Acoustic evidence and representations for fortisness in Polish stops

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According to Laryngeal Realism (Honeybone 2005; Beckman et al. 2013), which was devised to account for the VOT typology (Lisker & Abramson 1964), voiceless stops in languages such as Polish are phonologically unspecified. This assumption, however, has been challenged by phonological arguments that unvoiced stops in Polish may be phonologically active, either as part of a binary system (Rubach 1996), or, according to Laryngeal Relativism (Cyran 2004), in *sandhi*-voicing dialects as a privative |H| element. From a phonetic perspective, there is also reason to believe that Polish is problematic for Laryngeal Realism. Although production patterns safely place Polish in the voicing category with regard to the VOT typology, there is evidence that VOT is not entirely reliable as a perceptual cue to Polish voicing (Keating 1979; Schwartz & Arndt 2018). This presentation provides new acoustic data on the realization of the Polish laryngeal contrast, with particular attention to cues other than VOT: fundamental frequency (f0; Pitch) at vowel onset (e.g. Hanson 2009) and first formant (F1) frequency at vowel onset (F1Onset; Stevens & Klatt 1974).

We present data word-list data from initial /bdg/ and /ptk/ (1394 total tokens, counterbalanced for POA, high vowel contexts avoided) in the speech of 28 speakers of Polish. Fourteen of the speakers were functionally monolingual, with only an A1/A2 level of English, while the other group (also N=14) was made up of students of English philology, who had received explicit instruction in English phonetics. We measured VOT, type of /bdg/ realization (fully voiced, partially voiced, unvoiced), Pitch and F1Onset (averaged over the first 50 ms of the vowel). Generalized linear mixed models were run with these measures as dependent variables, Voicing and Voicing*Group as fixed factors, and Speaker and Item as random factors. The results may be summarized as follows.

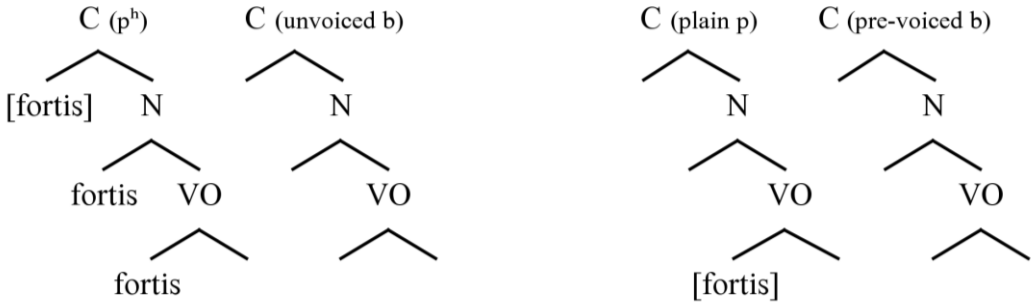
1. VOT of /ptk/ was equivalent for the two groups (Monolinguals: M=42.9 ms, SD=15.8; Students: M=43.3 ms, SD 17.7, p=.946), but the students of English showed less pre-voicing in /bdg/ (Monolinguals: M=-89.7 ms, SD=24.2; Students: M=-65.5 ms, 36.4, p<.001)
2. Collapsed across groups, Pitch and F1 Onset were higher for /ptk/ (p<.001) than /bdg/
3. For F1 Onset, there was a significant Voicing*Group interaction by which the monolinguals produced a significant contrast (mean difference of 0.6 Bark; p=.003) but the students of English did not (mean difference of 0.2 Bark; p=.279)
4. For Pitch, there was a significant Voicing*Group interaction by which the students of English produced a larger lenis-fortis contrast (mean difference of 14.9 Hz, p<.001) than the monolinguals (mean difference of 8.4 Hz, p=.019)

Result #1, which mirrors that of Zając (2015) for L2 English, suggests equivalence classification (Flege 1987), leading to L1 phonetic drift (e.g. Chang 2012), in the speech of the students of English for /bdg/, but not /ptk/. Result #2 suggests that voiceless stops in Polish are indeed 'fortis', associated with a raising effect of both pitch and F1 (of non-high vowels). Results #3 and #4 may have further implications for L1 drift, suggesting that the role of F1Onset in 'fortisness' decreases, while the role of Pitch in 'fortisness' increases, as a function of proficiency in L2 English.

The Onset Prominence framework (OP; Schwartz 2010 *et seq*., see Schwartz 2017 for discussion of laryngeal phonology) allows us to capture these diverse acoustic results, while at the same time maintaining the formal simplicity that gives Laryngeal Realism its appeal in representing the VOT typology. In OP, manner of articulation is a structural property, and stops are comprised of three structural nodes that encode separate phases of stop articulation

(Closure, Noise, Vocalic Onset: C, N, VO). While place specifications dock naturally onto Closure, variable timing of laryngeal gestures relative to supra-laryngeal articulation leads to flexibility in the docking site of laryngeal features. This is shown in (1), in which the VOT typology is captured in terms of a single feature [fortis], which when assigned to Closure (the leftmost tree) yields aspiration, and when assigned to VO (the 3rd tree from the left) yields short-lag VOT. There is no feature [voice], which reflects the status of phonation as an acoustic carrier signal (Traunmüller 1994). Consequently, pre-voiced and unvoiced /bdg/ are phonologically equivalent, explaining the asymmetry in Result #1. Additionally, the role of Pitch and F1Onset (Result #2) in 'fortisness' is expressed in an phonetically intuitive way – both these effects are realized in the initial portion of the vowel that the VO node represents. The differences between our speaker groups (Results #3 and #4), which appear to be the result of cross-linguistic interaction, will also be discussed with respect to the representations in (1).

(1) Two-series laryngeal systems in the OP framework – aspiration (left) vs. voice languages



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