PHONOTACTICALLY DRIVEN CUE WEIGHTING IN A SOUND CHANGE IN PROGRESS: ACOUSTIC EVIDENCE FROM WEST CENTRAL BAVARIAN

Katharina Thon, Felicitas Kleber

Institute for Phonetics and Speech Processing (IPS), LMU Munich
[k.thon|kleber]@phonetik.uni-muenchen.de

ABSTRACT

An analysis of acoustic recordings of fortis and lenis stops in pre- and postvocalic position in a variety of real words obtained from 23 speakers evenly distributed across younger and older West Central Bavarian (WB) as well as Standard German (SG) speakers showed that closure duration, the hitherto primary cue to the fortis/lenis contrast in WB becomes less important in younger WB speakers and in phonotactically previously illegal post-vocalic contexts while VOT – the primary cue to this contrast in SG – becomes more important in legal post-vocalic contexts. These results indicate that the apparent simultaneous change in acoustic cues occurs in different contexts and non-linearly at different paces. In initial position, older and younger WB speakers use VOT similarly to signal the fortis/lenis contrast but to a significantly lesser extent than SG speakers suggesting incomplete neutralization without indications of an ongoing change in this position in terms of apparent-time differences.

Keywords: German varieties, dialect levelling, acoustic cue change, incomplete neutralization

1. INTRODUCTION

The two main aims of the present paper are to investigate (i) a suspected change in cue weighting in the production of the word-medial fortis/lenis contrast in West Central Bavarian (WB) spoken in south-eastern Germany and (ii) the potential emergence of this contrast in initial position in WB. Both changes are presumed to occur as a result of dialect levelling towards Standard German (SG) [1].

The voicing or fortis/lenis contrast in SG occurs in both syllable-initial and postvocalic word-medial position and is signaled primarily by the length of positive voice onset time (VOT; lenis: short lag, fortis: long lag) values [2]. In medial position, proportional vowel duration in the vowel+stop closure sequence serves as a secondary cue to the contrast with longer vowels and simultaneously shorter stop closure durations signaling the three lenis stops /b, d, g/ and shorter vowels preceding stops with a longer closure duration cueing the three fortis counterparts /p, t, k/ [2, 3]. In this position the acoustic cues are not only differently weighted (cf. [4]) but they are also in a trading relationship, by which one cue may be offset by the other [5, 6]. In WB, on the other hand, the contrast is considered neutralized towards the lenis variant in initial position [7] and primarily cued by closure duration [8] in medial position. VOT plays no role [6]. A further difference between the two varieties is that phonemically long and short vowels can be freely combined with lenis and fortis stops in SG while in WB lenis stops (L) are always preceded by long vowels (V:) and fortis stops (F) by short vowels (V) [9–10] (cf. [11] for a discussion of allophonic vowel quantity). Because of this restriction some SG combinations are phonotactically illegal in WB and adjusted accordingly (e.g., V:F in SG /ˈfaː.tɐ/, 'father' > V:L in WB /fˈɔː.dɐ/; VL in SG /pˈʊd̥ɪŋ/ 'pudding' > VF in WB /pˈʊṭːɪŋ/) while others are legal (e.g., VF in SG /ˈpapa/ 'dad') but implemented differently in terms of acoustic cues.

The present study builds upon recent apparent-time results from two generations of the same speech community (cf. [6]) that suggest the gradual emergence of a VOT-based fortis/lenis contrast in Central Bavarian varieties spoken in Austria [12] and Germany [6], the leveling out of the phonotactic restrictions in medial position in WB [6, 9, 13, 14], and the often reported change in cue weighting in connection with diachronic sound change [15–17]. Regarding WB, younger speakers were shown to produce fortis stops with closure duration values in between the higher values produced by older WB and the substantially lower values found for SG speakers. Preliminary, though less robust results further suggest that VOT is used to a greater extent in medial position by younger vs. older WB speakers [6, 13]. The present study investigates whether these observations hold true for other lexical items produced by different WB speakers and whether the change robustly affects the merged contrast in initial position. In other words, this study is concerned with a generalization of this gradual sound change in terms of positional and lexical effects. Another issue is whether the suspected change in cue weighting affects word-medial stops differently as a function of phonotactic restrictions.

2. METHOD

2.1. Participants and speech materials

The analysis includes data from a total of 23 speakers who were assigned to one of three speaker groups: seven older WB speakers (aged 52–65, mean 57.3, SD 4.0; 4 female), eight younger WB speakers (aged 19–30, mean 25.7, SD 4.1; 4 female), and eight SG speakers (aged 21–82, mean 42.1, SD 20.43; 4 female). SG speakers were from Munich and its urban surroundings and self-identified as non-dialect speakers who only speak the in this area prevalent southern SG variety. Dialect speakers were from the rural parts of Upper Bavaria where WB is common and acquired as the first variety. Their dialect competence was assessed by the examiners who were native speakers of WB. None of the participants reported any hearing or speaking impairments.

Five monosyllabic words of a CVC(C) structure with stops in initial position and 35 disyllabic trochees of the form CˈVCVC(C) with stops in initial, (prevocalic) and word-medial (postvocalic) position were analyzed. Only words with alveolar stops were selected for analysis as this place of articulation is not affected by phonotactic restrictions regarding the cooccurrence of vowel length and subsequent stop voicing in SG [18]. The 40 stops in total were evenly distributed across position and the underlying voicing category (i.e., 10 lenis and fortis stops per position) as well as lexical frequency (high and low; which, however, is not analyzed as a predictor variable in the present study). Within the target words with medial stops, an equal number of long and short vowels preceded both lenis and fortis stops.

All target words are part of both the SG and the WB lexicon and were embedded in different semantically meaningful carrier declarative sentences. Target words preceded the phrase-final past participle, a position that usually triggers a nuclear pitch accent. While carrier sentences were presented in standard orthography to SG speakers (e.g. *Er will die Bar verkaufen.* ‘He wants to sell the bar’), a non-standardized but commonly used form (e.g. in text messages) was used for WB speakers (e.g. *Ea mog de Bar verkaffa.*).

2.2. Recording procedure and data preprocessing

Speakers were recorded using the SpeechRecorder software [19] and a head-mounted microphone either in a sound-attenuated at the Munich Institute of Phonetics and Speech Processing or online via WikiSpeech [20]. The audio signal was digitized at a minimum sampling rate of 44.1 kHz (48 kHz in some cases). Participants read each sentence, presented in randomized order, silently on a screen and reproduced it loudly from memory after the screen turned grey before the next sentence was presented. In case of an obvious mispronunciation the participants were asked to repeat the entire sentence. Out of three repetitions per sentence only the second repetition each was included in the present analysis (23 speakers × 40 target words = 920 tokens).

All utterances were automatically segmented using WebMAUS [21] and stored as an EMU speech database [22]. The relevant segment boundaries were subsequently checked and adjusted manually. These were the on- and offset of the utterance and the target word, respectively, and the segment boundaries of each phoneme within the target word. The target stops were further subdivided into closure and aspiration (corresponding to VOT) phase by manually adding an additional boundary right after the stop’s burst.

2.3. Data analysis

To factor out potential between group differences in speech rate, we normalized each stop’s closure and aspiration duration separately for word duration (with target stop duration being excluded). We refer to them as pClosure and pVOT, respectively. These proportional durations were the dependent variables in a total of four linear mixed-effects models (LMM) fitted separately to the data with stops in initial and medial position. In each of the four analyses Group (three ordered levels: SG > younger WB > older WB) and Stop (two levels: fortis and lenis) served as fixed factors and speaker and word as random factors. Because of the phonotactic restriction in WB regarding stops in medial position the underlying length of the preceding Vowel (two levels: short vs. long) was included as a third fixed factor in the LMMs fitted to postvocalic stops. Pairwise comparisons were computed in case of significant interactions.

All statistical analyses were run in R (v. 4.2.2, [23]) using tidyverse (v. 1.3.1, [24]), lmerTest (v. 3.1-3, [25]), and emmeans (v. 1.8.2, [26]).

3. RESULTS

3.1 Postvocalic stops in word-medial position

The LMM with pClosure as the dependent variable showed significant main effects for Group ($F[2, 25] = 4.5, p < .05$), Vowel ($F[1, 21] = 30.3, p < .001$), and Stop ($F[1, 24] = 24.6, p < .001$) as well as a significant interaction effect between Group and Vowel ($F[2, 21] = 5.2, p < .05$). Commensurate with Fig. 1, however, the speaker group dependent differences in pClosure emerged in particular in fortis stops and in a variety of ways that depended among others on Vowel, i.e., on its underlying quantity.

		Contrast	Estimate	*SE*	*df*	t.ratio	*p value*
pClosure	V:F	Standard – younger Bavarian	-0.046	0.043	28.4	-1.051	0.896
		Standard – older Bavarian	-0.117	0.047	28.5	-2.480	0.164
		Younger Bavarian – older Bavarian	-0.072	0.039	22.1	-1.839	0.463
	VF	Standard – younger Bavarian	-0.187	0.510	28.1	-3.705	0.011*
		Standard – older Bavarian	-0.170	0.055	29.5	-3.113	0.043*
		Younger Bavarian – older Bavarian	0.017	0.048	23.1	0.364	0.999
pVOT	V:F	Standard – younger Bavarian	0.051	0.015	21.9	3.342	0.031*
		Standard – older Bavarian	0.052	0.016	22.8	3.243	0.037*
		Younger Bavarian – older Bavarian	0.001	0.015	21.6	0.016	1.000
	VF	Standard – younger Bavarian	0.042	0.021	22	1.900	0.428
		Standard – older Bavarian	0.078	0.023	21.8	3.468	0.023*
		Younger Bavarian – older Bavarian	0.037	0.022	21.6	1.642	0.582

Table 1: Pairwise comparisons of estimated marginal means for pClosure and pVOT separately for long vowel plus fortis stop (V:F) and short vowel plus lenis stop (VF) sequences.

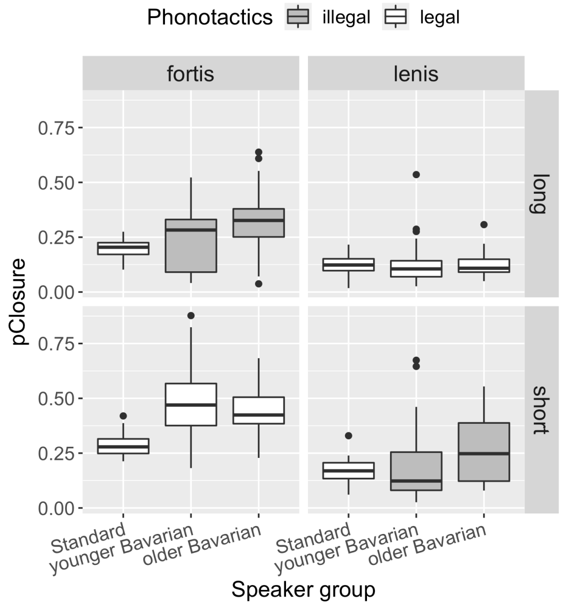

Figure 1: Proportional closure duration separately for the three speaker groups and the underlying stop and vowel category, respectively.

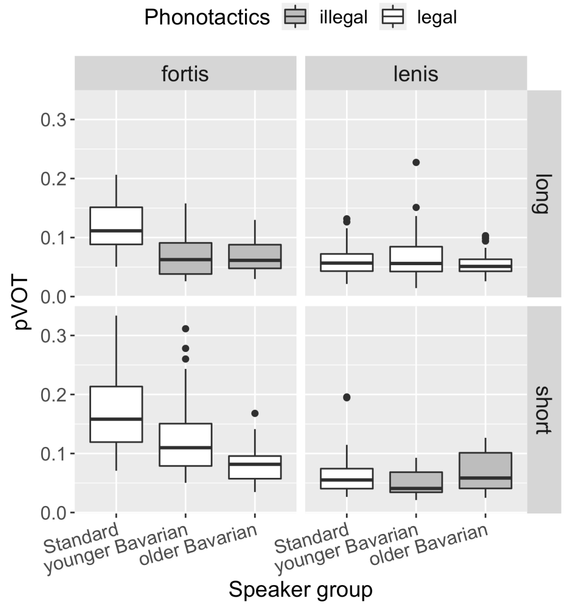

Figure 2: Proportional VOT separately for the three speaker groups and the underlying stop and vowel category, respectively.

SG speakers used closure duration to a lesser extent to signal the fortis/lenis contrast in particular compared to older WB speakers (cf. Fig. 1 and the significant contrast in the post-hoc pairwise comparison in Tab. 1). Interestingly, younger WB speakers took up an intermediate position in the production of V:F-sequences but not in that of VF sequences (cf. Tab. 1). This suggests that the importance of the closure duration cue diminishes in younger WB speakers but only in the sequence that is considered phonotactically illegal in WB. No such group or vowel quantity differences emerged for words with lenis stops.

The LMM with pVOT as the dependent variable showed again significant main effects for Group ($F[2, 21] = 3.9$, $p < .05$), Vowel ($F[1, 17] = 8.1$, $p < .05$), and Stop ($F[1, 22] = 22.2$, $p < .001$). This model further revealed significant interaction effects for Group and Stop ($F[2, 23] = 10.1$, $p < .001$), Vowel and Stop ($F[1, 15] = 5.8$, $p < .05$), and Group, Vowel and Stop ($F[2, 323] = 6.7$, $p < .01$). Commensurate with Fig. 2, SG speakers realized the fortis/lenis contrast on the basis of VOT and much more so than WB speakers (as seen by the significantly larger pVOT values for fortis stops in Fig. 2). In this analysis, too, younger WB speakers took up an intermediate position in the production of some words, most interestingly, however, not in that of V:F-sequences but in that of VF sequences (cf. Tab. 1). This suggests that VOT becomes more important for younger WB speakers to signal the fortis/lenis contrast but at first only in those sequences that are considered legal in Bavarian. Post-hoc pairwise comparisons revealed that the speaker group differences described above occur systematically only in words with fortis stops.

3.2 Prevocalic stops in word-initial position

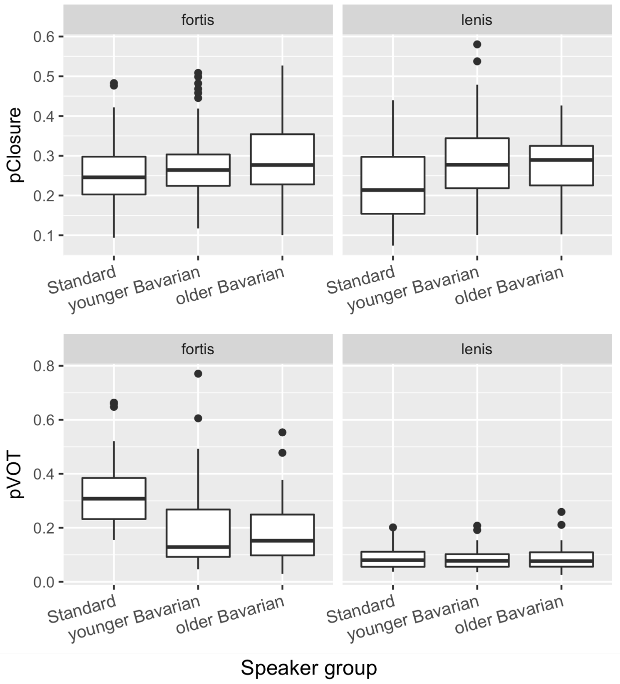

Figure 3: Proportional closure duration (top) and proportional VOT (bottom) separately for the three speaker groups and the underlying stop category.

Commensurate with the top row of Fig. 3, pClosure was significantly affected by Group ($F[2, 21] = 3.9$, $p < .05$) but not by Stop: WB speakers produced longer closure durations than SG speakers and in particular in lenis stops as shown by a significant interaction effect between the two fixed factors ($F[2, 374] = 4.3$, $p < .05$).

The LMM with pVOT as the dependent variable revealed significant main effects for Group ($F[2, 25] = 5.8$, $p < .01$) and Stop ($F[1, 30] = 39.3$, $p < .001$) as well as a significant interaction between these two ($F[2, 26] = 7.3$, $p < .01$). Commensurate with Fig. 3 all three speaker groups use VOT to produce the fortis/lenis contrast in initial position but the contrast appears more pronounced in SG than in WB as the significant difference between SG and both WB groups suggests. No such difference was found between the two WB groups.

4. DISCUSSION AND CONCLUSION

The present results are in line with previous findings on WB which indicated that the implementation of the post-vocalic fortis/lenis contrast becomes more SG-like [6, 9, 13, 14]. They further support our initial assumption that this gradual sound change in progress involves a reweighting of cues as documented for other changes in progress [15–17]. Interestingly, the present change in cue weighting appears to be conditioned by the underlying phonotactic differences between WB and SG.

While distinct closure durations, thus far the primary cue to distinguish postvocalic fortis and lenis stops in WB, diminish in contexts with preceding long vowels in younger compared to older WB speakers, neither of the two age groups use VOT in this hitherto in WB phonotactically illegal sequence. However, VOT differences, the primary cue to this contrast in SG, increase in younger compared to older WB speakers' realizations of words with fortis stops following upon short vowels, i.e., in sequences that are phonotactically legal in both varieties. Closure duration again remains a steadily strong cue in this context and this group of speakers. Thus, cues change non-linearly in production at different paces.

A post-hoc test of the relation between closure duration and VOT in postvocalic fortis stops at the group level using Pearson's *r* [27] revealed positive relationships in all three speaker groups with pVOT increasing in tandem with pClosure (WB young: r =0.58, WB old: r = 0.39, SG: r = 0.43). Contrarily to the trading relation between the two cues described in [5], this suggests the presence of cue enhancement [28], though on both dimensions and in particular in younger WB speakers [15]. Future studies should further investigate the nature and the role of enhancement during this particular sound change in progress (also by including further places of articulation).

The present results are less clear with respect to the second aim of this study. On the one hand, WB speakers contrasted lenis and fortis stops in word-initial position by means of clear differences in positive VOT, but to a lesser extent compared to SG speakers. This points towards incomplete [29] instead of complete neutralization [7] of the fortis/lenis contrast in initial position in WB. However, and in contrast to [6, 12], the present results do not support the initial assumption that this dialectal near-merger is currently being reversed as younger and older WB-speakers did not differ in this apparent-time comparison. This may be due either to differences in the lexical sets investigated (e.g., in place of articulation and lexical frequency) or the fact that reversals of mergers (as in initial position) are generally rare [30], also in comparison to changes in cue weighting regarding existing contrasts (as in medial position).

5. ACKNOWLEDGEMENTS

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