

## **(In)variance in Irish palatalization and velarization: an ultrasound study** (Proposed for oral presentation)

A classic problem in phonology and phonetics is the problem of the lack of invariance: segments that are all specified for a feature [F] may appear to realize that feature in various ways depending on many factors, including phonetic context (Perkell & Klatt 1986). Approaches to this problem include searching for articulatory rather than acoustic invariants, searching for more global invariants, and relinquishing the assumption of invariance. Though there is a large literature on this problem, there has been little or no investigation of (in)variance with respect to contrastive palatalization/velarization.

Irish is well known for its contrast between palatalized and velarized segments (see (1)). The contrast pervades virtually the entire phoneme system. In some respects there is obvious variability in the realization of this contrast. For example, there is variation by major place: palatalized coronals obstruents are realized as alveopalatals, the stops being significantly affricated; palatalized dorsals are palatal. There is also variation according to vowel context: the contrast could be more accurately described as palatalized vs. plain before back vowels, and plain vs. velarized before front vowels (2). However, the main articulatory correlate of the contrast involves tongue body position. Because there is no reliable articulatory data on Irish palatalization, we know little about the degree of variability in the realization of tongue body gestures associated with the contrast.

In this talk we present results of the first ultrasound study of Irish palatalization and velarization, with a focus on tongue body realization. We have collected data from the three major Irish dialect areas – Donegal, Conamara, Kerry (5 speakers each). We currently have results for three speakers of Conamara Irish, and we hope to have data from other dialects for the conference. Our data involves (largely) voiceless obstruent stops and fricatives across the three major places, all in syllable-initial position, followed by either /i:/ or /u:/. These stimuli allow us to gauge the degree of variability in the realization of palatalization and velarization according to vowel frontness, manner (stop vs. fricative), and place of articulation.

According to our preliminary findings, the realization of palatalization and velarization in terms of tongue body position is surprisingly uniform across manner distinctions, and perhaps more surprisingly, across vowel type (/i:/ or /u:/). (Russian, which also has a pervasive contrast in palatalization, has been shown to evince little vowel-to-vowel coarticulation (Öhman 1966).) What systematic variability we find seems to affect the realization of velarization more than palatalization, and depends on major place of articulation: for coronals the realization of velarization seems least robust and consistent.

This finding for coronals might be explained by the fact that palatalized coronal obstruents cue the contrast not only by means of tongue body position (and resultant formant transitions), but by means of affrication and noise cues. We are testing this hypothesis by looking for an inverse correlation by speaker between the robustness of these other cues and the degree of velarization. If confirmed, it would be an interesting example of trade-off between acoustically orthogonal phonetic cues to one segmental contrast in the phonology.

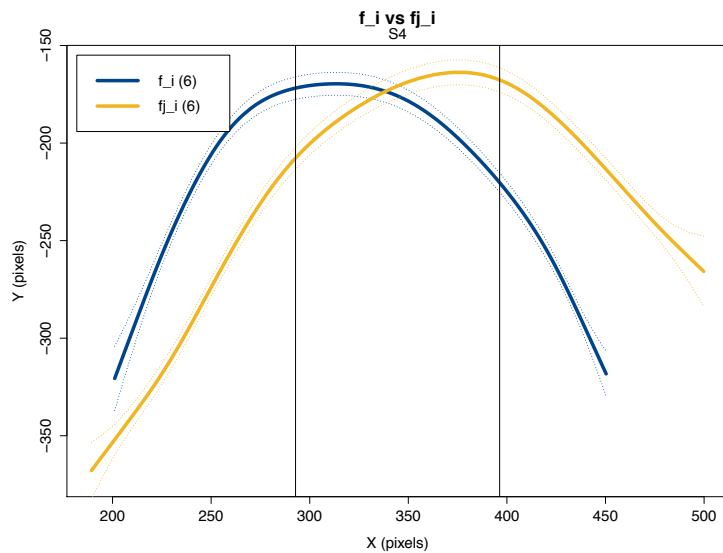
## Examples/Figures

### (1) Secondary palatalization in Cois Fharráige Irish

bʲɔ:n	‘peak’	bɔ:n	‘white’
pʲɔ:n	‘pen’	pɔ:n	‘pawnshop’
brɔ:dʲ	‘neck, throat’	brɔ:d	‘drizzle’
skɔ:lʲ	‘shadow’	skɔ:l	‘supernatural being’

### (2) Velarization of non-palatalized consonants before front vowels

/bʲo:/	[bʲo:]	<i>beo</i>	‘alive’	/bo:/	[bo:]	<i>bó</i>	‘cow’
/bʲi:/	[bʲi:]	<i>bí</i>	‘be (imp.)’	/bi:/	[bʷi:]	<i>buí</i>	‘yellow’



Sample analysis for one speaker, velarized vs. palatalized labial fricative before /i:/. Smooth-spline Anova used to find best-fit curve over five repetitions (Davidson 2006).

## References

- Davidson, Lisa (2006). Comparing tongue shapes from ultrasound imaging using smooth-spline analysis of variance. *Journal of the Acoustical Society of America* 120.1, 407-415.
- Öhman, S.E.G. (1966). Coarticulation in VCV utterances: spectrographic measurements. *Journal of the Acoustical Society of America* 39, 151-168.
- Perkell, J. S. & D. H. Klatt (eds.) (1986). *Invariance and variability in speech processes*. Hillsdale, NJ: Erlbaum.