



Perceptual Prominence of Accent Types and the Role of Expectations

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Abstract

This paper is concerned with how accent types can contribute to the perceived prominence of the accented words, both when they are presented in a sentence devoid of context and when a context is used to build expectations of more or less prosodic prominence. In a prominence rating experiment in German, target words were presented with four different levels of prosodic prominence (L+H*, H*, H+L*, deaccented) in isolated sentences. In a second prominence rating experiment, words with two of these levels of prominence (L+H* and H+L*) were presented with a prior context evoking the expectation that the upcoming information was either exciting or neutral. In a third experiment, this reduced set of stimuli was also assessed for appropriateness, i.e. as to whether the target stimulus matched expectations evoked by the context provided. Results indicate that, both with and without prior context, pronounced accentual rises (L+H*) involve a particularly high level of perceptual prominence. Contextually induced expectations had no effect on the perception of prominence. However, the extra prominence for L+H* was only appropriate in the exciting context. Falling accents (H+L*) were lower in prominence, and were appropriate in both contexts, indicating that they did not need to be contextually licensed.

Index Terms: prominence, prosody, accent types, speech perception, appropriateness, expectations, German

1. Introduction

There is ample evidence for West-Germanic languages that information status and focus domains of different sizes and types are marked by the level of prominence expressed by different pitch accent types. That is, new or less accessible information and words in narrow and contrastive focus have been found to involve greater prosodic prominence (see e.g. for information status: [1, 2, 3, 4]; for focus: [5, 6, 7]). Accordingly, listeners have been found to be able to interpret an element's level of prominence as indicative of the information structure that the speaker is intending to convey (e.g. [7, 8, 9]).

For German, a direct relation has been attested between the impression of an element standing out (i.e. perceptual prominence) and different accent types, which can be attributed to three tonal dimensions in the acoustic signal [10] (see also [11]). Most important for German listeners is the direction of pitch movement in the vicinity of the accented syllable, with rises being more prominent than falls (see also [12]). The extent of the pitch excursion/on glide (steep - shallow) and the height of the f₀ target corresponding to the starred tone (high - mid - low) are also relevant, but are perceptually less decisive.

However, there is also evidence that the perception of prominence is not only determined by the auditory input but

may also be affected by intrinsic properties of words, language-specific expectations, and interpretations of pragmatic and phonological context (e.g. [12, 13]). For instance, [13] showed that expectations about the focus structure may even overwrite the prominence information provided by the acoustic signal.

The current paper investigates German accent types with the aim of providing further evidence for their perceptual prominence (on more naturally produced data) and to further investigate the effect of contextually induced expectations that are not related to information structural aspects. Two perception experiments assessed untrained listeners' intuitions about the degree of prominence of words in isolated and in contextualized sentences (prominence rating task), so as to investigate both the prosodic and contextual influences on prominence perception. In a third study, we additionally evaluated the appropriateness of the sentences with respect to the context (appropriateness rating task). Three pitch accent types (L+H*, H*, H+L*) plus deaccentuation were tested in the absence of context, while two pitch accent types (L+H* and H+L*) were tested in relation to prior contexts that trigger the expectation that the following test sentence either contains information about an exciting and unusual event (EXCITING) or information about an ordinary, predictable event (NEUTRAL). Two previous EEG studies on the same stimuli [14] revealed that a high level of prosodic prominence (L+H*) – regardless of context – consumes attentional resources and engenders processing costs. Further, inappropriate accents engendered prediction error responses. A production study on the contextualized sentences [15] confirmed that exciting information was made more prominent by a predominant use of rising accents (L+H*, H*) with large tonal onglides, compared to neutral information which was made less prominent by using fewer and smaller rising onglides as well as more and larger falling onglides (H+L*, H+L*). Based on these previous findings, we formulated the following hypotheses for the current perception experiments.

Hypothesis 1a (prominence - isolated sentences):

If no context is provided and only the acoustic signal plays a role, we expect (according to [10]) an increase in perceptual prominence of the target items from deaccentuation (Ø) through falling (H+L*) and shallow rising (H*) to steep rising (L+H*) nuclear pitch accents.

Hypothesis 1b (prominence - contextualized sentences):

If a context is present, we expect that a context expressing excitement leads to an increase in perceptual prominence for both rising (L+H*) and falling (H+L*) accents.

Hypothesis 2 (appropriateness - contextualized sentences):

Test sentences with a prominent accent (L+H*), typically found on new information, should match the EXCITING but not the NEUTRAL context. Conversely, test sentences with a less prominent accent (H+L*), typically found on contextually derivable information, should match the NEUTRAL context and be permissible after the EXCITING context.

- (2) (a) *Rate mal, was uns heute passiert ist!* **EXCITING**
*Wir haben **MiLE**na getroffen.* **L+H*/H+L***
 “Guess what happened to us today! We met Milena.”
- (b) *Heute ist nichts Besonderes passiert.* **NEUTRAL**
*Wir haben **MiLE**na getroffen.* **L+H*/H+L***
 “Today, nothing special happened. We met Milena.”

Sixty EXCITING and NEUTRAL context sentences were created along the lines of (2a) and (2b) with different lexical material (120 context sentences) and were produced with as neutral prosody as possible. We endeavoured to keep the contexts semantically unspecific and to control them with respect to their effect on the information structure of the following sentences: In all test sentences the target word and the sentence-final participle are part of a broad focus domain and are not derivable from the context. Furthermore, the 80 filler sentences (see above) were also provided with EXCITING and NEUTRAL contexts so that both context types were equally distributed over the four different filler conditions (H* accent on each word of the sentence).

No adjustments were made to the context stimuli. For the experimental session, context and target sentences were merged into one stimulus separated by a pause of 400 ms. Altogether, the second set of stimuli also contains 320 items, involving 240 test/critical items (60 lexically different context sentences x 2 context types crossed with 60 lexically different test sentences x 2 intonation contours) plus 80 filler items (40 lexically different context sentences x 2 context types evenly combined with 20 lexically different filler sentences x 4 accent positions).

2.2. Procedures

The three studies were conducted through web-based questionnaires implemented with the *SoSci Survey* software available at www.sosicisurvey.de [19]. In all studies critical and filler items were evenly distributed and pseudo-randomized across four different lists: In order to prevent repetition effects, test sentences with the same lexical material were assigned to different lists. This means that each experimental list contained 60 lexically different test sentences (15 sentences per experimental condition) and 20 filler sentences (5 sentences per condition). Furthermore, in order to avoid systematic order effects in the exposure to the stimuli, experimental stimuli were presented in different condition sequences across the lists. Each participant saw only one of the four experimental lists. Accordingly, each participant rated 80 stimuli (60 critical and 20 filler items) in the main part of an experiment. At the beginning of a study, participants were familiarized with the experimental procedure by means of a short practice part including six stimuli.

In the two prominence rating studies the participants’ task was to evaluate how highlighted/prominent each word in a target sentence sounded. The participants were told to give their judgments for each word by placing a roll bar on a continuous horizontal line without scaling (visual analogue scale) with the left pole labelled “not at all highlighted” and the right pole labelled “strongly highlighted” (see Fig. 2). The responses were encoded as interval data ranging from 1 (left pole) to 100 (right pole). Hence, higher ratings reflect a higher degree of perceptual prominence. The evaluation was carried out for each stimulus on a separate page. Both the context sentence (if applicable) and the target sentence were presented acoustically and orthographically. Participants were able to control when and how often to play a stimulus.

1. Geben Sie für jedes Wort im zweiten Satz der folgenden Äußerung an, wie stark hervorgehoben es für Sie klingt:

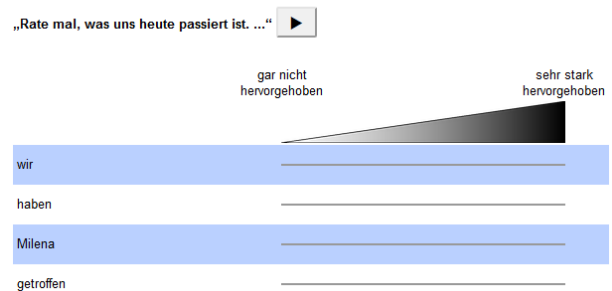


Figure 2: Example from the prominence rating task with contextualized test sentences.

In the appropriateness rating study, the participants’ task was to evaluate how well the melody of a target sentence matched the preceding context. Judgments were given by placing a roll bar on a visual analogue scale with the left pole labelled “does not match at all” (= 1) and the right pole labelled “matches very well” (= 100) (see Fig. 3). Higher ratings reflect a higher degree of appropriateness. The evaluation was carried out for each stimulus on a separate page. While both the context and the target sentence were presented acoustically, only the context sentence was presented orthographically. Participants were able to control when and how often to play a stimulus.

1. Geben Sie an, wie gut in der folgenden Äußerung die Sprachmelodie des zweiten Satzes zum ersten Satz passt:

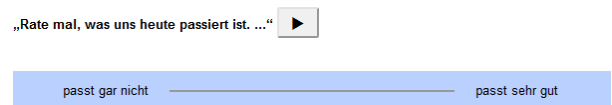


Figure 3: Example from the appropriateness rating task with contextualized test sentences.

2.3. Participants and analysis

The three perception experiments were conducted separately with different groups of native German speakers. None of them reported any auditory or visual impairment.

- Prominence ratings of isolated sentences: 22 participants (7 female, 15 male), aged between 19 and 49 years (mean = 26.2, SD = 8.4)
- Prominence ratings of contextualized sentences: 23 participants (12 female, 11 male), aged between 18 and 40 years (mean = 25.2, SD = 5.7)
- Appropriateness ratings of contextualized sentences: 23 participants (16 female, 7 male), aged between 19 and 43 years (mean = 24.2, SD = 5.7)

To test for statistical significance of the ratings on the visual analogue scales, we calculated linear mixed-effect models using the *lmer()* function from the *lme4* package for *R* [20]. The models for the isolated sentences (prominence ratings) included *PROSODY* (L+H*, H*, H+L*, Ø) and *WORD* (pronoun, auxiliary, noun, participle) as fixed factors as well as by-subject intercepts and slopes for *PROSODY* as random factors. The models for the contextualized sentences (prominence and appropriateness ratings) included *CONTEXT* (EXCITING, NEUTRAL), *PROSODY* (L+H*, H+L*) and *WORD* (if applicable) as fixed factors as well as by-subject intercepts and slopes for *PROSODY* and *CONTEXT* as random factors.

3. Results and discussion

3.1. Prominence ratings

Likelihood ratio tests on the prominence ratings of the isolated sentences revealed a significant effect of *PROSODY* ($\chi^2 = 37.84$, $p < .001$) and *WORD* ($\chi^2 = 3125.1$, $p < .001$) as well as an interaction between both factors ($\chi^2 = 1992.8$, $p < .001$). Figure 4 shows that accented words were generally perceived as more prominent than unaccented words.

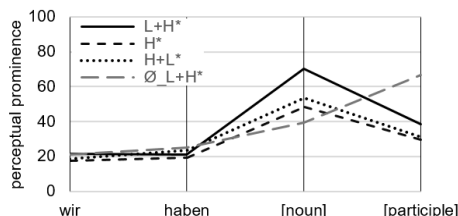


Figure 4: Mean prominence ratings of each word in isolated sentences with different intonation.

As to different accent types, L+H* accents were clearly rated as most prominent, with similar values for L+H* accents on the noun ($M = 70$, $SD = 19$) and on the participle in the \emptyset condition ($M = 67$, $SD = 22$). H* ($M = 48$, $SD = 22$) and H+L* ($M = 53$, $SD = 21$) accents received medial prominence values. Hence, Hypothesis 1a is mostly confirmed. As to the unaccented words, pronouns ($M = 20$, $SD = 17$) and auxiliaries ($M = 22$, $SD = 17$) were rated as least prominent. However, deaccented nouns (\emptyset : $M = 39$, $SD = 20$) as well as unaccented participles (L+H*: $M = 39$, $SD = 20$; H*: $M = 30$, $SD = 17$; H+L*: $M = 31$, $SD = 20$) reveal somewhat higher prominence scores, which might be related to a higher probability for being accented in the given sentence structure. Nevertheless, these relatively high values are surprising since we would rather expect a clearer perceptual contrast between adjacent accented and unaccented words. Instead, it may be that the prominence of one word bleeds into adjacent ones, possibly owing to the fact that cues are rarely confined to the accented word, especially in late peak accents, where they can extend onto following syllables.

As to the contextualized sentences, a likelihood ratio test showed that *CONTEXT* had no effect on the prominence ratings ($\chi^2 = .07$, $p = .79$). However, further model comparisons revealed a significant effect of *PROSODY* ($\chi^2 = 22.68$, $p < .001$) and *WORD* ($\chi^2 = 4954.9$, $p < .001$) as well as an interaction between these two factors ($\chi^2 = 400.03$, $p < .001$) and between *CONTEXT*, *PROSODY* and *WORD* ($\chi^2 = 408.65$, $p < .001$). Figure 5 shows that the prominence ratings of the sentences with an L+H* ($M = 71$, $SD = 19$) and H+L* ($M = 51$, $SD = 24$) nuclear accent on the target word were replicated when presented in context. However, Hypothesis 1b was not confirmed, since contextually induced expectations turned out to have no effect on the perception of prominence.

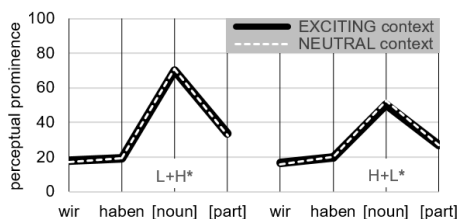


Figure 5: Mean prominence ratings of each word in contextualized sentences with an L+H* or H+L* nuclear accent.

In general, both prominence rating studies suggest that in German a pronounced rising pitch on a stressed syllable (as in L+H* accents) is a decisive tonal cue to prominence that leads to enhanced perceptual prominence (in line with [10, 12, 14]).

3.2. Appropriateness ratings

Likelihood ratio tests on the appropriateness ratings of contextualized sentences revealed no effect of *CONTEXT* ($\chi^2 = 2.39$, $p = .12$), but a significant effect of *PROSODY* ($\chi^2 = 6.72$, $p < .01$) as well as an interaction between *CONTEXT* and *PROSODY* ($\chi^2 = 33.36$, $p < .001$). Figure 6 shows that Hypothesis 2 is confirmed:

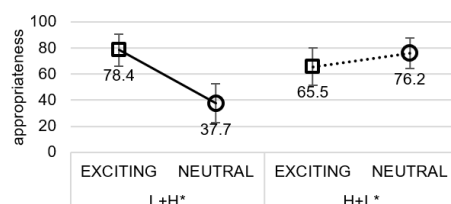


Figure 6: Mean appropriateness ratings and standard deviations of contextualized sentences with an L+H* or H+L* nuclear accent.

Prominent L+H* accents were perceived as appropriate in the EXCITING context but not in the NEUTRAL one. Less prominent H+L* accents obtained the highest appropriateness scores in the NEUTRAL context, but were also perceived as appropriate in the EXCITING context. This suggests that falling (H+L*) accents - similar to H* accents and due to their lower perceptual prominence - may serve as prosodic default realization which is in line with the observation that H+L* accents commonly occur in reading style, especially in isolated sentences (all new, broad focus) or paragraph-finally [21].

4. Summary and conclusions

The present paper assessed the perceptual prominence of different prosodic realizations of stimuli without and in context, and their appropriateness with respect to expectations as to how exciting the content of a following utterance will be.

Results provide further evidence for the relevance of the tonal onglide in prominence perception. Accents with a pronounced rising f_0 (as in L+H*) involve an extra high level of perceptual prominence, whereas accents with a falling f_0 (as in H+L*) were less conspicuous, involving a medium level of prominence. The different levels of perceptual prominence appear to license the use of a particular accent type in different contexts: While L+H* accents were only appropriate as a marker of EXCITING information, H+L* accents were equally appropriate as a marker of NEUTRAL and EXCITING information.

Furthermore, listeners' prominence ratings appear to rely primarily on acoustic cues: Contrary to previous findings for English (e.g. [13]), listeners in our study did not take contextual information into account when rating perceptual prominence.

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