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The role of pitch accents on the identification of metrical prominence

Word stress is an important yet abstract linguistic concept. In stress-timed languages metrical prominence plays a crucial role in speech perception: infants use linguistic rhythm resulting from interstress intervals to identify their native language and acquire parts of their phonology [1] and listeners rely on stress for word segmentation [2], possibly because of the prominence of stressed syllables. They are longer [3,4], louder [5], have more peripheral vowel quality [6,7] and are produced with greater vocal effort [8,9]. Since pitch accents are associated with stressed syllables, prominence-lending pitch movements are an additional cue in accented words. In the current study we investigate whether pitch accent type and hence different associations of tones with stressed syllables affect stress perception in German.

We investigate the effect of three different pitch accents (H+L*L-%, L+H*L-%, L*H-^H%) on the identification of word stress. We selected 108 trisyllabic German nouns, 36 experimental words with penultimate stress, 36 distractors with antepenultimate and 36 with final stress. The words were recorded by a trained female speaker of Standard German with a non-emphatic, high-falling accent on the stressed syllable. To obtain different pitch accent conditions we resynthesized the stimuli using PSOLA-resynthesis in Praat [10]. The F0 peak was a) positioned in the syllable preceding the stressed one and the stressed syllable was low-toned ("early-peak" condition: H+L*), b) positioned on the stressed syllable, followed and preceded by low tones ("medial-peak" condition: L+H*), c) positioned on the last syllable and the stressed syllable was low-toned ("late-peak" condition: L*H-^H%) see Figure 1.

Participants indicated the position of the stressed syllable by pressing one of three buttons of a button-box. Responses and reaction times were recorded (from the offset of the words), without feedback or timeout. Stimuli were presented acoustically via headphones (intertrial-interval: 500ms) and participants were instructed to answer as fast as possible. We tested 36 monolingual native German speakers (Ø = 22.8 years, 12male). Results showed a significant effect of pitch accent condition on error rates (all p-values < 0.01), see Figure 2. Square-root transformed reaction times between 0 and 2000ms also differed as a function of intonation condition (all p-values < 0.05), see Figure 3. There were more errors and longer reaction times in conditions in which the pitch-peak was not associated with the stressed syllable ("early-" and "late-peak" conditions) compared to the condition in which the pitch peak was realized on the stressed syllable ("medial-peak" condition).

Our findings show that listeners have difficulties in the meta-linguistic identification of metrical prominence when the stressed syllable is low toned and preceded or followed by high pitch (either by high leading tones: H+L* or by high boundary tones L* H-^H%). These data suggest that the position of the pitch peak is so important to listeners that they are misled in their judgments. Our findings are in line with evidence from an eye-tracking experiment by [11] showing that online speech perception is also influenced by pitch accent types.

Figure 1: Example of smoothed F0-contours in the three intonation conditions after manipulation (F0-range shown from 120 to 300 Hz).

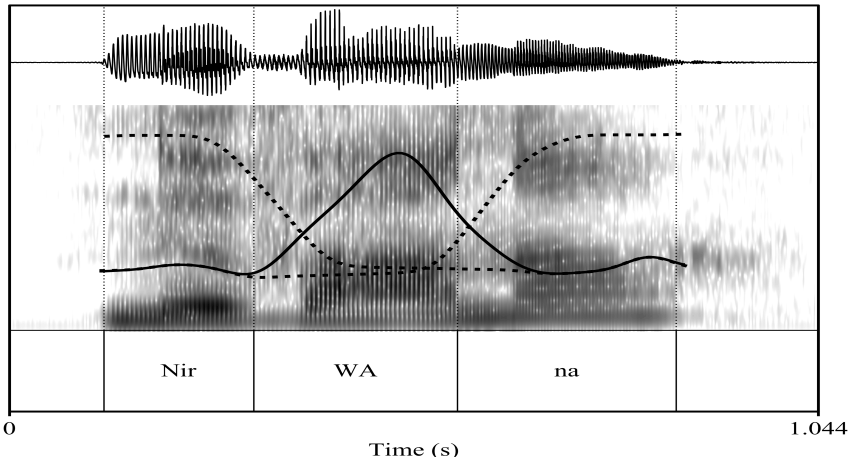


Figure 2: Reaction times for correct responses. Whiskers show +/- 1 standard error.

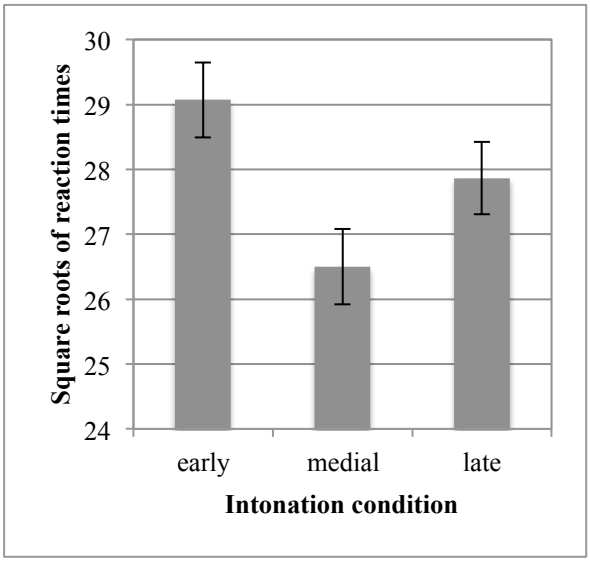
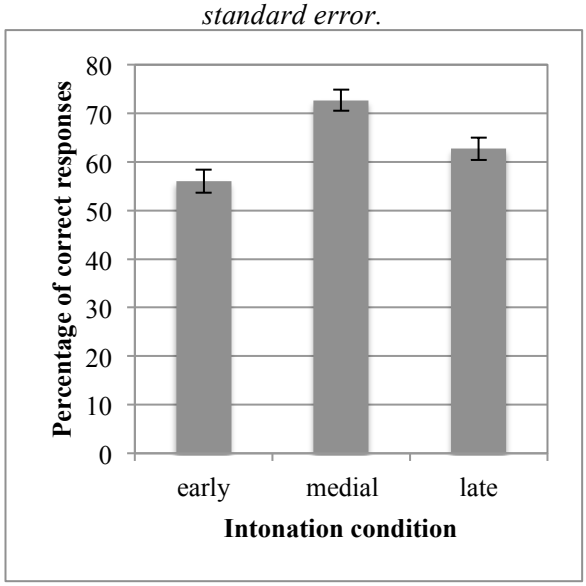


Figure 3: Percentage of correct responses in each intonation condition. Whiskers show +/- 1 standard error.



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