



Regional Variation in pre-boundary lengthening from a horizontal and vertical perspective: Evidence from German dialect- and standard-targeted speech

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Abstract

Pre-boundary lengthening (PBL), the increase in duration of segments preceding a prosodic boundary, has been suggested to be a universal phenomenon that is implemented in language-specific ways. So far, research has focused on differences in the implementation of PBL *across* languages but never *within* languages. Simultaneously, PBL has mainly been investigated experimentally, while the need for analyzing speech corpora, not designed for studying PBL, rather than speech obtained in laboratory settings has been distinctly expressed.

The present study investigates regional variation in PBL in German, viewing the implementation of PBL from a horizontal perspective, i.e. between different German dialects, and from a vertical perspective, i.e. between each dialect and Standard German. Data from a corpus designed to investigate segmental characteristics of German dialects, containing dialect- and standard-targeted speech, were analyzed for PBL. Results reveal differences in PBL from a horizontal and vertical perspective. The dialect data show regional variation in PBL while the standard-targeted data approach PBL-patterns such as observed for Standard German.

Index Terms: pre-boundary lengthening, prosodic phrasing, language variation, dialectology, German

1. Introduction

Pre-boundary lengthening, i.e., the production of segments immediately preceding prosodic boundaries with longer duration than segments earlier in a phrase (henceforth referred to as PBL), has been attested as an important cue to prosodic boundaries for a large variety of languages from different families, such as Indo-European [1, 2, 3], Finno-Ugric [4, 5, 6] or Asian languages [7, 8]. Therefore, research has come to assume that it is a universal phenomenon, e.g. [5, 9]. At the same time, PBL is assumed to be implemented in language-specific ways since effects of the specific phonological and prosodic systems of different languages on the amount of PBL have been observed. For example, PBL was found to be restricted in terms of the absolute and the percent duration increase of short vowels to preserve phonemic length contrasts in the quantity languages of Finnish [5], Estonian [6], Hungarian [4, 10] and Czech [11].

Besides quantity distinctions, language-specific intonation phenomena were found to affect the amount of PBL. For example, [7] observed for Japanese, that a language-specific pitch accent on the initial syllable of disyllabic words restricted the increase of PBL within the final syllable which does not

comply with the pattern of progressive lengthening. According to the progressive lengthening hypothesis [1], the amount of PBL generally increases towards the prosodic boundary. In Japanese, PBL was suppressed in the final syllable to maintain the specific prominence of the initial pitch-accented syllable. If lengthening had not been restricted, the final syllable might have become too salient in relation to the initial syllable. For Standard German, the Final Rime hypothesis has been proposed, stating that the final-syllable rime triggers a drastic increase in PBL, rendering the final syllable considerably longer than preceding syllables. The final rime thus causes an abrupt and sharp increase in the amount of lengthening [2].

So far, language-specific variation as to the amount of PBL have only been investigated for standard languages, while regional effects on the amount of PBL in the varieties of a language, such as local dialects, have been neglected. Motivation to investigate such regional differences, however, comes from research on regional varieties of German, although references to PBL are rare. For example, [12] found that penultimate nuclei are lengthened about the same whereas ultimate nuclei are lengthened much more in the East Swiss variety of Bern than in the South Swiss variety of Brig. Similar to the findings for Japanese, [13] observed that non-pitch-accented final syllables were lengthened more in the West Central German variety of the city of Mannheim, which is characterized by specific pitch accents [14], than in the Low German variety of the city of Hamburg.

Findings of regional variation in the amount of PBL would lend additional support to the assumption that PBL is a phenomenon that is learned by speakers and not merely due to a motor-based deceleration of the physical speech production mechanism, e.g. [5, 9]. This assumption is, on the one hand, based on studies on PBL in infant speech, e.g. [15], which show that speakers learn the specific PBL patterns of their native language and, on the other hand, supported by studies on inter-individual speaker variation in PBL [16]. Less is known, however, about intra-individual variation in PBL. Thus, it remains unclear if speakers vary PBL when switching between different speech styles. As prosodic aspects of dialects strongly persist in standard-targeted speech [14], this would not be expected. An investigation of PBL in regional varieties would also offer the opportunity to observe such differences in PBL between dialect- and standard-targeted speech styles. Therefore, the present study investigates the following two hypotheses for regional varieties of German:

- There are differences in PBL between regions
- There are no differences in PBL between speech styles

2. Methods

Most of the studies that have investigated PBL relied on controlled speech elicited in experimental settings. Yet, the need for confirming these observations by analyzing speech corpora which were not designed for the purpose of studying PBL has been distinctly expressed for several decades (e.g., [17], [4], [5], [9]). Nonetheless, only few corpus studies have since been conducted. Recently, [9] conducted a corpus study on 25 understudied languages, which confirms previous experimental findings on language-specific variation in PBL and aims to contribute to the methodological innovation of investigating PBL in corpus analyses. The present study intends to drive this innovation further and thus deliberately refrained from an experimental study in favor of a corpus analysis.

2.1. Corpus

We analyzed data from the REDE-corpus [18], compiled within the framework of the project www.regionalsprache.de. The REDE-corpus contains, amongst other types of speech material, a set of 40 recorded sentences, which were originally designed to study segmental features of German local dialects [19] and translated by the same speakers once in dialect-targeted and once in standard-targeted speech. This material was chosen as it has the advantage of not being controlled for PBL but still offering a certain degree of comparability.

2.1.1. Recordings

The recordings took place in the speakers' own homes. During the recording session of dialect-targeted speech, an experimenter read each of the 40 sentences out loud to the speakers, who repeated them in their dialect. The speakers never read the sentences and some time elapsed between the reading and the repetition of each sentence to think for the translation. During the recording session of standard-targeted speech, the speakers were played recordings of the translations of the 40 sentences by speakers of a different dialect than their own, which they then had to translate into Standard German.

2.1.2. Subjects and data

The REDE-corpus comprises data of 150 places in Germany. Data from 8 places were selected for the present analysis according to their location in certain dialect areas: Two places from the Alemannic, the Bavarian, the West Central German and the Low German area were selected. Data from 26 speakers (age ~ 40+) were selected who were native speakers of the local dialects under discussion.

2.2. Procedure

The recordings of the 40 sentences were annotated in Praat [20]. Both the dialect- and standard-targeted recordings were manually transcribed. Word and segment boundaries were set and labelled using the automatic segmentation web service WebMAUS [21] and manually corrected according to the annotation guidelines by [22]. In addition, syllable boundaries were manually set and syllables labelled according to their word-internal position, main stress, and their structure. Main stress was encoded by capitalizing the position label and syllable structure was encoded by CV-sequences. Intonation phrase boundaries were identified and labelled by boundary tones according to the GToBI system [23].

During analysis, each word that occurred at such a tone label was labelled as final, all other words as non-final. Segments were grouped into sound classes, comprising obstruents, fricatives, affricates, sonorants and vowels. Sounds < 30 ms and > 4 standard deviations above mean were identified as outliers and thus 8% of the data excluded from further analysis. A test to exclude obstruents from the analysis as they are known to lengthen hardly or unsystematically showed only minimal effects on the results, and therefore all the data were analyzed.

2.3. Analysis

Linear mixed effects regression models were fitted to the data of each syllable using the software R [24] and the lme4 package [25]. The models accounted SEGMENT DURATION as a function of PHRASE POSITION, VARIETY and SPEECH STYLE as fixed effects. Random slopes and intercepts were included for SPEAKER as well as random slopes for SYLLABLE STRUCTURE and SOUND CLASS. Post hoc tests for each syllable position were performed using the emmeans package [26].

3. Results

Figure 1 shows the duration of segments in antepenultimate, penultimate and ultimate syllables in phrase-final and non-phrase-final position in dialect-targeted speech. A comparison of the respective syllables reveals that segment durations in ultimate syllables are significantly lengthened in each variety (Alemannic: $\beta = -0.211$, $t = -11.319$, $p < 0.001$; Bavarian: $\beta = -0.206$, $t = -10.853$, $p < 0.001$; West Central German: $\beta = -0.199$, $t = -9.99$, $p < 0.001$; Low German: $\beta = -0.209$, $t = -10.148$, $p < 0.001$).

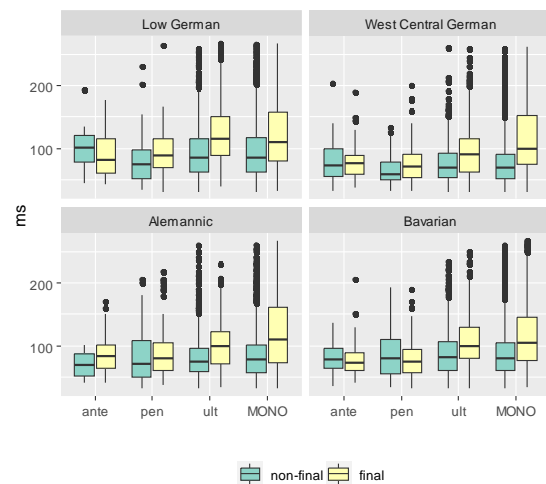


Figure 1: Segment durations in dialect-targeted speech in phrase-final and non-phrase-final position

Segments in antepenultimate and penultimate syllables do not show significant PBL-effects. The neighboring dialect areas of Alemannic and West Central German, though, both show a tendency for segments in penultimate syllables to be lengthened (Alemannic: $\beta = -0.086$, $t = -1.705$, $p = 0.095$; West Central German: $\beta = -0.119$, $t = -2.014$, $p = 0.05$). In this way, the varieties comply with Standard German in supporting the progressive lengthening and indirectly also the Final Rime hypothesis, as segments in ultimate syllables are lengthened drastically more than preceding syllables, which may be due to

the segments within the final rime. The annotation procedure used in the present study would have allowed such a subsequent analysis, as single segments were numbered according to their word-internal position from the prosodic boundary using an automated procedure and syllable structures labelled, but it would have been beyond the scope of this paper. Likewise, monosyllables are significantly lengthened in each of the varieties (Alemannic: $\beta = -0.285$, $z = -14.886$, $p < 0.001$; Bavarian: $\beta = -0.241$, $t = -16.868$, $p < 0.001$; West Central German: $\beta = -0.354$, $t = -17.478$, $p < 0.001$; Low German: $\beta = -0.216$, $t = -15.714$, $p < 0.001$).

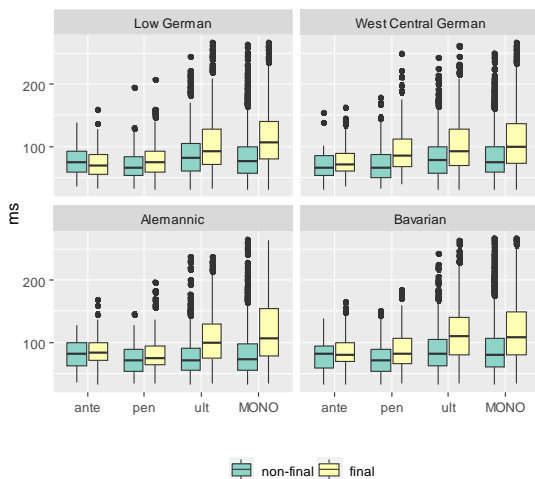


Figure 2: Segment durations in standard-targeted speech in phrase-final and non-phrase-final position

The standard-targeted data in Figure 2 show a similar picture, with some interesting differences, however. As with the dialect-targeted data, segments in ultimate syllables were significantly lengthened in each variety (Alemannic: $\beta = -0.275$, $t = -15.667$, $p < .001$; Bavarian: $\beta = -0.233$, $t = -14.589$, $p < 0.001$; West Central German: $\beta = -0.168$, $t = -8.836$, $p < 0.001$; Low German: $\beta = -0.177$, $t = -8.867$, $p < 0.001$) and so were monosyllables (Alemannic: $\beta = -0.304$, $z = -18.396$, $p < 0.001$; Bavarian: $\beta = -0.252$, $z = -17.929$, $p < 0.001$; West Central German: $\beta = -0.249$, $z = -14.010$, $p < 0.001$; Low German: $\beta = -0.259$, $z = -16.326$, $p < 0.001$).

In contrast to the dialect-targeted data, however, segments in penultimate syllables also show a significant PBL-effect in Bavarian and West Central German (Bavarian: $\beta = -0.166$, $t = -3.775$, $p = 0.0003$; West Central German: $\beta = -0.211$, $t = -3.070$, $p = 0.0032$). In Alemannic and Low German, they show a tendency to be lengthened in penultimate syllables (Alemannic: $\beta = -0.084$, $t = -1.707$, $p = 0.092$; Low German: $\beta = -0.137$, $t = -2.110$, $p = 0.038$) and in Low German also in antepenultimate syllables. (Alemannic: $\beta = 0.009$, $t = 0.020$, $p = 0.9840$; Bavarian: $\beta = -0.02$, $t = -0.407$, $p = 0.686$; West Central German: $\beta = -0.02$, $t = -0.407$, $p = 0.686$; Low German: $\beta = 0.103$, $t = 1.786$, $p = 0.083$).

The tendencies of segments in antepenultimate syllables to be lengthened and the significant lengthening of segments in penultimate syllables in standard-targeted speech suggest that, as the speech style targets Standard German, PBL, in the varieties, approaches the patterns observed for Standard German, for which PBL has been found as far as to the antepenultimate syllable. Different varieties, however, seem to

approach the patterns of Standard German differently, which as such constitutes one form of regional variation. Horizontal and vertical regional differences in PBL become clearer, however, when looking at the amount of PBL in final position across the varieties in dialect- and standard-targeted speech.

3.1. Regional variation

Figures 3 and 4 each compare only the phrase-final segment durations for each of the syllables across regions in dialect-targeted and in standard-targeted speech.

3.1.1. Horizontal perspective

In dialect-targeted speech, significant regional effects on phrase-final segment durations in ultimate syllables can be observed (Alemannic – Low German: $\beta = -0.176$, $t = -6.583$, $p < 0.001$; Bavarian – Low German: $\beta = -0.104$, $t = -4.225$, $p < 0.001$; Bavarian – West Central German: $\beta = 0.112$, $t = 4.658$, $p < 0.001$; Low German – West Central German: $\beta = 0.216$, $t = 8.980$, $p < 0.001$). Apart from a significant difference between Bavarian and West Central German, the differences all suggest a general contrast between Low German and High German, which comprises the Alemannic, the Bavarian and the West Central German area. A weaker contrast remains in the penultimate syllable (Low German – West Central German: $\beta = 0.167$, $t = 3.332$, $p = 0.006$) and is also visible by tendency in monosyllables (Low German – West Central German: $\beta = 0.065$, $t = 2.895$, $p = 0.020$; Bavarian – Low German: $\beta = -0.056$, $t = -2.980$, $p = 0.015$). Since antepenultimate syllables did not show a significant PBL-effect, they were excluded from further analysis.

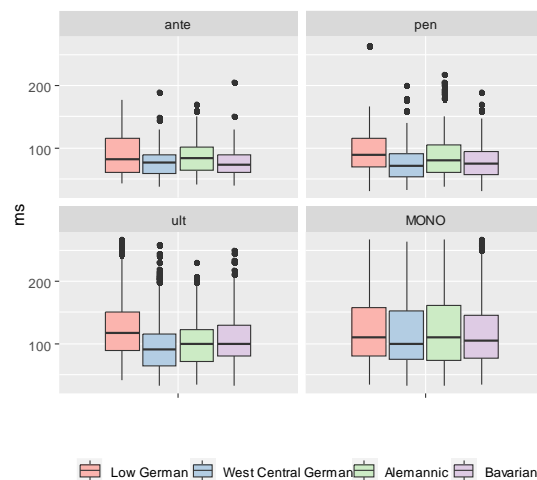


Figure 3: Segment durations in phrase-final position across varieties in dialect-targeted speech.

In standard-targeted speech, the general contrast between Low and High German in ultimate syllables disappears except for Bavarian. Instead, differences between the varieties within the High German area arise (Bavarian – Low German: $\beta = 0.109$, $t = 7.841$, $p < 0.001$; Alemannic – Bavarian: $\beta = -0.106$, $t = -7.618$, $p < 0.001$; Bavarian – West Central German: $\beta = 0.107$, $t = 7.527$, $p < 0.001$). The same holds for monosyllables (Alemannic – Bavarian: $\beta = -0.097$, $t = -7.832$, $p < 0.001$; Bavarian – Low German: $\beta = 0.079$, $t = 6.681$, $p < 0.001$; Bavarian – West Central German: $\beta = 0.072$, $t = 5.740$, $p < 0.001$). In penultimate syllables, segment durations only tend

to differ between Bavarian and Low German ($\beta = 0.067$, $t = 2.440$, $p = 0.071$).

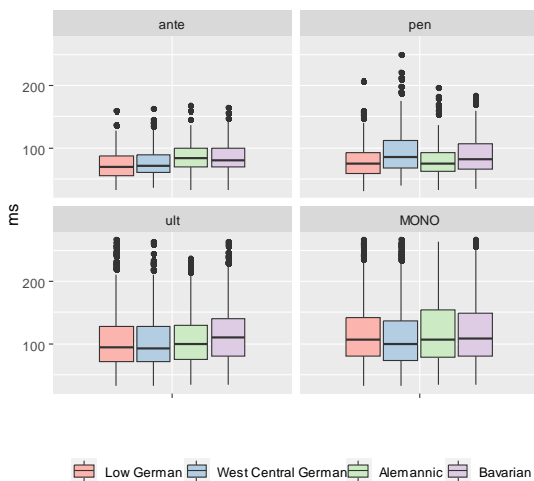


Figure 4: Segment durations in phrase-final position across regions in standard-targeted speech.

3.1.2. Vertical perspective

Effects of speech style were observed for ultimate syllables in each of the varieties (Alemannic: $\beta = -0.142$, $t = -4.866$, $p < 0.001$; Bavarian: $\beta = -0.122$, $t = -5.706$, $p < 0.001$; West Central German: $\beta = -0.095$, $t = -3.924$, $p = 0.001$; Low German: $\beta = 0.129$, $t = 5.412$, $p < 0.001$) and also for monosyllables in Bavarian ($\beta = -0.105$, $t = -5.387$, $p < 0.001$) and Low German ($\beta = 0.061$, $t = 3.035$, $p = 0.003$). In penultimate syllables, the analysis still yields significant effects of speech style for Bavarian ($\beta = -0.109$, $t = -2.866$, $p = 0.006$) and West Central German: $\beta = -0.173$, $t = -4.016$, $p = 0.001$). Low German shows a tendency for an effect of speech style in the penultimate syllable ($\beta = 0.125$, $t = 2.401$, $p = 0.020$).

4. Discussion

The present corpus analysis set out to investigate regional variation in PBL from a horizontal perspective, i.e., between different local dialects of German, and from a vertical perspective, i.e., between individual dialect- and standard-targeted speech styles. It showed PBL effects in data from a corpus of speech not controlled for investigating PBL and hence validated the methodological approach to investigate PBL by analyzing speech corpora to complement experimental studies, as a few pioneering studies have done before [5, 9].

Two hypotheses guided the present corpus study: First, that there are regional differences in the patterns of PBL and, second, that there are no differences between speech styles, as speakers, who were socialized in local dialect, transfer their dialect-specific PBL patterns to standard-targeted speech as prosodic aspects of dialect speech are more persistent than segmental aspects [14]. Results confirm the first hypothesis and the findings of studies on more general aspects of prosody in German regional varieties, e.g. [12, 13]. In general, syllables immediately preceding the prosodic boundary showed strong PBL-effects in each variety. These included ultimate syllables and monosyllables. PBL effects on penultimate syllables were weaker in dialect-targeted than in standard-targeted speech. In the antepenultimate syllable, tendential effects of PBL could

still be observed in the antepenultimate syllable in standard-targeted speech for Alemannic and Low German.

These differences suggest that, in standard-targeted speech, PBL-patterns also target – to different degrees in different varieties – the patterns of Standard German. For Standard German, it has been demonstrated that syllables as far from the prosodic boundary as the antepenultimate syllable can be affected by PBL [2]. Like Standard German, both dialect- and standard-targeted data show a stronger PBL-effect the closer the prosodic boundary is approached and thus support the progressive lengthening hypothesis. At the same time, both dialect- and standard-targeted data indirectly support the Final Rime hypothesis as ultimate syllables were drastically longer than preceding syllables, which may be due to the segments within the final rime. Future research will reveal this.

Regarding the amount of PBL in phrase-final position, regional effects were observed between the varieties in dialect-targeted speech. Most clearly, results show a general contrast between Low German and High German. In standard-targeted speech, the Low German and the High German varieties compared to each other become more homogenous in the amount of PBL, while the High German varieties among themselves become more heterogeneous. This supports the observation that PBL patterns differently approach the pattern of Standard German in standard-targeted speech. The High German varieties approach the pattern to different degrees, which results in more heterogeneity in the amount of PBL amongst these varieties as in dialect-targeted speech. That is, the homogeneity of the High German dialect systems becomes disrupted by striving towards the standard language.

Effects of speech style were most strongly observed in ultimate syllables and in monosyllables, where also the strongest PBL-effects were observed. While effects of speech style were found in each of the varieties for ultimate syllables, they were only found for monosyllables in Bavarian and Low German. In penultimate syllables, significant effects of speech style were found in Bavarian and West Central German. This complies with the observation that PBL-patterns in standard-targeted speech approach the more linear pattern of progressive lengthening reported for Standard German by increasing the amount of PBL in the penultimate syllable. The second hypothesis, stating that PBL does not differ between speech styles as dialect-specific aspects of prosody persist in standard-targeted speech, could thus not be confirmed.

The differences that the present corpus study uncovered from a horizontal and a vertical perspective between German varieties gained new insights in the nature of PBL, i.e. that it is subject to regional variation, and complement the findings of experimental studies. Future research should address the perceptual relevance of these regional differences.

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