

Investigating universality of consonant and vowel intrinsic F0 effects

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1. Background

- Vowel and Consonant intrinsic F0 effects (VFO, CFO) have been attested in almost every language in which it has been studied (Ohde 1984, Whalen & Levitt 1995, Gonzales 2009, among others)

	VFO	CFO
F0 pattern	High > Low	Voiceless > Voiced

- Many have referred to these effects as **'universal'** potentially stemming from articulatory gestures inherent to the segments (Halle & Stevens 1971, Löfqvist et al. 1989, Kingston & Diehl 1994)
- If these effects are truly universal, we might expect all languages to show the effect in the same way (i.e. in terms of both effect size and duration)

Gaps in previous work:

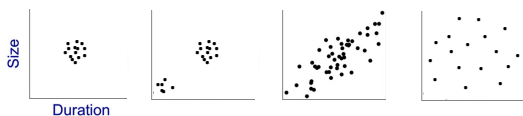
- A cross-linguistic comparison exists for VFO effect size (meta-analysis of 31 languages: Whalen & Levitt 1995)
- Larger scale studies have been done recently for CFO effect size (Sonderegger et al. 2017, Babinski 2020)
- Previous studies show variation that may provide conflicting evidence for a universal explanation (e.g. languages with opposite CFO patterns (Xu & Xu 2003, Francis et al. 2006), tonal languages with no CFO effect (Connell 2002))

Current study:

- Provides a cross-linguistic comparison for both CFO and VFO that includes both **effect size** and **duration** using comparable data of typologically diverse languages

2. Questions & Hypotheses

- Are CFO effects universal? (i.e. do all languages show a similar CFO effect in terms of both effect size/duration)
- Are VFO effects universal when we consider effect duration?



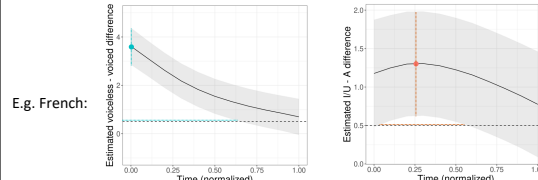
- What can the variation (if any) across languages tell us about intrinsic F0 effects more generally? Are the effects robust (i.e. in the same direction)?
- What are the implications of such variation across languages for processes in sound change?

3. Methodology

- corpus analysis of read speech from 16 languages
 - GlobalPhone (Schultz et al. 2013)
 - Librispeech (Panayotov et al. 2015)
- aligned & extracted using Montreal Forced Aligner, PolyglotDB (McAuliffe et al. 2017)
- CV in utterance-initial position; Vowels: [i], [u], [a]

Analysis

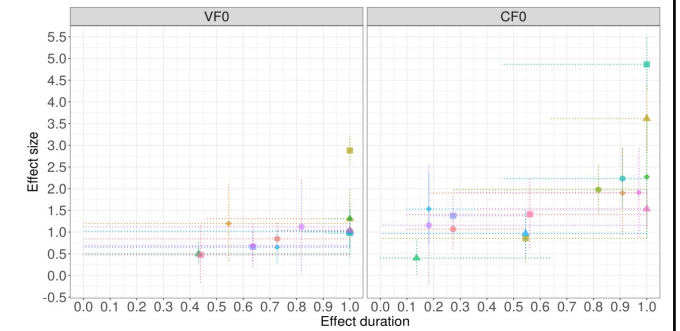
- 1 GAMM per language (F0 semitones; Predictors: VOICING, VOWEL, TONE (where applicable); Random smooth & intercepts for speakers & words, respectively)
- (voicing contrast defined as "most voiced" and "least voiced" per language, in terms of VOT)
- Estimated smooths for VOICING + VOWEL on F0 over time:



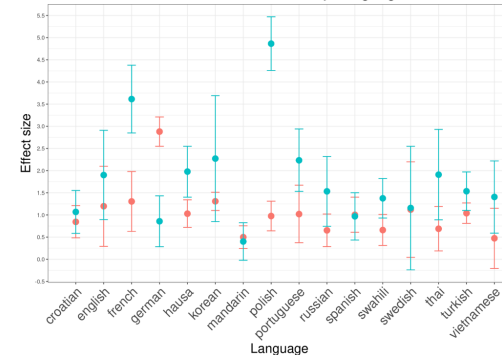
E.g. French:

4. Results

- Languages differ both in effect size and duration
- There is no clear correlation between effect size and duration
- No categorical split between tonal vs non-tonal languages (though more work on tonal languages should be considered)



Intrinsic F0 Effect Size by Language



language

- croatian
- english
- french
- german
- hausa
- korean
- mandarin
- polish
- portuguese
- russian
- spanish
- swahili
- swedish
- thai
- turkish
- vietnamese

- Comparing intrinsic F0 effects within languages:
- (For most): CFO > VFO
- There is an overall range of effect size for both CFO and VFO, though some languages (e.g. Mandarin, Polish, French) deviate from the average tendency

5. Conclusions

- CFO effect is fairly robust in that it exists (and is in the same direction) in nearly all the languages examined in this comparison. However, it is clear that the effect is not uniform across languages.
- Variation exists both in terms of effect size and duration across languages
- This variation is in line with recent proposals that there are multiple mechanisms involved (Xu & Xu 2021)
- The VFO results for effect size replicate previous findings (and cross-linguistic comparison by Whalen & Levitt 1995): almost all languages show a VFO effect, but when compared with CFO, VFO effect size is smaller overall
- This may be in line with the generalization/tendency for CFO to potentially lead to sound change processes (e.g. tonogenesis) while VFO effects do not

Acknowledgements

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