Slow or Long? Generational Variation of Pre-boundary Lengthening in Different Dialect Areas of German

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Abstract

Pre-boundary lengthening (PBL), the increase in duration of segments immediately before prosodic boundaries, is well researched for variation between languages but studies on variation within languages are scarce. The present paper reports on a corpus analysis that investigated variation in PBL between different dialect regions of German and between different generations of speakers in these regions. Results suggest regional variation in PBL in terms of a north-south contrast. Low German speakers in the north produce stronger PBL than High German speakers in the south, in particular with older generations. Results are discussed in light of articulation rate.

Index Terms: Pre-boundary lengthening, prosody, language variation, German, corpus linguistics

1. Introduction

Pre-boundary lengthening, the increase in duration of segments immediately preceding prosodic boundaries, is a widely attested acoustic correlate of prosodic phrasing. It is one of several phonetic cues to prosodic boundaries, in particular, intonation phrase boundaries. In intonation languages, such as Standard German, other major boundary cues include boundary tones and pauses. As a major cue to prosodic boundaries, PBL fulfils different functions, such as facilitating syntactic parsing (e.g., [1]), organizing discourse ([2]) or differentiating meaning (e.g., [3]). Since it has been attested in many languages, PBL is considered to be universal, but its universality is still controversial (e.g., [4]). Similarly controversial is its status in the language system. It is unclear, whether PBL really fulfills the functions mentioned above or if it is just a by-product of physical inertia of the articulation muscles (i.e., they relax and decelerate towards phrase edges), of the cognitive effort of planning the next part of an utterance, or of the production of the pitch contour of boundary tones (see [5] for a discussion).

PBL exhibits many different forms in different languages, showing a large amount of variation in domain (i.e., the number of segments affected by PBL) and degree (i.e., the extent to which segments are lengthened). Segments in the final syllable immediately before the phrase boundary are most likely affected by PBL and lengthened the most. Whether PBL also occurs in penultimate or antepenultimate syllables before the boundary is still controversial. If it does, the degree of lengthening is usually weaker the larger the distance to the boundary. The ways in which PBL is implemented in different languages is related to the functional load of phonological or prosodic factors in the individual language systems. For example, in quantity languages, such as Czech [6] or Hungarian [7], quantity has the function to distinguish between long and short vowel phonemes. Therefore, short vowels are generally lengthened less before phrase boundaries in relative proportion to long vowels, so that short vowels never reach the inherent (i.e., unlengthened) duration of long vowels. The reason for this is that the phonemic quantity distinctions should always be maintained, otherwise the phonological system of quantity languages is disrupted. To mention another example, [8] found that, in Japanese, a lexically distinctive pitch accent on the first syllable of disyllabic words leads to a weaker degree of PBL in the second syllable compared to disyllabic words which were not initially accented. The authors speculate that an unlimited degree of PBL in the last syllable would weaken the salience of the pitch accent on the preceding syllable. Similarly, in tone languages, such as Mandarin Chinese or Southern Bantu, PBL might be stronger due the absence or weakness of boundary tones ([9]).

Variation between languages in PBL has received much attention in recent years from a language-typological perspective. What has passed the focus of research so far, however, is language-*internal* variation. For example, language-structurally and geographically definable subsystems of German ([10]), henceforth referred to as *dialects*, exhibit similar factors as previously mentioned for different standard languages. As [11] outlines, the mid-west German dialect of Moselle Franconian exhibits lexical tone accents, similar to Chinese or Swedish. The neighboring dialect of Rhine Franconian exhibits non-functional, but salient intonation phenomena (e.g., [12]). In addition, Upper German dialects, such as Alemannic or Central Bavarian dialects, show specific phonotactic quantity relations in certain vowel-consonant sequences (e.g., long vowel plus lenis consonant vs. short vowel plus fortis consonant, [13]). Furthermore, Low German dialects differ considerably from the system of Standard German, for example, in a preference for simple syllable structures, which might allow stronger lengthening of individual segments affected by PBL ([14]).

PBL has been attested for Standard German read speech, elicited in experimental settings, ([3], [15], [16]) and in spontaneous speech, obtained from existing corpora ([17], [18]). Studies on spontaneous speech in Standard German are rare and the number of studies amongst them that investigate regional variation is even smaller. [19] observe variation in PBL between the Swiss German dialects of Bern (High Alemannic in the synonymous canton in central Switzerland and Brig (Highest Alemannic) in the canton of Valais in the south of Switzerland. Bernese speakers lengthen the nuclei of unstressed syllables immediately before the phrase boundary by 60%. In contrast, Valais speakers lengthen them by 92%. Penultimate syllable nuclei were lengthened in both regions by about 30%. [20] reports for Germany that Rhine Franconian speakers in the city of Mannheim lengthen unstressed syllables more than North Low German speakers in the city of Hamburg

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(22%). The present paper therefore aims to answer the research question: Does PBL vary between different dialect areas of German? In light of dialect change [14], the present study takes previous research one step further by asking in addition: Does PBL differ between different generations of dialect speakers?

2. Methods

Data from the REDE-corpus compiled in fieldwork of the project "regionalsprache.de" (REDE, [21]) were annotated and analyzed for measuring segment duration before intonation phrase boundaries and within intonation phrases.

2.1. The REDE-corpus

The REDE-corpus provides data from 148 locations within the Federal Republic of Germany, covering the dialect areas illustrated in the geographic classification by [22] after [23] and [24] in Figure 1. 10 locations, marked in Figure 1, were selected for analysis. They included Oldenburg (West Low German), Stralsund (East Low German), Bergisch Gladbach and Wittlich (Central Franconian), Osthofen (Rhine Franconian), Dresden (East Central German), Rudersberg (Swabian) and Waldshut-Tiengen (High Alemannic) as well as Trostberg and Passau (Central Bavarian). Apart from Oldenburg and Stralsund, all other locations investigated are in High German dialect areas.

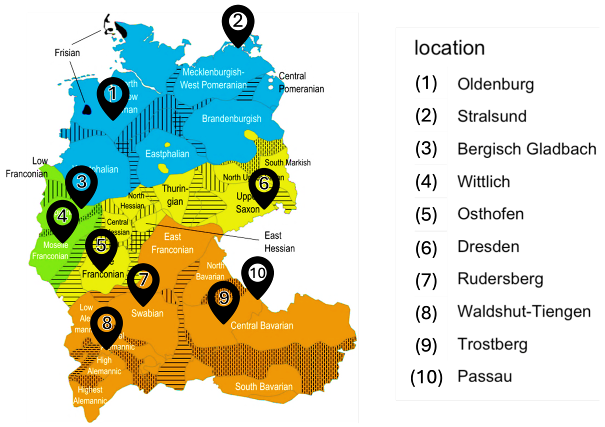

Figure 1: *Distribution of locations investigated.*

At each location, at least 3 informants (one 65 years of age or older, one between 45 and 55 years of age, and one between 18 and 23 years of age) were recorded at their private residences or workplaces between 2008 and 2012. The informants belonged at least to the third generation of their families living at the respective location, they had not left the location for more than one year and both their parents came from the same location. In total, 51 informants were analyzed (4 to 7 speakers per location).

Each informant had to perform 5 tasks, which elicited more and less controlled as well as more and less regional speech. The tasks included:

1) Translating records of 40 sentences spoken in dialect into Standard German (see [25] for the sentences)
2) Reading the fable "The Northwind and the Sun"
3) A guided interview with a fieldworker who spoke standard German
4) An informal conversation with a self-chosen familiar interlocutor, such as a close friend from the same location
5) Translating the same 40 sentences from task (1), this time read aloud in Standard German by a fieldworker, into the dialect of the respective location

The hypothesis was that dialect intensity would increase form task 1) to 6). The dialect translations are hence assumed to show the highest dialect intensity ([14]). For these translations, the speakers were told to listen carefully to each sentence read aloud by the fieldworker and to utter the sentence as closely targeted to the dialect of their location but still as naturally as possible. The translations thus constitute semi-spontaneous speech and were selected for the present study due to their dialect intensity. The sentences consisted in several intonation phrases, such as: "*[Im Winter]*$_{IP}$ *[fliegen die trockenen Blätter]*$_{IP}$ *[in der Luft herum]*$_{IP}$." ("In winter the dry leaves fly around in the air.") A total of 2098 utterances were analyzed.

2.2. Annotation Procedure

In each utterance, boundaries of all segments and words were set in Praat ([26]) using WebMAUS ([27]) and manually corrected following the guidelines by ([28]). Syllable boundaries within polysyllabic words were manually set and lexical stress indicated. Intonation phrase boundaries were located by inspecting the pitch contour for boundary tones ([29]) and each word carrying a boundary tone was labelled as final. The following further information were annotated using a Praat script: 1) the length of each word in terms of number of syllables, 2) the stress pattern of each word in terms of position of main lexical stress, 3) the length of each intonation phrase (i.e., the intervals between the initiation and termination of speech in each recording) and 4) the length of each utterance (i.e., the length of the recording, excluding any silence intervals and hesitations or speech errors). Moreover, each segment and each syllable was numbered by the script from right to left within each word in order to indicate their distance from the right word edge (which, in the case of final words, is their distance from the intonation phrase boundary). Also, the number of syllables was counted within each utterance.

All words longer than three syllables (e.g., *DURCHgelaufen*, 'walked through', *zuRÜCKkamen*, 'came back', or *KiderREIen* 'childish nonsense') and trisyllabic words with stress on the final syllable (e.g., *KindeREIN*, 'childish nonsense', with schwa apocope) were excluded from the analysis due to a low number of segments observed per word structure (< 500). Subsequently, 6 different word structures remained in the data set: Trisyllabic words with either initial or medial stress (e.g. *KOCHlöffl*, 'cooking spoon', or *GeSCHICHte*, 'history') disyllabic words with initial or final stress (e.g., *WOchen*, 'weeks' or *heRUM*, 'about') and stressed or unstressed monosyllabic words (e.g., *MANN*, 'man', or *von* 'of'). Thus, stressed and unstressed syllables occurred in three syllable positions before the intonation phrase boundary: ultimate (i.e., immediately before the boundary), penultimate and antepenultimate. Segments in all three syllable positions were analyzed in order to see where PBL begins. Stressed and unstressed syllables were analyzed separately to avoid confounding lengthening due to PBL and lengthening due to lexical stress or accentual prominence. Furthermore, segments were classified as vowels, sonorants, fricatives, affricates and obstruents. Obstruents were excluded from the analysis since their lengthening potential is limited. In total, 69,754 segments were measured.

2.3. Measurements

To test if the data showed a PBL-effect, the duration of all segments within final and non-final words was measured and compared. If there was a duration difference between the phrase positions, this was counted as a PBL-effect if final segments were significantly longer than segments within an intonation phrase (for the statistical analysis, see section 2.4.). Regional contrasts in the degree of PBL were observed if final segment duration differed significantly between locations in different dialect areas. To make sure that regional differences observed were not due to slower or faster speech between regions (see [30] for a detailed investigation), the average articulation rate across all utterances was calculated for each location. Articulation rate was calculated according to equation (1):

$$artRate = \frac{\text{utterance duration} - \text{silences} - \text{ phrase final words}}{\text{number of all syllables within utterance}} \quad (1)$$

Articulation rate was calculated as in many preceding studies (e.g., see for an overview and application of this calculation [30]) by taking the duration of each utterance without any periods of silence, hesitations or speech errors and dividing the remaining duration by the number of syllables per utterance. In the present case, the duration of phrase-final words was also taken from the utterance duration to avoid circularity. After all, should a stronger or weaker PBL degree be in fact a regional trait, locations where final segments are lengthened more would show a slower articulation rate and locations with a weaker PBL degree would show a faster articulation rate.

2.4. Statistical analysis

To test if a PBL-effect existed in the data, linear mixed effects models were fitted to the segment duration data of each syllable in R ([31]) using the lmr4 package ([32]). The model accounted for SEGMENT DURATION as a function of PHRASE POSITION. Random intercepts for INFORMANT, SENTENCE and SEGMENT CLASS were included.

To test, if the degree of PBL varied between regions, a second linear mixed effects model was fitted to the final segment duration data of each syllable accounting for FINAL SEGMENT DURATION as a function of LOCATION. Random intercepts for INFORMANT, SENTENCE and SEGMENT CLASS were again included. The same model was applied to the average articulation rate data, then accounting for ARTICULATION RATE as a function of LOCATION

3. Results

The first linear mixed effects model yielded significant segment duration differences ($p<0.001$) in monosyllabic words as well as in the ultimate and penultimate syllables of words, such as *KOCHl<u>öffl</u>*, *<u>WOchen</u>*, and in the ultimate syllable of words like *GeSCHICH<u>te</u>* and *he<u>RUM</u>*. Lengthening hence inconsistently reached the penultimate syllable and was most robust in initially-stressed disyllabic words, such as *WOchen.* Segments in antepenultimate syllables (i.e., the initial syllables of trisyllabic words) were not sigificantly lengthened. Figure 2 shows final and non-final segment duration within stressed and unstressed syllables in ultimate position before the intonation phrase boundary (e.g., *KOCHlö<u>ffl</u>*, *WO<u>chen</u>*, *he<u>RUM</u>*, *<u>MANN</u>*). Final segment duration clearly exceeds non-final segment duration in each location. The duration difference is robust in stressed and unstressed syllables, although stress seems to increase the duration difference, in particular in Central Franconian, Rhine Franconian and Alemannic locations (Bergisch-Gladbach and Wittlich, Osthofen, Rudersberg and Waldshut-Tiengen).

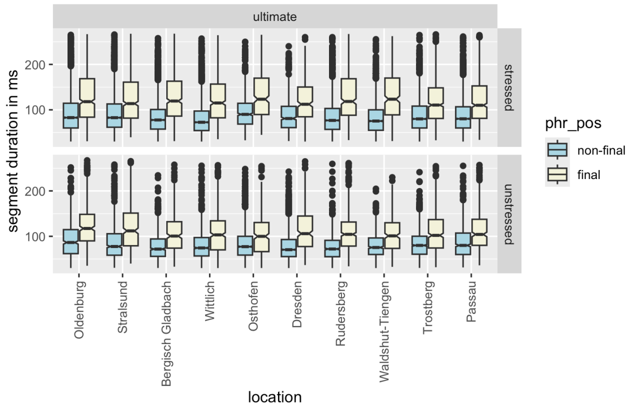

Figure 2: *Difference between phrase-final and non-phrase-final segment duration in ultimate syllables.*

Yet, in Figure 3, the locations show no clear differences in final segment duration in stressed syllables immediately before the phrase boundary. Neither did the second linear mixed effects model yield significant regional effects for stressed syllables. For unstressed syllables, however, the model yielded significant regional contrasts between the Low German location of Oldenburg and the High German locations (Glad..: $p<0.01$, Wit.: $p<0.01$, Osth.: $p<0.001$, Rud.: $p<0.005$, Wald.: $p<0.001$, Trost.: $p<0.05$) and a tendential contrast to Dresden ($p<0.1$). The contrasts were most significant with West Central German and West Upper German locations. However, Oldenburg did not significantly contrast with Stralsund, the only other Low German location in the data set. Stralsund showed significant regional contrasts to the West Central and Upper German locations of Osthofen ($p<0.05$), Waldshut-Tiengen ($p<0.05$) and tendentially to Rudersberg ($p<0.1$). Figure 3 shows that final segment duration in unstressed syllables is longer in Oldenburg and Stralsund than in the High German locations.

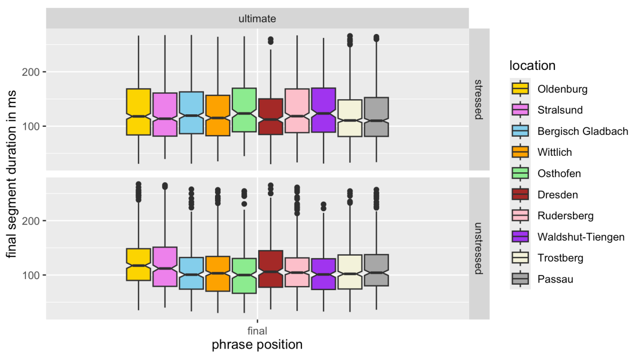

Figure 3: *Phrase-final segment duration in ultimate syllables per location.*

Figure 4 shows that this difference only concerns the old generation and, by tendency, also the middle-aged generation of Low German informants in Oldenburg. The older Oldenburg informants produce the longest final segment duration. They differ significantly ($p<0.05$) from all locations except Stralsund and Dresden, and tendencially from Wittlich and Passau ($p<0.1$). The middle-aged informants tendentially lengthen final segments more in Oldenburg than in Osthofen, Rudersberg, and Waldshut-Tiengen, and in Stralsund than in Waldshut-Tiengen ($p<0.1$). Final segment duration decreases over the generations in Oldenburg so that the contrast between the Low and High German locations becomes successively neutralized. In the old generation, the locations of Oldenburg, Stralsund, Bergisch Gladbach, Wittlich and Osthofen show a continuum: Final segment duration decreases from Low German to Central Franconian and Rhine Franconian. These dialects also form a geographical continuum. The East Central German location of Dresden and the Upper German locations are more heterogeneous. In the middle-aged generation, the continuum is interrupted between Low German and Central Franconian. In the young generation, the continuum flattens down to one level from Oldenburg to Dresden. The young generation is generally rather homogenous, but a slight contrast between the Low-Central German continuum and the Upper German dialect area is still discernable in the young generation.

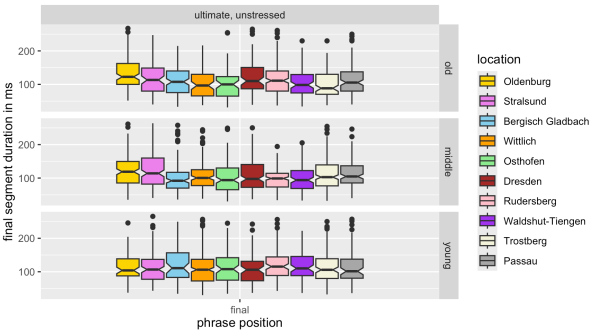

Figure 4: *Phrase-final segment duration in unstressed ultimate syllables per generation.*

The average articulation rate of the old Oldenburg informants, based on the calculation procedure described in section 2.3., is 145 ms/syll and thus slower than that of the middle-aged (97.4 ms/syll) or young informants (99.1 ms/syll). However, the old Osthofen informants have a slower articulation rate (152.5 ms/syll) but show shorter final segment duration than the old Oldenburg speakers. Neither did they show a significantly slower articulation rate than the old informants in the other locations according to the second linear mixed effects model. Articulation rates are given in Table 1.

Table 1: *Average articulation rate per location.*

Location	Old	Middle	Young
Oldenburg	145	97.4	99.1
Stralsund	119.9	122.6	88.8
Berg. Gladbach	118.7	94.7	91.9
Wittlich	126.3	104.5	104.8
Osthofen	152.5	118.8	127.3
Dresden	155.6	116.3	108.1
Rudersberg	122.5	119.8	100.6
Waldshut-T.	128.9	119	106
Trostberg	123.6	124.3	121.9
Passau	120.7	122.2	95.8

4. Discussion

The present study revealed robust PBL in a corpus of semi-spontaneous dialect translations and thus contributes to research on PBL in German spontaneous speech (e.g., [17], [18]). It supports studies on PBL in language varieties and supports research on variation in PBL within the German language area with a larger data set ([19], [20]). Also, the study complements experimental studies on PBL as words with a different number of syllables and position of lexical stress were compared, which provided exact observations of the PBL-domain.

Findings of experimental studies on Standard German could be replicated with the present regional corpus data. Thus, it was found that PBL robustly affects syllables immediately before an intonation phrase boundary, but that the PBL-domain expands further to the left if stressed syllables occur earlier in the final word. Thus, the PBL-domain included the penultimate syllable of disyllabic words if it was stressed (*WOchen*), and continued on to the stressed antepenultimate syllable of trisyllabic words (e.g., *KOCHlöffl*). In a study on Standard German, [3] found that PBL began in the nuclues of the stressed syllable in proper names such as RaMOna and KArolin. They conclude that the PBL-domain is anchored on the stressed syllable. However, in the present data, the PBL-domain did not include the stressed antepenultimate syllable. The present results therefore support a model proposed by [33], which states that the PBL-domain is not achored but only attracted to the stressed syllable if its distance to the phrase boundary is too large.

The main aim of the present study was to investigate if PBL varied between different dialect areas of German and between different generations of dialect speakers. The findings suggest regional variation in terms of a north-south contrast. Final segments are lengthened more in Low German than in High German dialects. This observation is plausible in light of the strong typological distance between these dialects. A possible factor enhancing the degree of PBL in Low German might be phonotactics. Low German prefers simpler syllable structures than High German and avoids consonant clusters ([14]). Segments in simpler syllable structures have more potential to be lengthened. PBL hence cannot be affected by complex syllable shortening of segments. If stronger PBL was actually a regional trait of Low German, the fact that this contrast was only significant in old dialect speakers can be explained in terms of dialect competence. Low German dialect areas are characterized by a situation of diglossia that concerns mainly old speakers who still possess knowledge of Low German dialects, while younger speakers often possess no dialect competence anymore (e.g., [34, 35]). Another explanation for longer final segment duration in older speakers might be a slower articulation rate. However, although older speakers showed a slower speech rate in Oldenburg than younger speakers, slower articulation rate data did not correspond to stronger PBL across the locations and the old Oldenburg informants did not show a significantly slower articultion rate than the old informants in the other locations. Regional variation was not maintained in stressed syllables, however. This may be because of the fact that stressed syllables are additionally lengthened due to prominence and therefore do not offer enough leeway for regional variation.

In conclusion, the present study suggests regional variation in PBL between Low and High German that corresponds to the dialect competence of different speaker generations. Further research will be conducted on fully spontaneous regional conversation data in order to confirm the results.

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6. References

[1] L. Frazier, K. Carlson, C. Clifton, “Prosodic phrasing is central to language comprehension,” *Trends in Cognitive Sciences* vol. 10, no. 6, pp. 245–249, 2006.

[2] N. Ots and P. Taremaa, “Chunking an unfamiliar language: Results from a perception study of German listeners,” in F. Schubö, S. Zerbian, H. Sandra, and I. Wartenburger (eds.), *Prosodic boundary phenomena*. Berlin: Language Science Press, pp. 87–118, 2023.

[3] F. Schubö and S. Zerbian, “Phonetic content and phonological structure affect pre-boundary lengthening in German,” in *Proc. 10th International Conference on Speech Prosody*, Tokyo, Japan, May 2020, pp. 111–115.

[4] L. White, S. Benavides-Varela, K. Mády, Are initial-consonant lengthening and final-vowel lengthening both universal word segmentation cues? Journal of Phonetics, vol. 81, 2020, pp. 1–14.

[5] A. Lameli, N. Spina, “The Signs of Time: The Indexical Value of Pre-boundary Lengthening,” in M. Scharinger, C. Kauschke, T. Hoffmeister (eds.), *Repräsentationen im linguistischen und interdisziplinären Kontext*, Germanistische Linguistik, in press.

[6] N. Spina and F. Schubö, “Vowel length affects pre-boundary lengthening in Czech,” in *Proc. 1st International Conference on Tone and Intonation (TAI)*, Sonderborg, Denmark, Dec. 2021: 166–170.

[7] L. White and K. Mády, “The long and the short and the final: Phonological vowel length and prosodic timing in Hungarian,” in *Proc. 4th Conference on Speech Prosody*, Campinas, Brazil, Jan. 2008, pp. 363–366.

[8] J. Seo, S. Kim, H. Kubozono, and T. Cho, “Interaction between rhythmic structure and preboundary lengthening in Japanese,” in *Proc. 19th International Congress of Phonetic Sciences*, Melbourne, Australia, Aug. 2019, pp. 637–641.

[9] S. Zerbian, Sentence intonation in Tswana (Sotho-Tswana group), in L. J. Downing and A. Rialland (eds.), *Intonation in African Tone Languages*, Berlin/Boston: De Gruyter, 2017, pp. 393–433.

[10] A. Lameli, “Gesprochenes Deutsch in den Regionen. Eine Standortbestimmung für die Bundesrepublik Deutschland,” in N. Proske, T. Weber, M. Dannerer, A. Deppermann (eds.), *Gesprochenes Deutsch. Struktur, Variation, Interaktion*. Berlin/Boston: De Gruyter, pp. 51–80, 2025.

[11] J.E. Schmidt, *Die mittelfränkischen Tonakzente*. Stuttgart: Steiner, 1986

[12] J. Peters, *Intonation deutscher Regionalsprachen*, DeGruyter, 2006.

[13] S. Moosmüller and J. Brandstätter, “Phonotactic information in the temporal organization of Standard Austrian German and the Viennese dialect,” *Language Sciences*, vol. 46: pp 84–95, 2014.

[14] A. Lameli, “Syllable structure spatially distributed. Patterns of monosyllables in German dialects,” *Journal of Germanic Linguistics*, vol. 34, no. 3, pp. 241–287, 2022.

[15] M. Belz, O. Rasskazova, J. Krivokapić, C. Mooshammer, “Interaction between Phrasal Structure and Vowel Tenseness in German: An Acoustic and Articulatory Study,” *Language and Speech*, vol. 66, no. 1, pp: 3–34, 2023.

[16] G. Kentner, I Franz, C. A. Knoop, and W. Menninghaus, “The final lengthening of pre-boundary syllables turns into final shortening as boundary strength levels increase,” *Journal of Phonetics*, vol. 97, 2023, pp. 1–17.

[17] B. Peters, K. J. Kohler, T. Wesener, “Phonetische Merkmale prosodischer Phrasierung in deutscher Spontansprache,” Universität Kiel: Institut für Phonetik und digitale Sprachverarbeitung, 2003.

[18] A. Batliner, A. Kießling, R. Kompe, H. Niemann, E. Nöth, “Tempo and its Change in Spontaneous Speech,” in *Proc. European Conference on Speech Communication and Technology*, vol. 2, Rhodes, Sep. 1997, pp. 763–766.

[19] A. Leemann and B. Siebenhaar, “Intonational and temporal features of Swiss German,” in *Proc. 16th International Congress of Phonetic Sciences (ICPhS)*, Saarbrücken, Germany, Aug. 2007, pp. 957−960.

[20] T. Streck, *Finale Dehnung im Deutschen: Eine kontrastive Untersuchung zu den städtischen Varietäten von Mannheim und Hamburg*, Staatsexamensarbeit University of Freiburg, 2004.

[21] J. E. Schmidt, J. Herrgen, R. Kehrein, and A. Lameli, (eds.), *Regionalsprache.de (REDE III). Forschungsplattform zu den modernen Regionalsprachen des Deutschen*. Marburg: Forschungszentrum Deutscher Sprachatlas, 2022.

[22] J. E. Schmidt, “Vom traditionellen Dialekt zu den modernen deutschen Regionalsprachen,” in Deutsche Akademie für Sprache und Dichtung, Union der deutschen Akademien der Wissenschaften (eds.), *Vielfalt und Einheit der deutschen Sprache: Zweiter Bericht zur Lage der deutschen Sprache*. Tübingen: Stauffenburg, 2017, pp. 105–143.

[23] A. Lameli, *Strukturen im Sprachraum. Analysen zur arealtypologischen Komplexität der Dialekte in Deutschland*. Berlin/Boston: De Gruyter Mouton, 2013.

[24] P. Wiesinger, “Die Einteilung der deutschen Dialekte,” in: W. Besch, U. Knoop, W. Putschke, H. E. Wiegand (eds.), *Handbücher zur Sprach und Kommunikationswissenschaft*, 1(2), De Gruyter, pp. 807–900, 1983.

[25] A. Lameli, *Erläuterungen und Erschließungsmittel zu Georg Wenkers Schriften. Unter Mitarbeit von Johanna Heil und Constanze Wellendorf*. Hildesheim/New York/Zürich: Olms, 2014.

[26] P. Boersma and D. Weenink, "Praat: doing phonetics by computer", Computer program, version 6.1.33, URL: http://www.praat.org/, 2020.

[27] The Munich Automatic Segmentation System (MAUS), web service, version 3.12, URL: https://clarin.phonetik.uni-muenchen.de/BASWebServices/interface/WebMAUSBasic, Aug. 2025.

[28] A. E. Turk, S. Nakai, and M. Sugahara, “Acoustic Segments Durations in Prosodic Research: A Practical Guide,” in A. Steube (ed.), *Language, Context & Cognition - Methods in Empirical Prosody Research*, pp. 445-472, 2006.

[29] M. Grice and S. Baumann, “Deutsche Intonation und GToBI,” in: *Linguistische Berichte*, vol. 191, pp. 267–298, 2002.

[30] M. Hahn: *Sprechgeschwindigkeit und Reduktion im deutschen Sprachraum. Eine Untersuchung zur diatopischen Variation standardintendierter Vorleseaussprache*, Hildesheim/Zürich/ New York: Georg Olms Verlag, 2022

[31] R Core Team, “R: A language and environment for statistical computing,” R Foundation for Statistical Computing, Vienna, Austria.

[32] D. Bates, M. Mächler, B. Bolker, and S. Walker, “Fitting Linear Mixed-Effects Models Using lme4.” *Journal of Statistical Software*, vol. 67, pp. 1–48, 2015.

[33] A. Katsika, “The role of prominence in determining the scope of boundary-related lengthening in Greek,” *Journal of Phonetics*, vol. 55, pp. 149–181, 2016.

[34] R. Kehrein, *Regionalsprachliche Spektren im Raum: Zur linguistischen Struktur der Vertikale*. Stuttgart: Steiner, 2012.

[35] A. Adler, C. Ehlers, R. Goltz, A. Kleene, and A. Plewina, *The current status and use of Low German. Initial results of a representative study*. Leibniz Institut für deutsche Sprache, 2018.