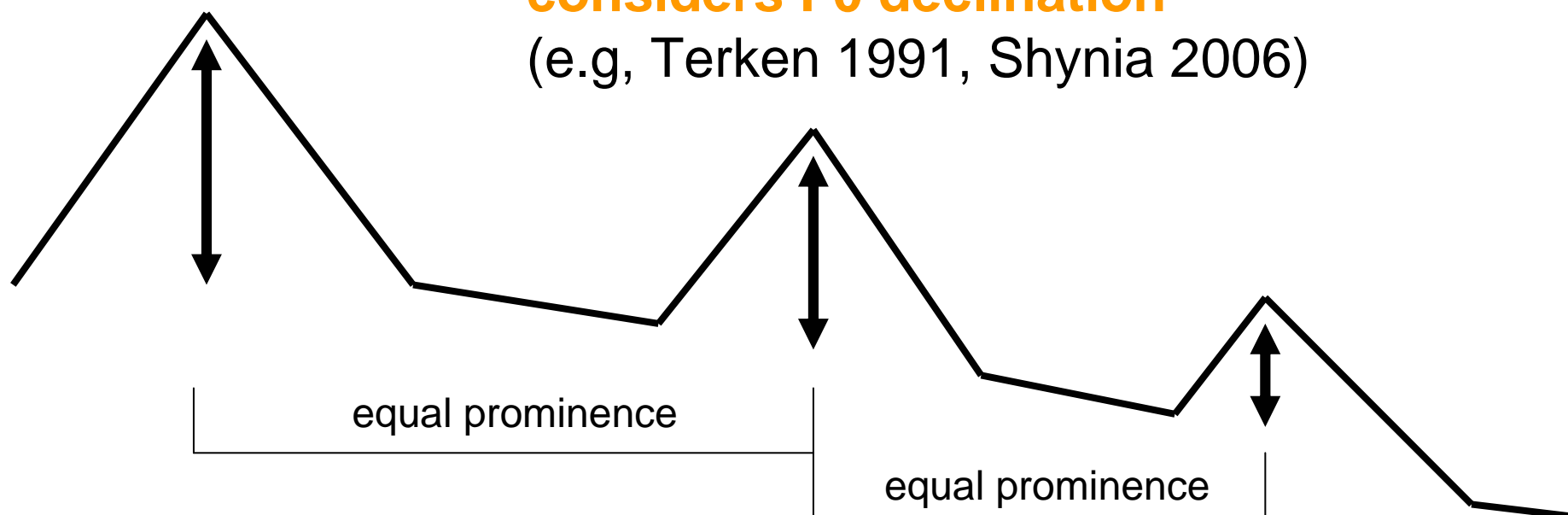


Introduction

- What do we know about this top-down effects?

(1) Perceptual prominence construction considers F0 declination

(e.g, Terken 1991, Shynia 2006)





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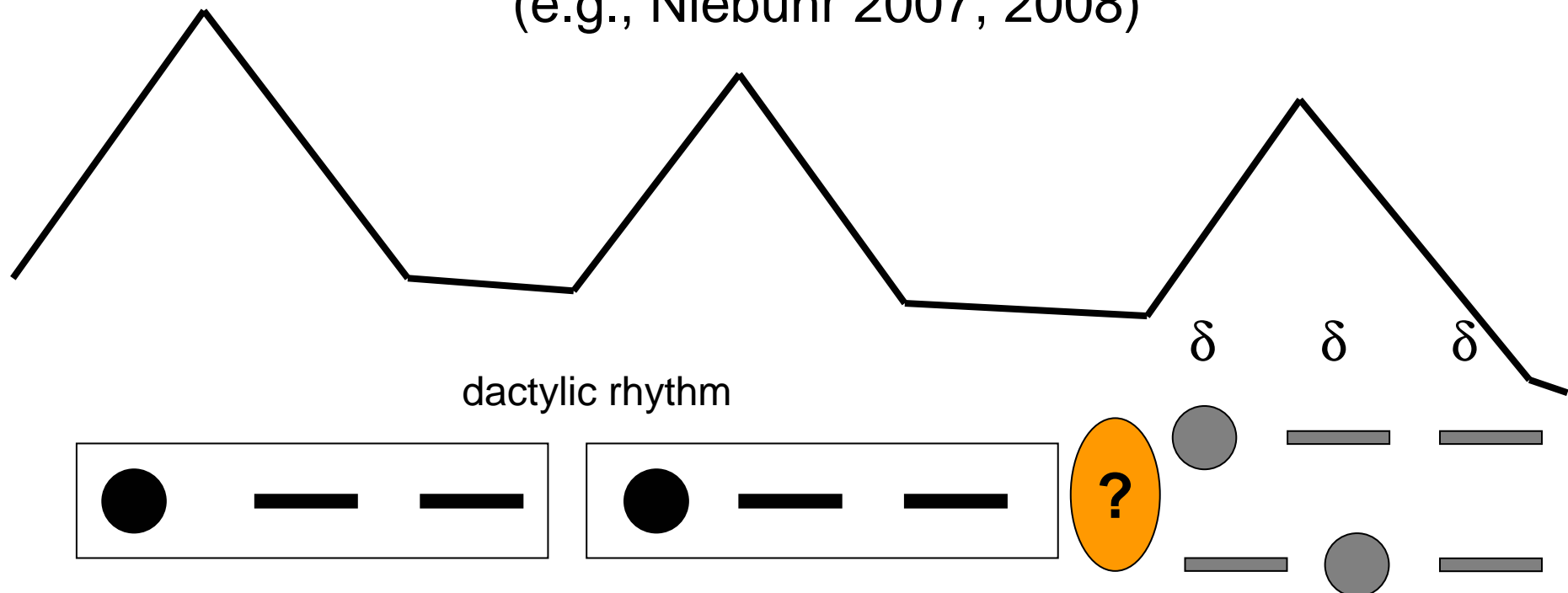
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Introduction

- What do we know about this top-down effects?

(2) Perceptual prominence construction is influenced by global melodic rhythms (e.g., Niebuhr 2007, 2008)





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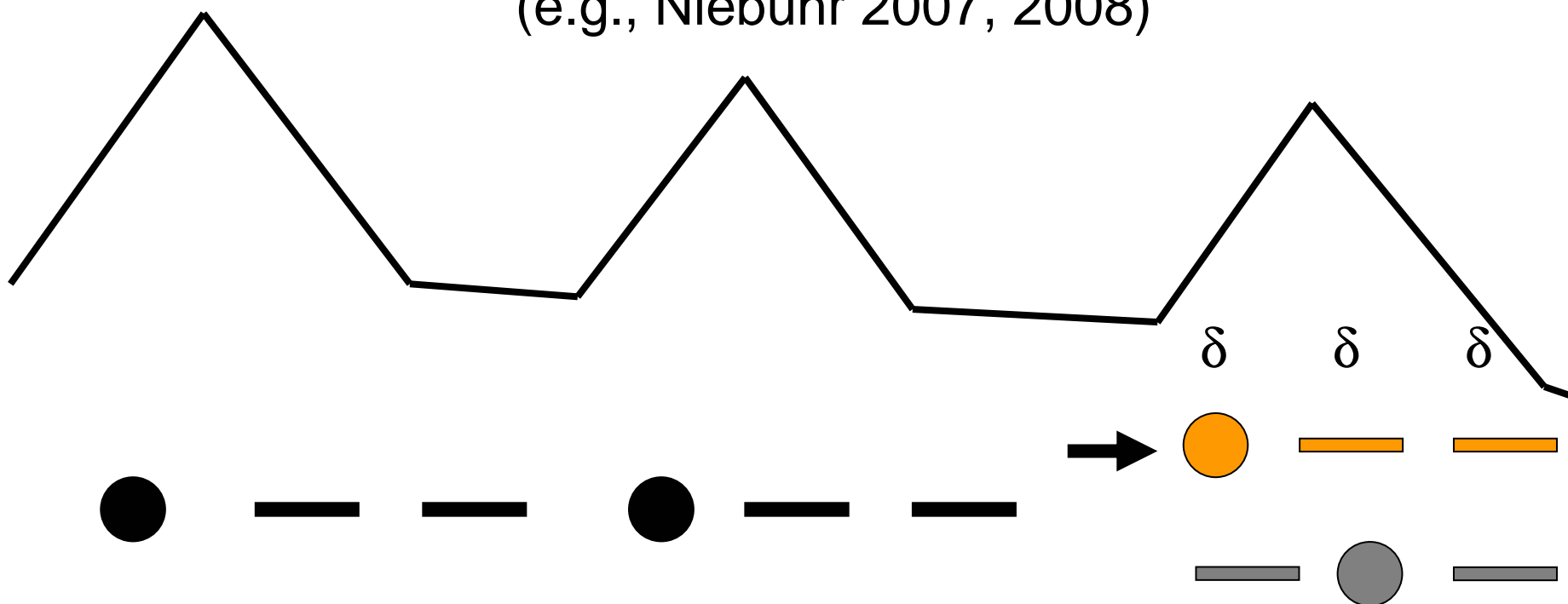
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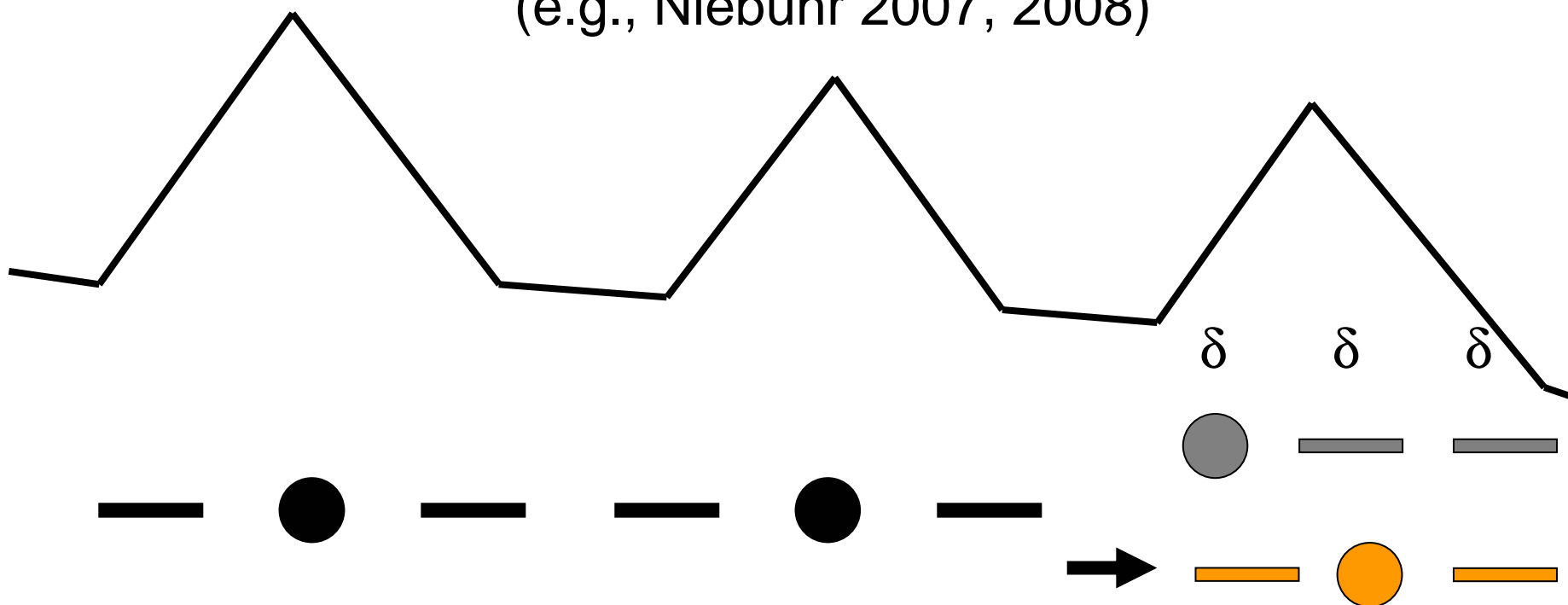
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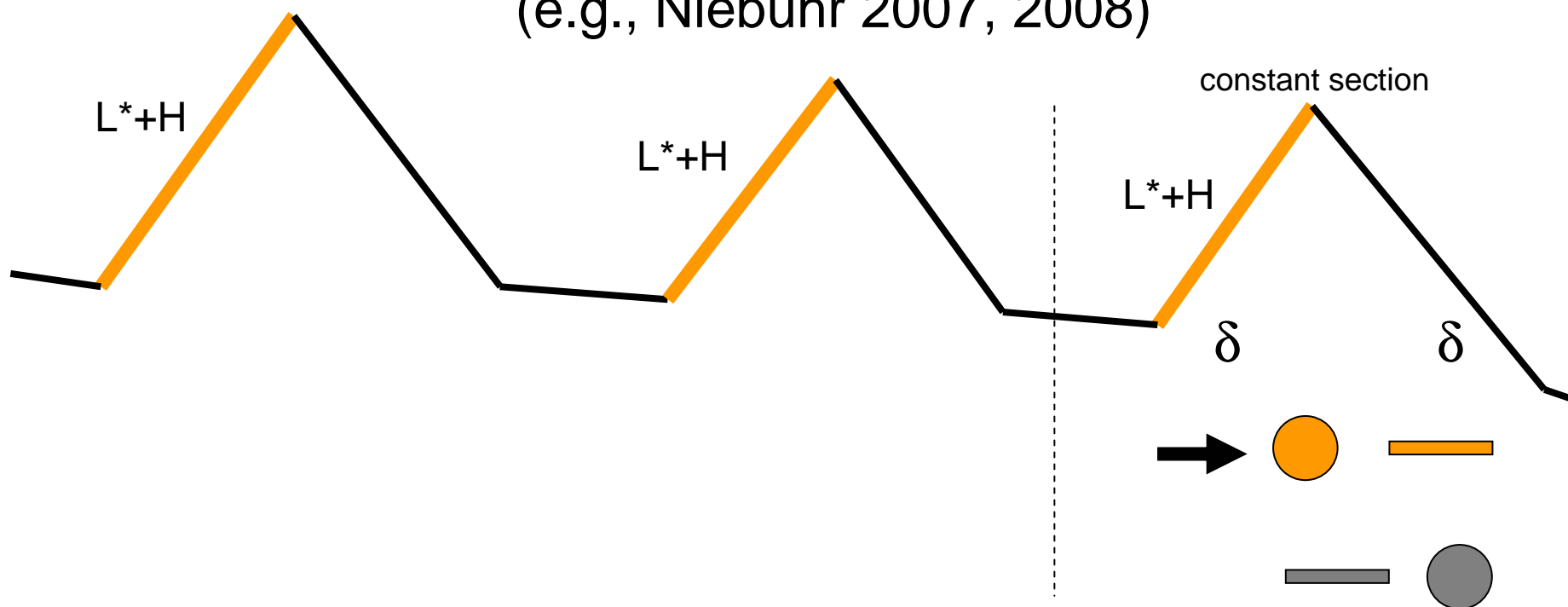
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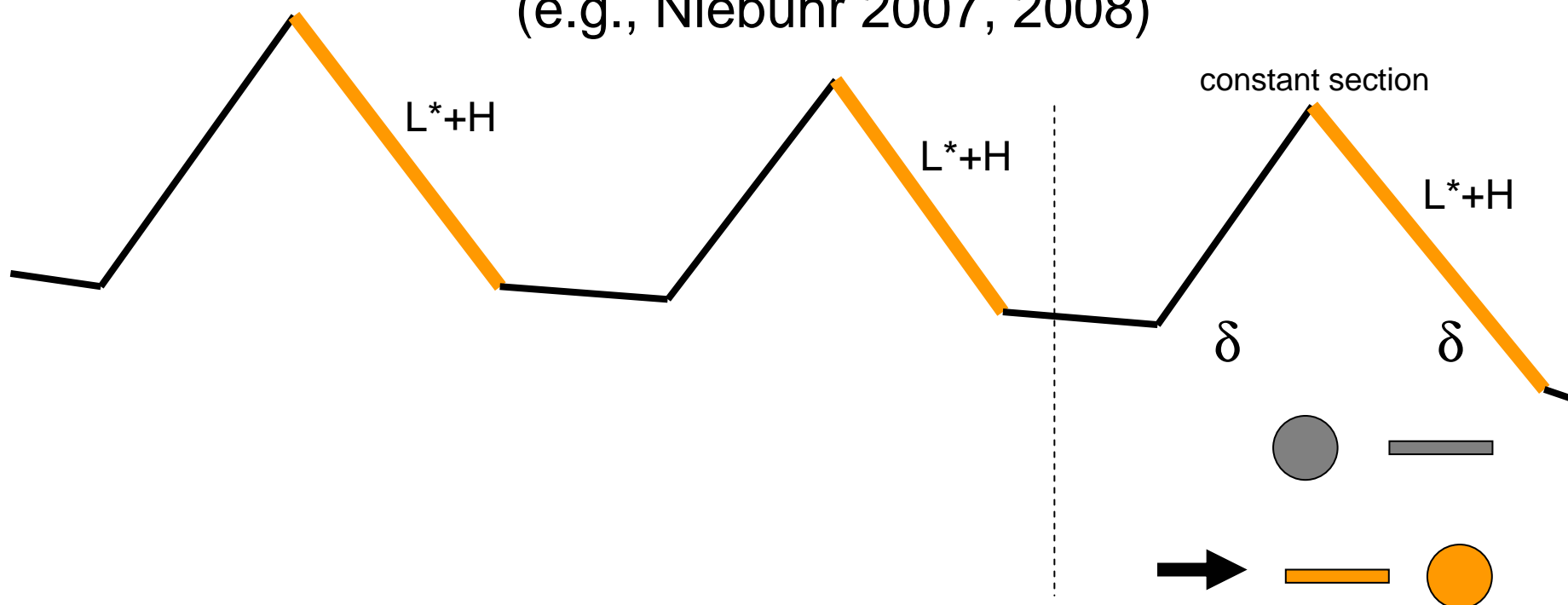
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Introduction

- What do we know about this top-down effects?

(3) Linguistic knowledge, e.g., word class
(e.g., Jensen 2006)

(4) Visual cues, e.g., eye(-brow) movements
(e.g., Krahmer et al. 2002)

under comparable
phonetic conditions

adjective

noun

verb





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Introduction

- Aim of the present study: further investigation of prominence-construction aspects
 - (2): Relationship between perceived prominence and F0 movements (prominence-lending vs. prominence-cueing discussion, Ladd 1996)
- Niebuhr (2008): global pitch-accent context changed the listener's interpretation which the part of the rising-falling target contour represents the primary accentual movement \Rightarrow This then determined the accented-syllable position and hence the local prominence pattern, in which the accented syllable is standing out.
 - \Downarrow
- Here, the contour alignment and the related probability of occurrence of intonation patterns was supposed to influence the subject's interpretation of the primary accentual movements and hence the of the local prominence pattern.



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Introduction

- Aim of the present study: further investigation of prominence-construction aspects
 - (3): Relationship between perceived prominence word class
 - Jensen (2006): sentence-medial words are perceived as less prominent than initial and final ones. Moreover, adjectives yield higher perceptual prominence than nouns and verbs. However, there is hardly any difference between the latter two word classes.
⇓
 - Are prominence differences between nouns and verbs masked by effects of the syntactic order (e.g., SVO) ?



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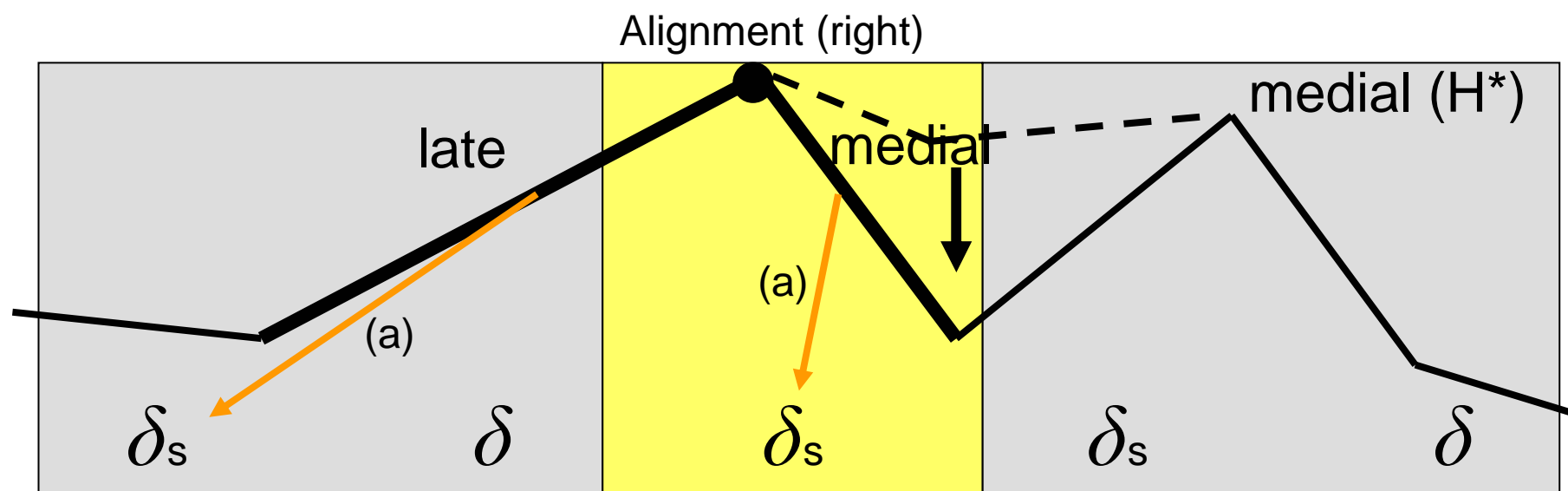
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Method

- Five-syllable utterance with double-peak intonation pattern
- Indentation successively lowered in 7 steps of 1st
- 3 words (hence 3 lexically stressed syllables)



TWO possible interpretations ?!

- (a) **two** accents, **late** and **medial**, in a hat pattern (= L*+H H*)
- (b) **single** rising-falling late-peak accent contour (= L*+H)



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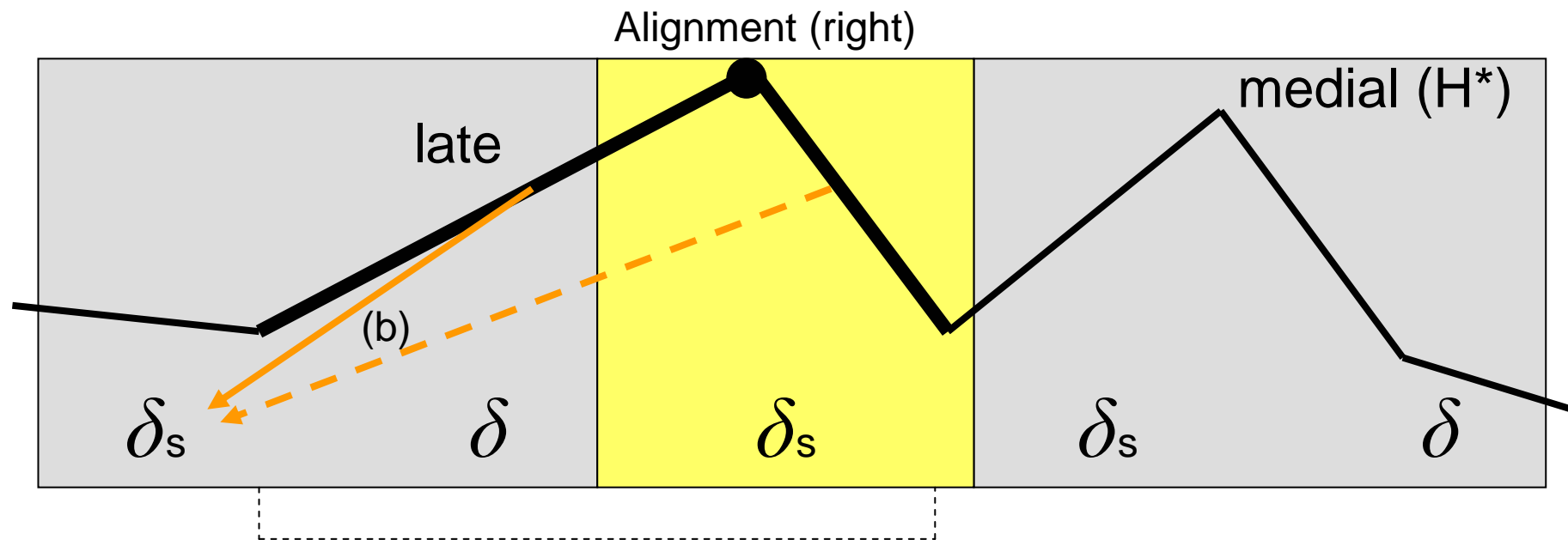
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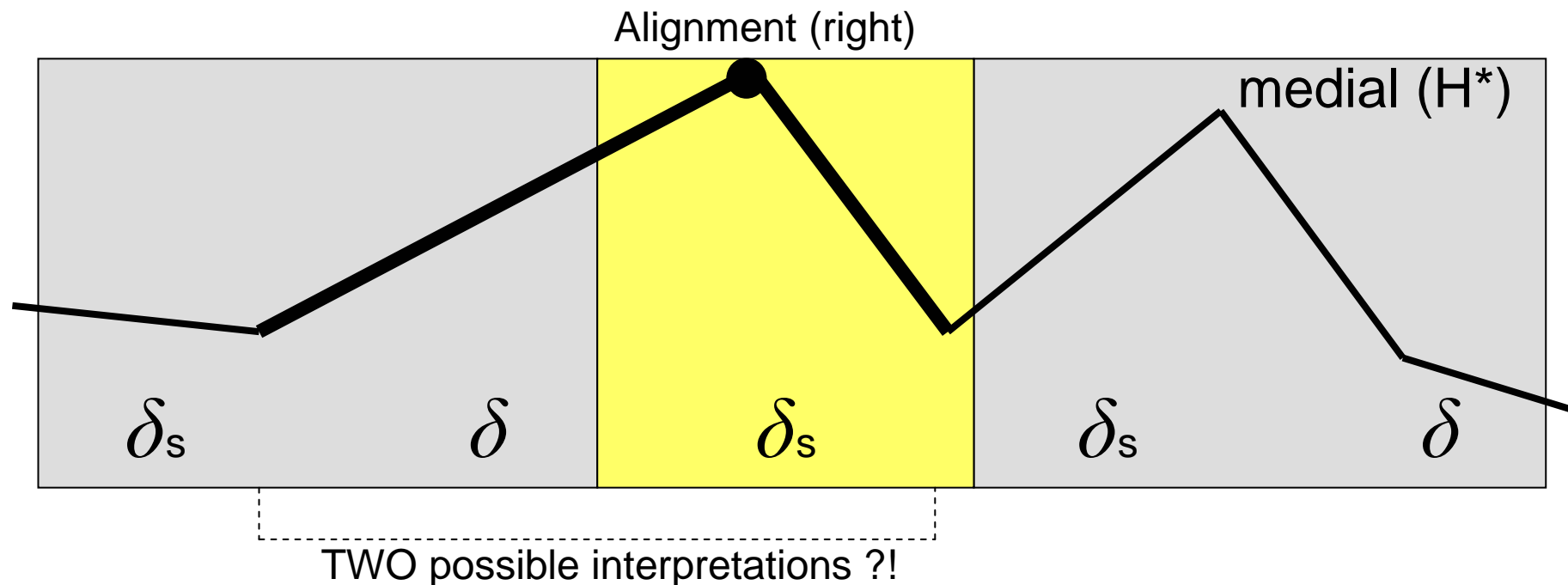
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Method

Decisive: different frequencies of occurrence for the two interpretations, based on the Kiel Corpus of Spontaneous Speech (n= ca. 2.100; Kohler et al. 2006)

- (a) **late-medial** (= L*+H H*) is very uncommon hat pattern= **5%**, just **3,4%** overall
- (b) **single** rising-falling late peak (= L*+H) is much more likely, **9,9%** overall



- (a) **two** accents, **late** and **medial**, in a hat pattern (= L*+H H*)
- (b) **single** rising-falling late-peak accent contour (= L*+H)



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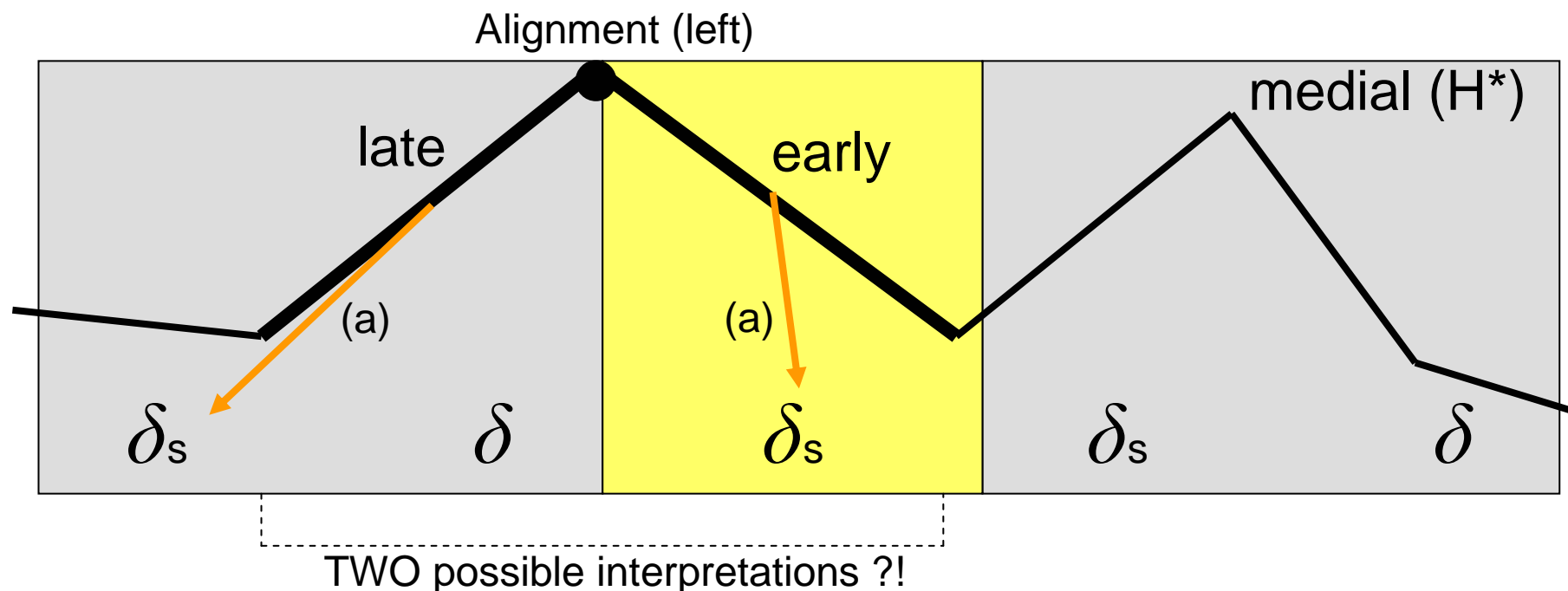
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Method

Decisive: different frequencies of occurrence for the interpretations, based on the Kiel Corpus of Spontaneous Speech (n= ca. 2.100; Kohler et al. 2006)

- (a) **late-early** (= L*+H H+L*) is a very frequent hat pattern = **31%**, or **19,5%** overall
- (b) **single** late-peak interpretation is less likely



- (a) **two** accents, **late** and **early**, in a hat pattern (= L*+H H*)
- (b) **single** rising-falling late-peak accent contour (= L*+H)



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Method

Assumptions for intonation-pattern variable:

- ⇒ The „*alignment (right)*“ condition leads to the interpretation of the (initial) rising-falling contour as a **single late-peak accent**
- ⇒ The „*alignment (left)*“ condition leads to the interpretation of the (initial) rising-falling contour as a **two-accent late-early hat pattern**
- ⇒ Only in the latter interpretation, the fall is a separate pitch-accent movement ⇒ the medial, monosyllabic word is accented ⇒ it is perceived as **more prominent** than in the single late-peak interpretation (although there are less F0 movements!).
- ⇒ Moreover, **lowering the indentation** (i.e. extending the fall) will only **raise the prominence** of the medial, monosyllabic word, if the fall is interpreted as a separate pitch-accent movement of that word. Otherwise, the prominence of the medial, monosyllabic word remains unaffected or decreases (due to an increasing prominence in the two surrounding words)



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Method

- The two intonation patterns combined with two utterances
- (1) **“Mosel, Saar, Ruwer”**
 - Frequent enumeration of three German rivers (e.g., found on wine bottles)
 - = Noun, **Noun**, Noun
- (2) **“Ursel sah Robert”**
 - Phonetically similar segmental string (“Saar” and “sah” are identical !)
 - Produced with comparable speaking rate, loudness, and voice quality
 - = Noun, **Verb**, Noun
- The words, particularly “Saar” and “sah”, may be regarded as similarly (in-)frequent.
- Located in the same position in the utterance
- Word-class effects can be investigated without frequency or syntax as confounding variables



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Method

Assumption for word-class variable:

- ⇒ The marginal effects of Jensen show up more clearly. That is, the verb “sah“ appears less prominent than the noun „Saar“ under comparable conditions



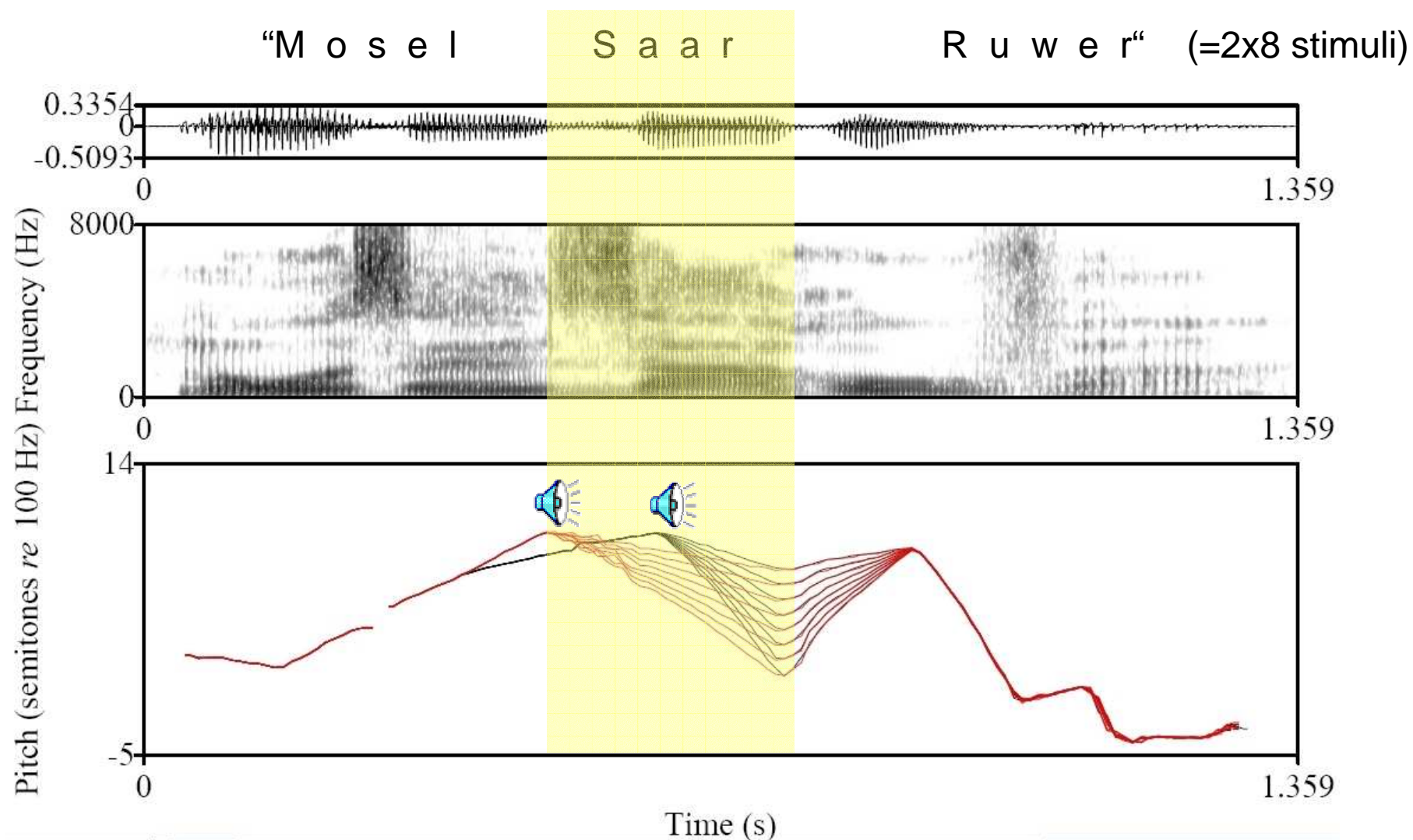
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Method





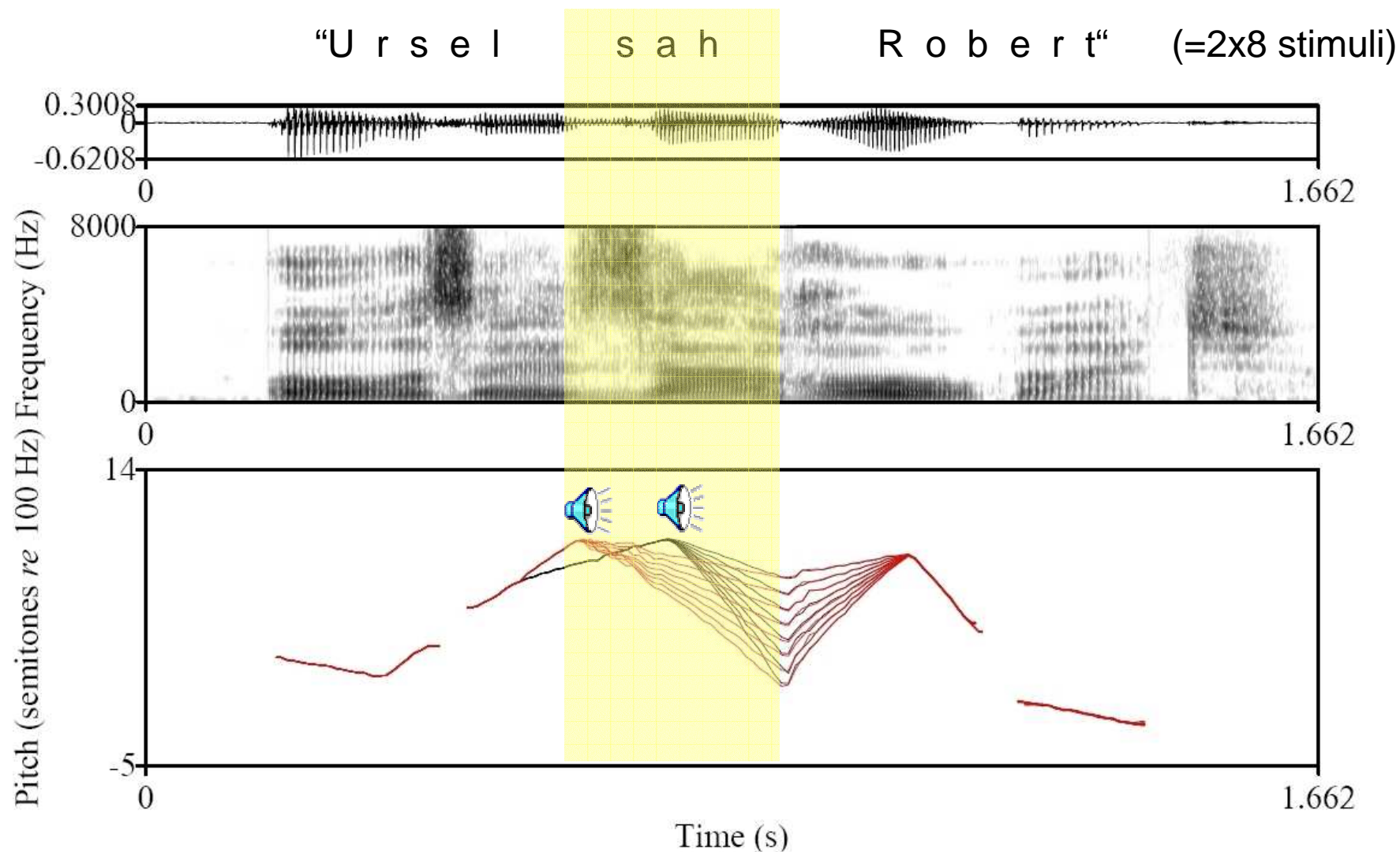
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Method





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Method

- The 2x8 stimuli of each utterance with 5 repetitions in randomized order (= 90 stimuli for each utterance)
- Separate perception tests for the stimuli of the two utterances, but in the same session with the same subjects
- 12 native speakers of German as subjects
 - Prior to the actual experimental sessions: they judged, which of the two stimuli of each utterance with the lowest indentation sounded more ‘surprised’ (‘surprise’ = attitudinal meaning of the German late peak)
 - In the experimental session, they judged for each stimulus the prominence of “Saar” or “sah” in relation to the two surrounding two words on a 7-point scale.

-3 ... +3, with 0 = equally prominent

	+3	
	+2	
	+1	
	-1	
	-2	
	-3	
mosel / ursel	saar / sah	ruwer / robert

gleich
0 X
gleich



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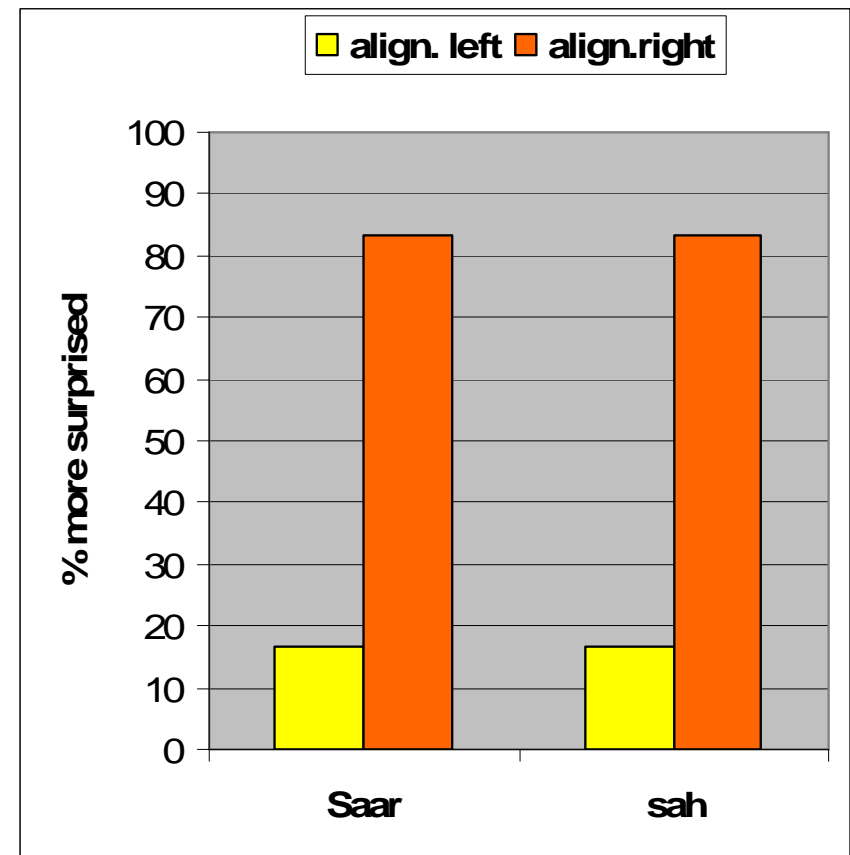
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Results

- Which intonation pattern does sound more surprised in each of the two utterances (“Mosel, Saar, ...” vs. “Ursel sah...”)

- utterances with the “alignment right” condition are clearly judged by the subjects to sound more surprised
- suggests in line with the initial expectation that the subjects interpreted the rising-falling contour in the “alignment right” condition as a single late-peak accent, whereas the “alignment left condition” is perceived as a two-accent hat pattern, i.e. late-early





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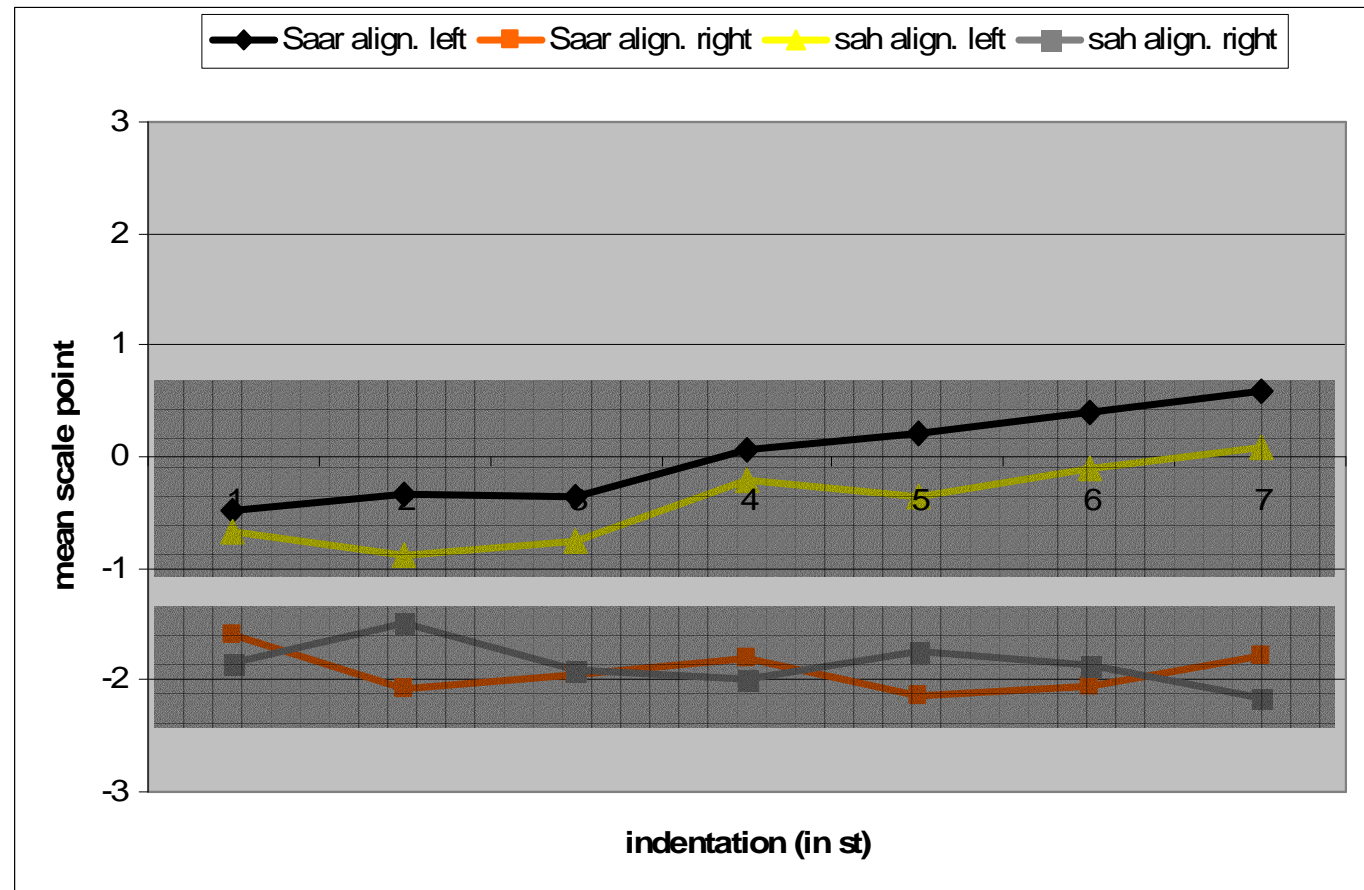


Results

- ANOVA yielded...
- Significant main effect : “alignment” ($p < 0.001^{***}$)



Higher relative prominence of “Saar”/ “sah” for “left” alignment





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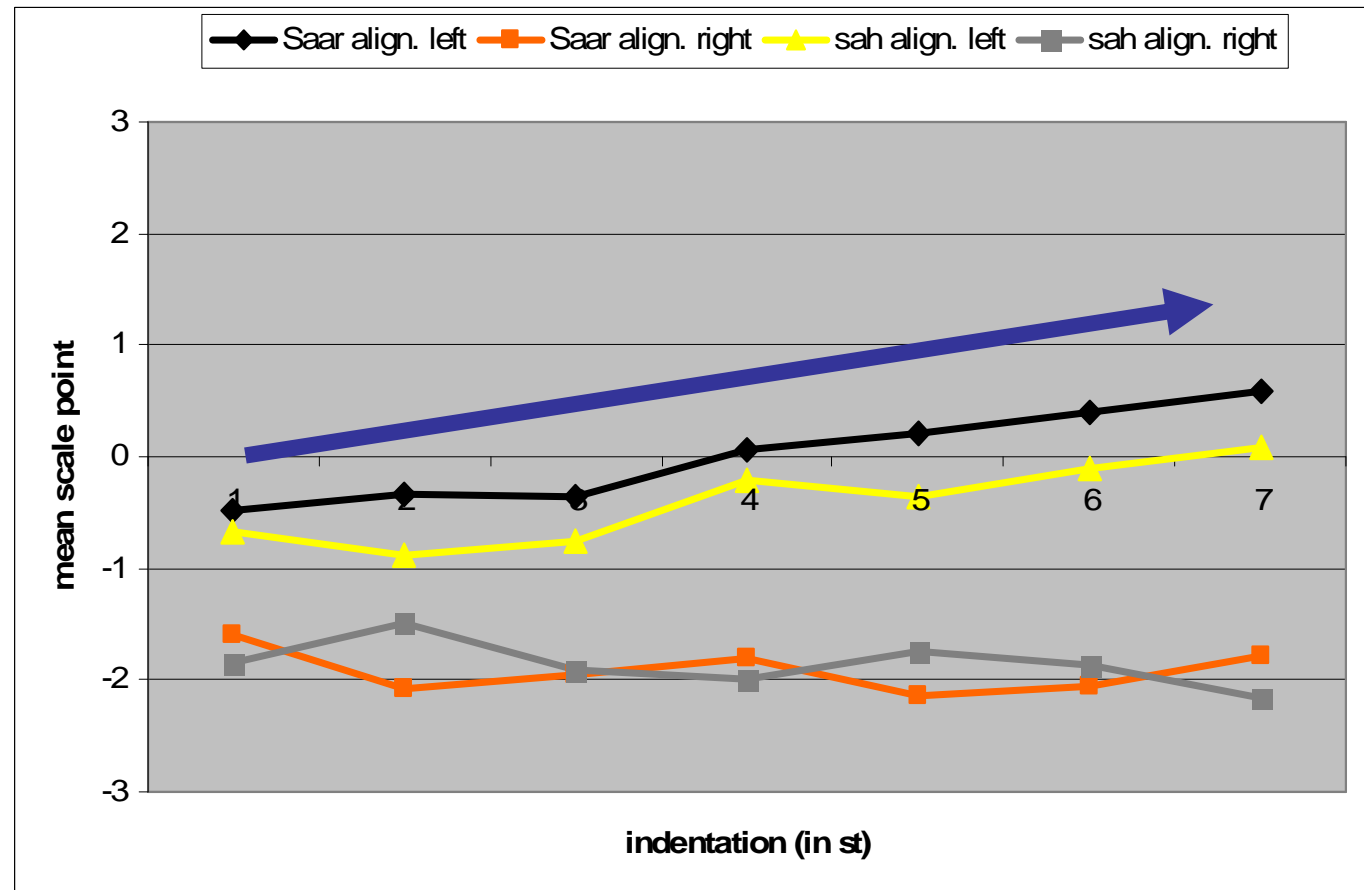


Results

- ANOVA yielded...
- Significant main effect : “degree of indentation” ($p < 0.001^{***}$)



Successively
higher relative
prominence for
more pronounced
indentations (1-7st)





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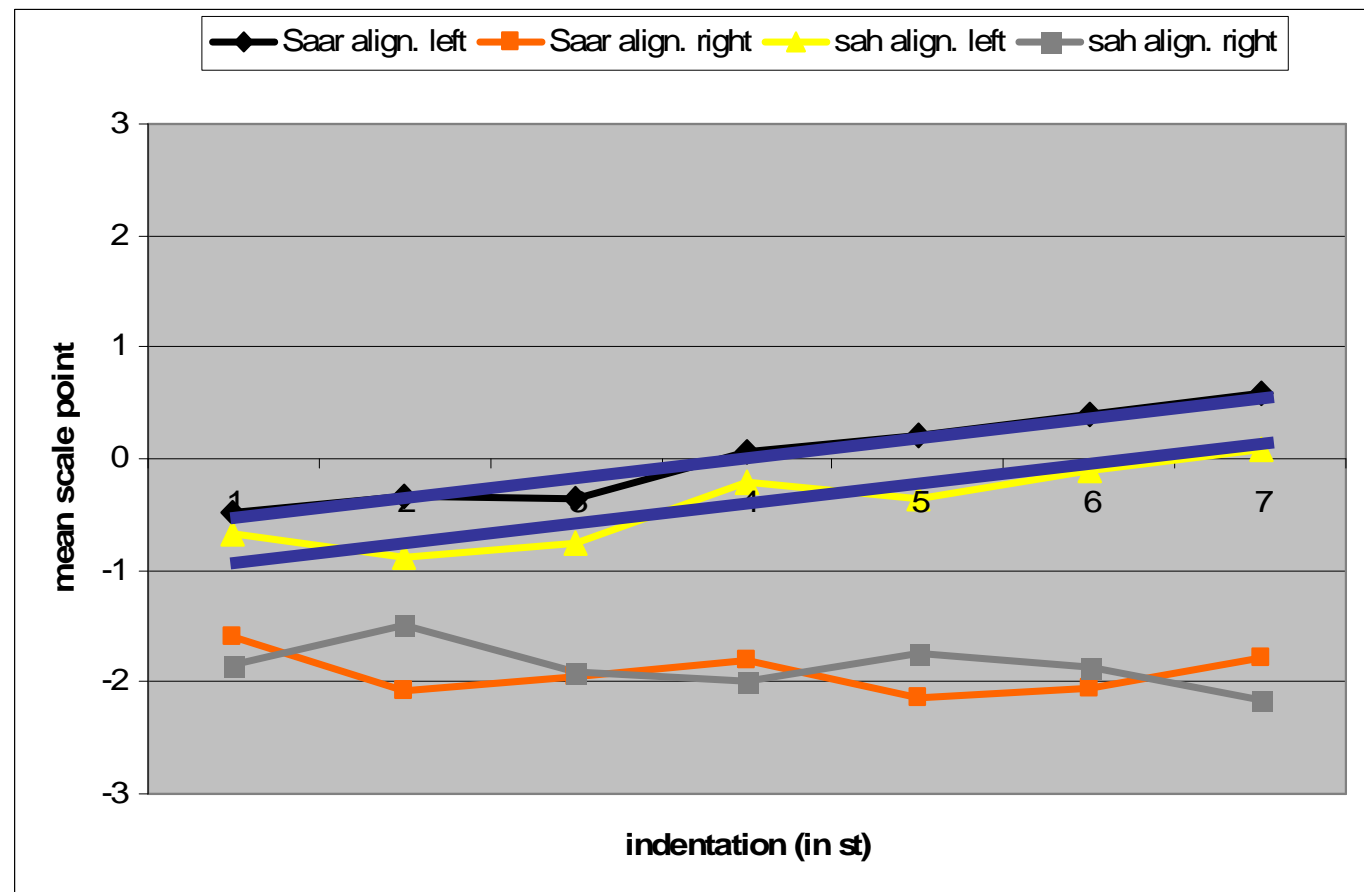


Results

- ANOVA yielded...
- Significant main effect : “word class” ($p < 0.05^*$)



Slightly higher
prominence
judgements for
noun “Saar” than
for verb “sah”





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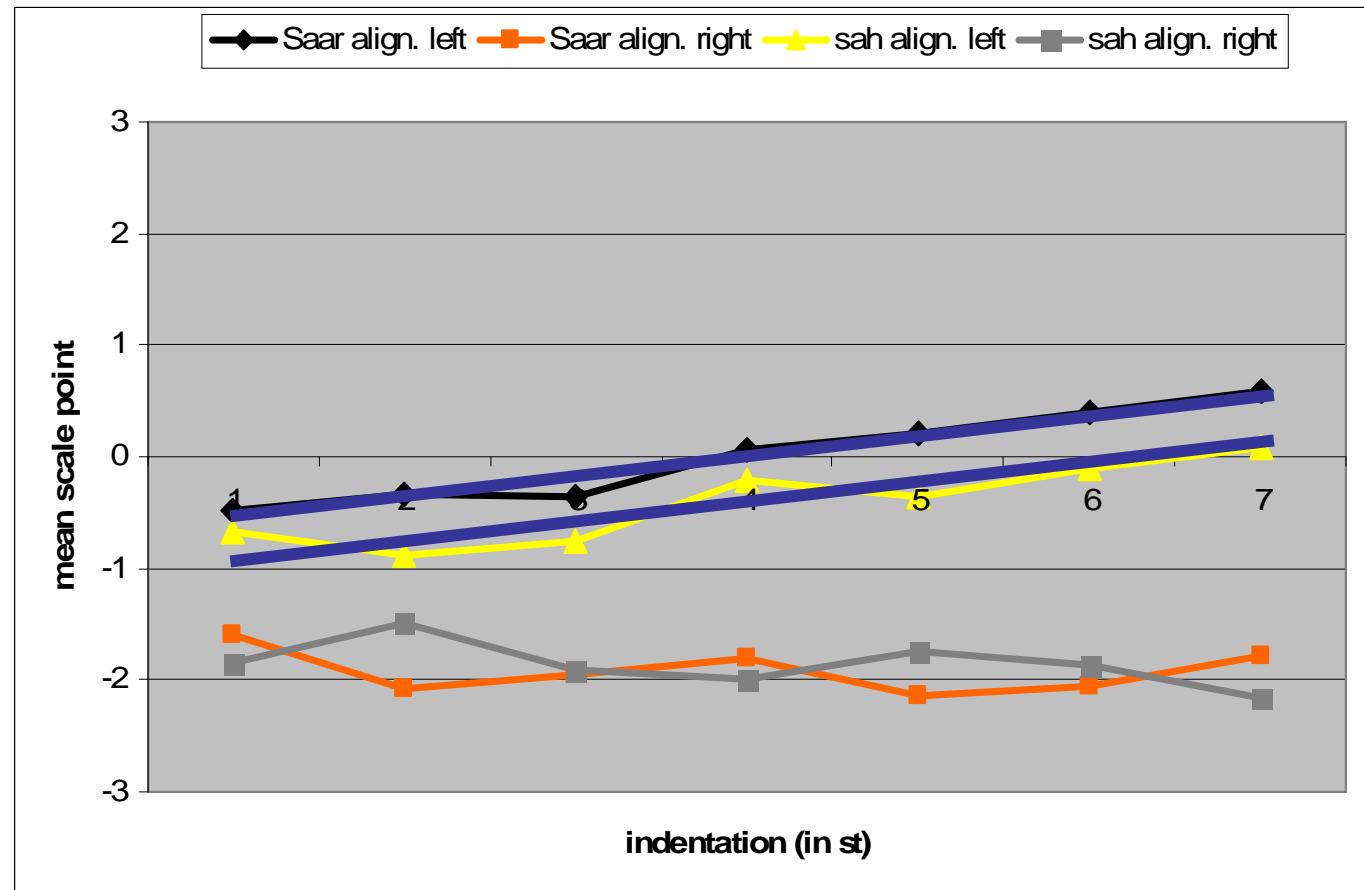


Results

- ANOVA yielded...
- Significant interaction : “alignment” * “word class” ($p < 0.01^{**}$)



Effect of word class just shows up for the “left” alignment cond.





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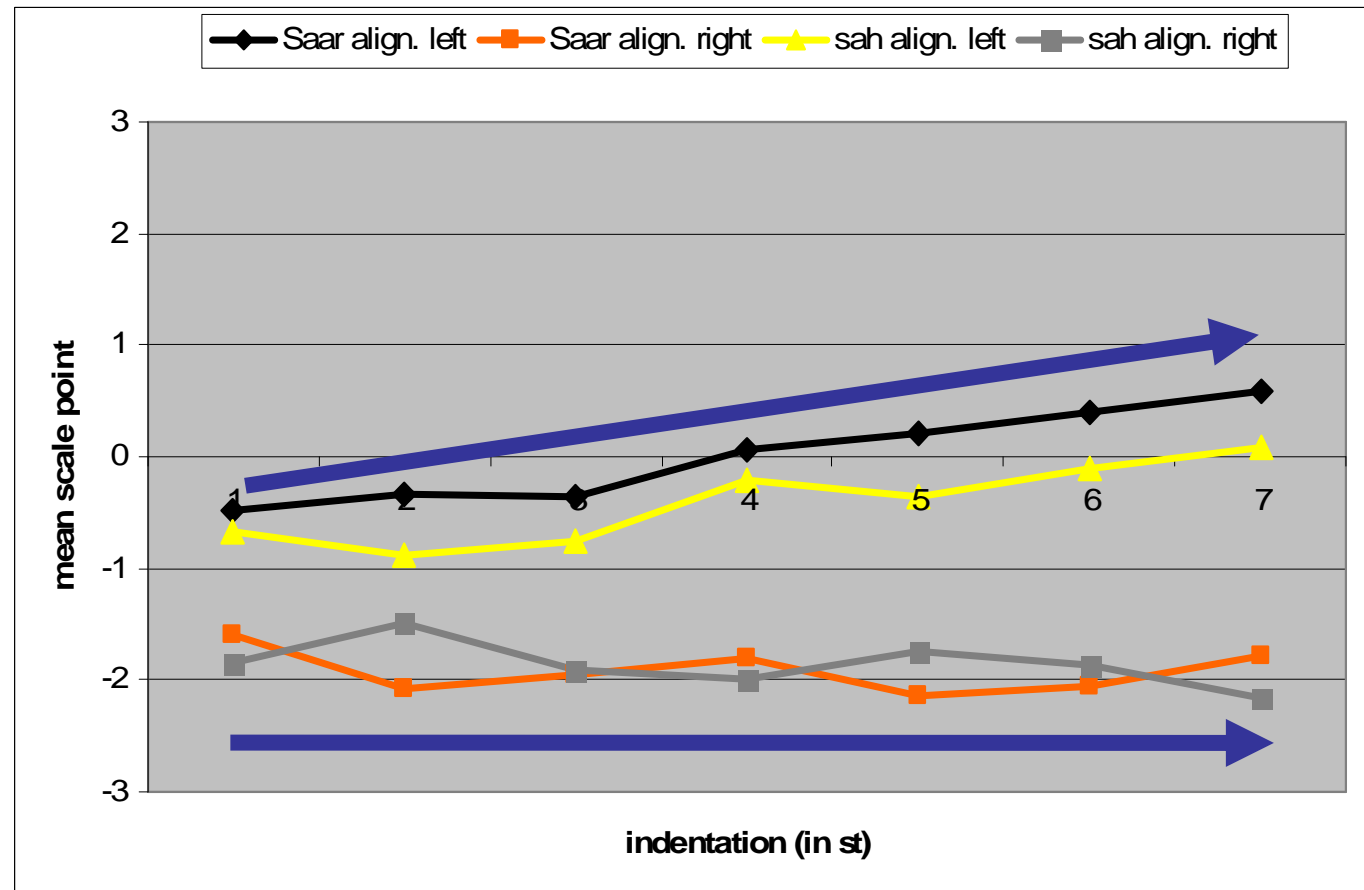


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- ANOVA yielded...
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Conclusions

- Probability of occurrence of intonation patterns can influence the subject's interpretation of F0 movements / contours (at least, if the alignment allows for multiple interpretations)
- F0 movements just raise AND change the prominence level of a coinciding syllable / word, if they are interpreted as accentual movements, i.e. as movements of intonation categories associated with that syllable / word (in line with "prominence-cueing" perspective)
- In line with Jensen (2006), word class may in fact have a (small) effect on prominence perception. \Rightarrow Nouns > Verbs
However, just in the case of accentual movements
- Lowering the indentation increased the prominence
 \Rightarrow suggests that range of F0 movement (i.e. F0 change) is related to prominence (rather than absolute F0 height?!, cf. Terken 1991)



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Conclusions

Prominence is a cognitive construction that is only partially signal-based

Thank you for your attention