

INVESTIGATING UNIVERSALITY OF INTRINSIC F0 EFFECTS

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INTRINSIC F0 EFFECTS

Vowel Intrinsic F0 (VF0)

- F0 affected by vowel *height*
- F0 for high vowels > low vowels

Consonant Intrinsic F0 (CF0)

- F0 affected by *voicing*
- F0 following “voiceless” > “voiced”

Automatic/
Controlled/
both

Meyer 1896, Tayler 1933, Lehiste 1976, Shadle 1985, Whalen & Levitt 1995, Whalen et al. 1995, Connell 2002, Esposito 2002, Gonzales 2009, Hoole & Honda 2011, Van Hoof & Verhoeven 2011

House & Fairbanks 1953, Lehiste & Peterson 1961, Kingston 2007, Hombert 1978; Kohler 1982; Ohde 1984; Kingston & Diehl 1994; Hanson 2009; Dmitrieva et al. 2015, Kirby & Ladd 2016; Coetzee et al. 2018; Kirby 2018; Gao & Arai 2019; Kirby et al. 2020

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sound change

F0 perturbations for voicing →
lexical tone

Why?

PREVIOUS STUDIES

- Vast literature on VF0 and CF0, (mostly) independently
- But comparisons across languages/studies is difficult
 - primarily small number of speakers
 - lab speech, different methodologies
- How can make comparisons across languages?
 - How can we look at the distribution of these effects?

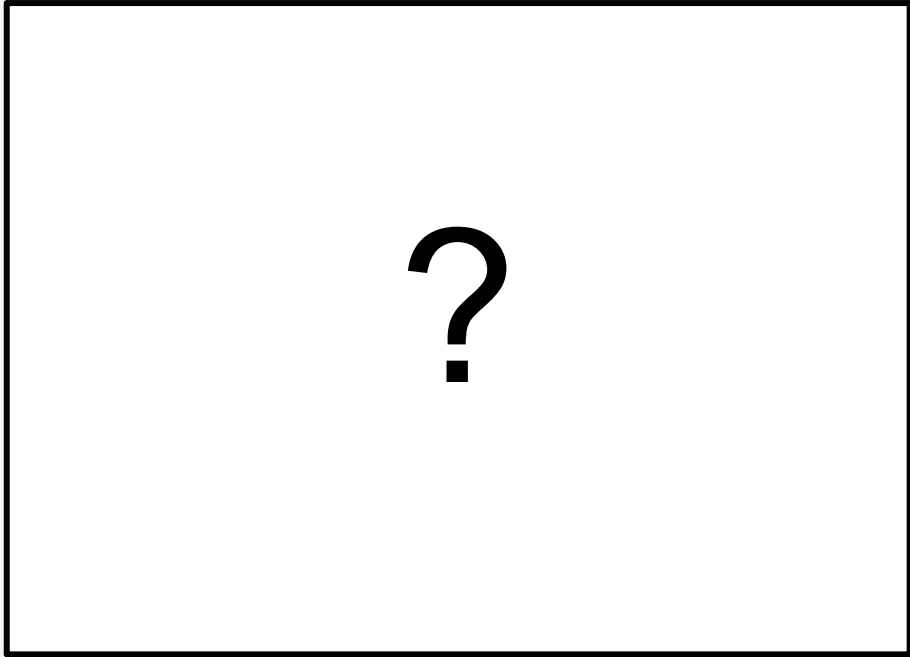
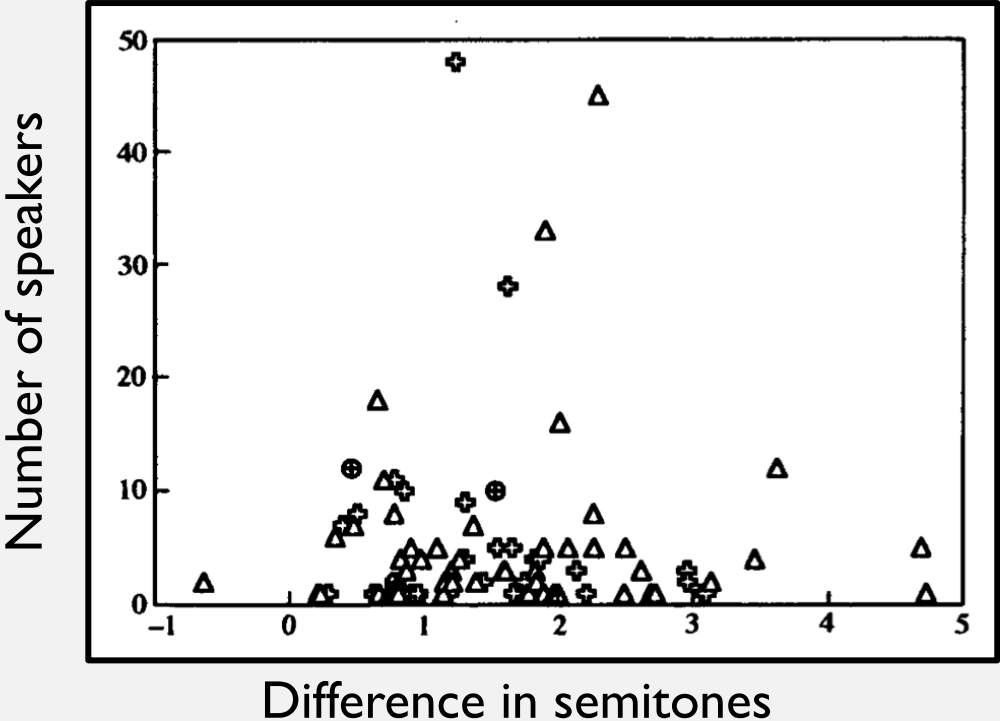
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- One potential solution: meta-analysis

META-ANALYSIS

VF0

CF0



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- Another potential solution: cross-linguistic corpus analysis

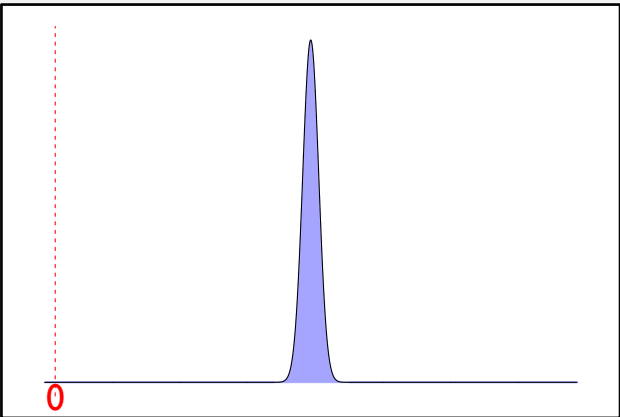
QUESTIONS

1. Do we find VF0 and CF0 across all languages?
2. What is the distribution of these effects across languages?
 - How (much) do they differ?
 - In what ways? (size, duration)
3. What is the relationship between VF0 and CF0?
 - This can tell us more about:
 - the extent to which these effects are automatic vs controlled
 - their role in sound change

POSSIBLE OUTCOMES

DISTRIBUTION OF IF0 EFFECTS

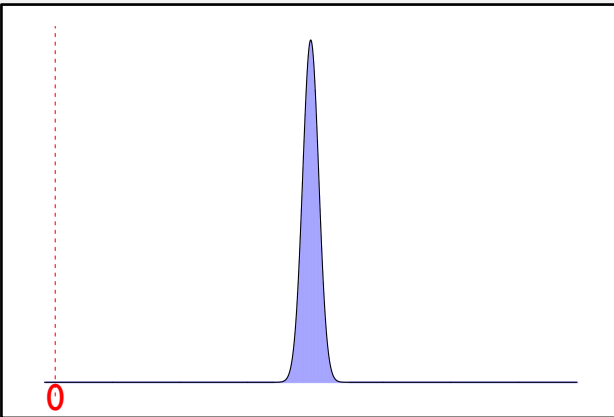
DISTRIBUTION OF IFO EFFECTS



Automatic
(version 1.0)

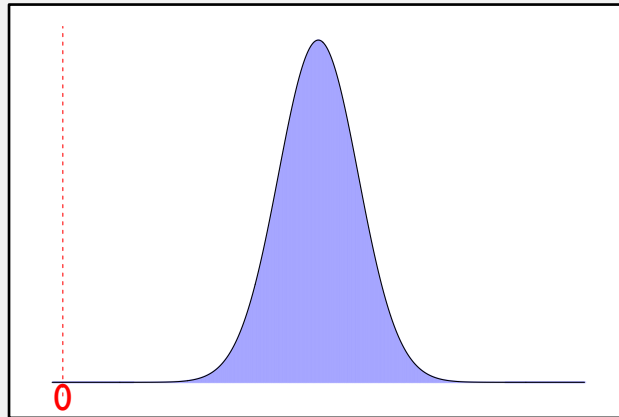
All languages
the same

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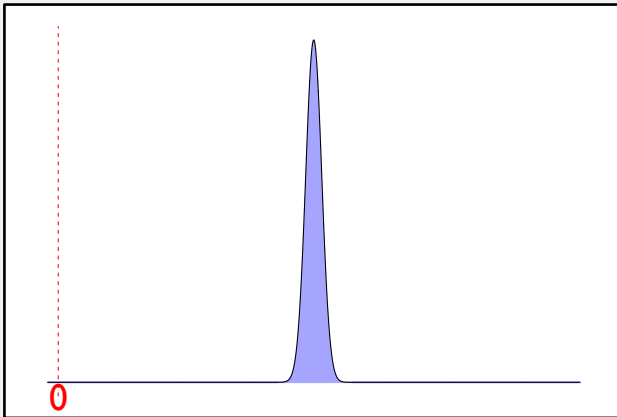
All languages
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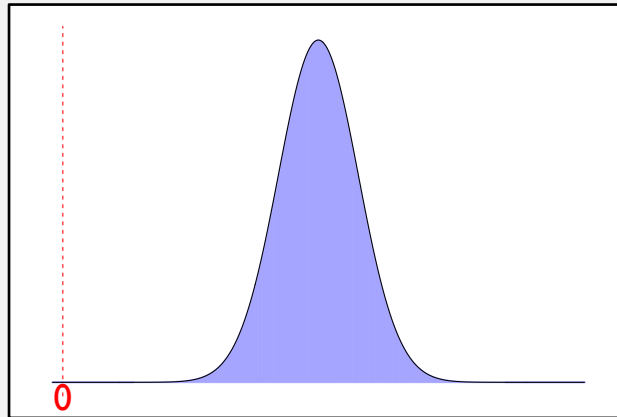
Automatic
(version 2.0)

Some variation

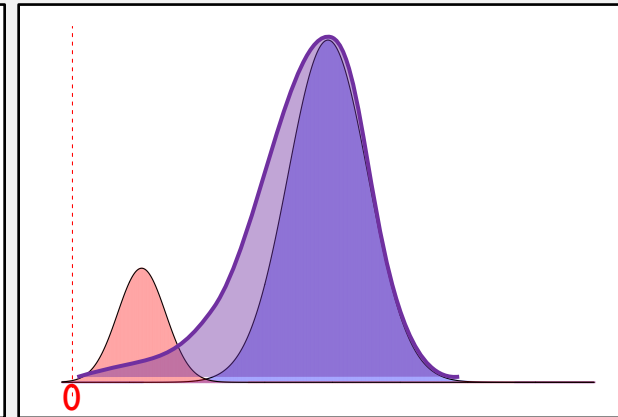
DISTRIBUTION OF IF0 EFFECTS



Automatic
(version 1.0)



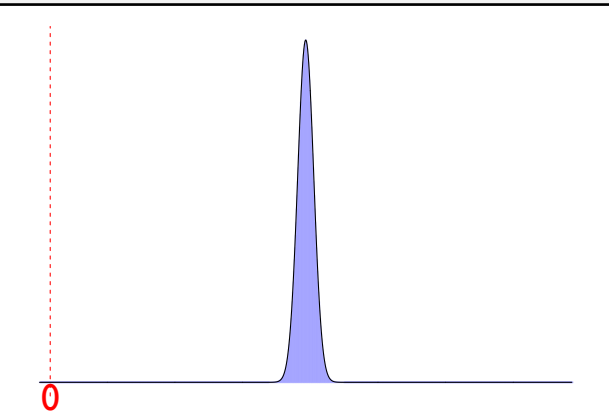
Automatic
(version 2.0)



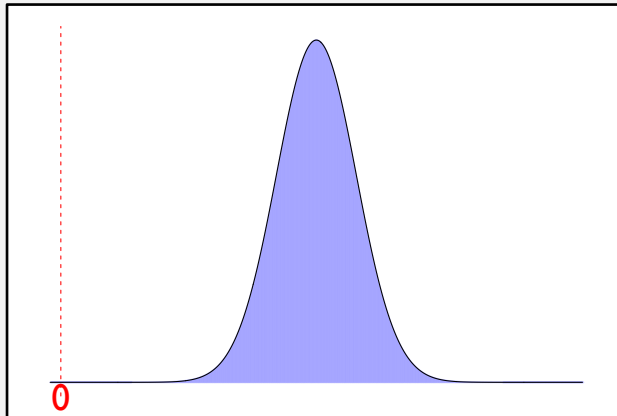
Controlled

Some languages
have a smaller
effect

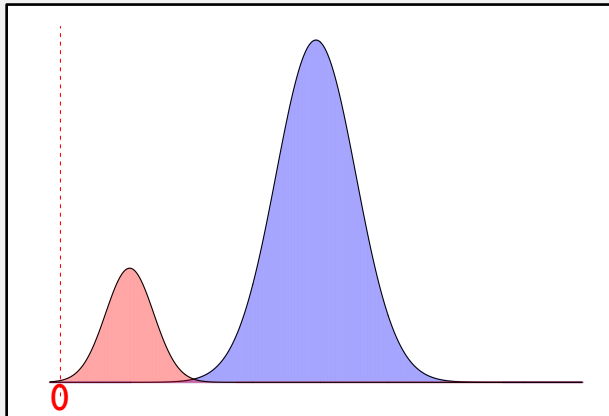
DISTRIBUTION OF IFO EFFECTS



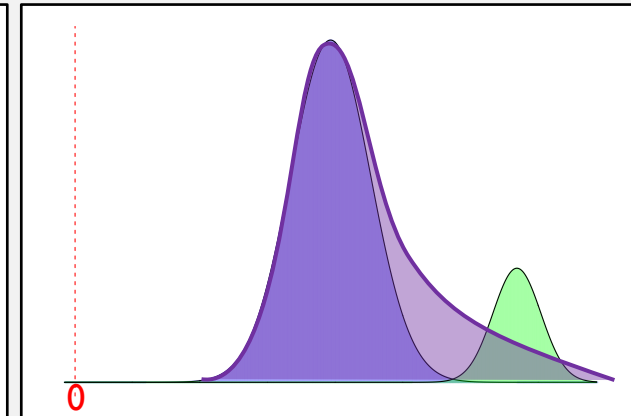
Automatic
(version 1.0)



Automatic
(version 2.0)



Controlled



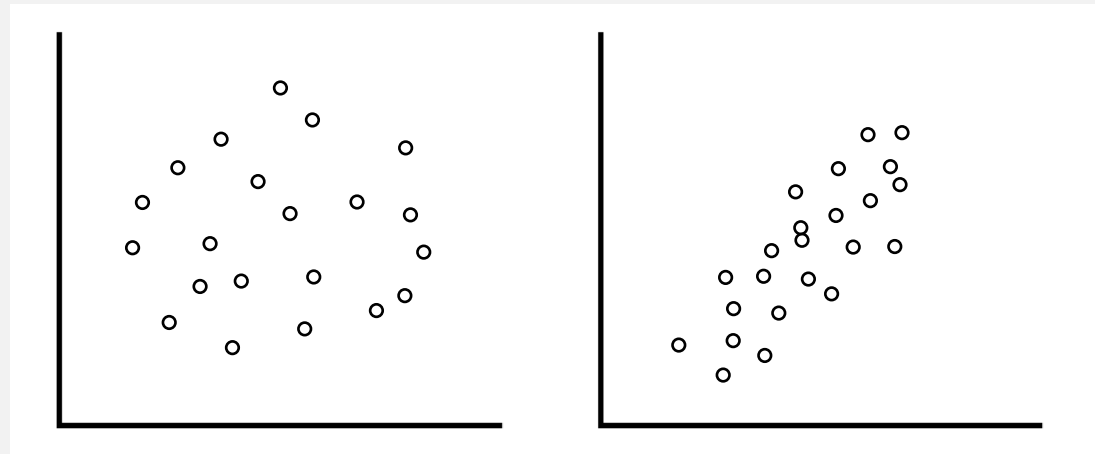
Controlled

Some languages
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effect

RELATIONSHIP BETWEEN INTRINSIC F0 EFFECTS

- Between intrinsic F0 effects:
- Are VF0 and CF0 correlated?

SOME POSSIBILITIES



No correlation

Positive Correlation

Different mechanisms responsible for different IFO effects

Languages restrict *any* F0 differences for functional reasons

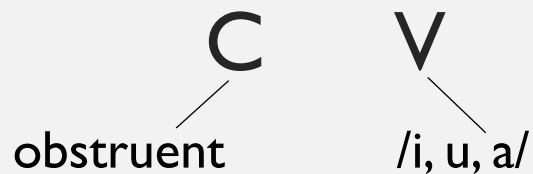
Languages are free to enhance one or the other, or both

Hoole & Honda 2011

Xu & Xu 2021

CURRENT STUDY

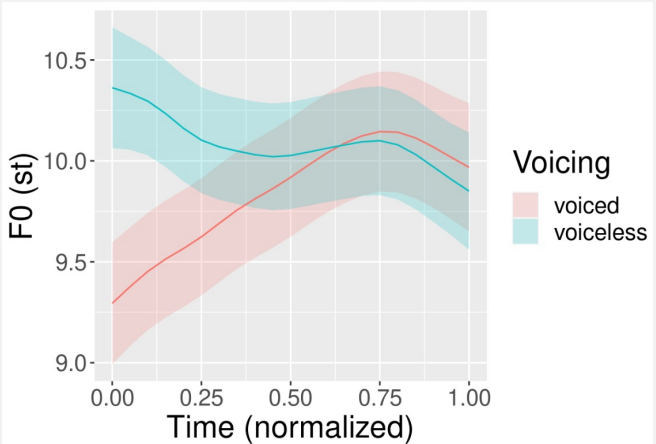
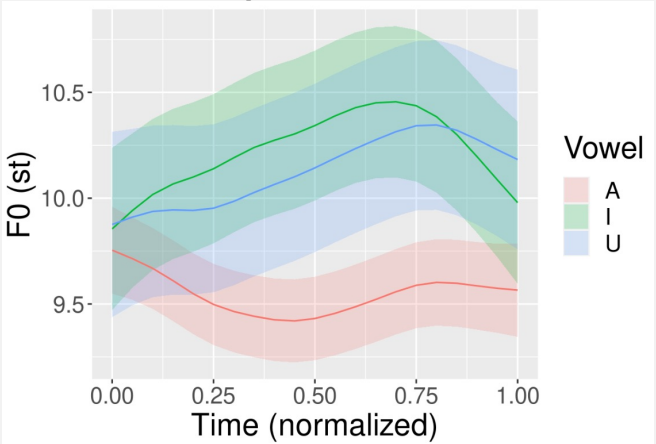
- 16 languages from read-speech corpora:
- Methods:
- forced-aligned read sentences
- measured F0 from utterance-initial CV syllables
- after exclusions: 69-132 speakers and 0.7-8.1k vowels per language



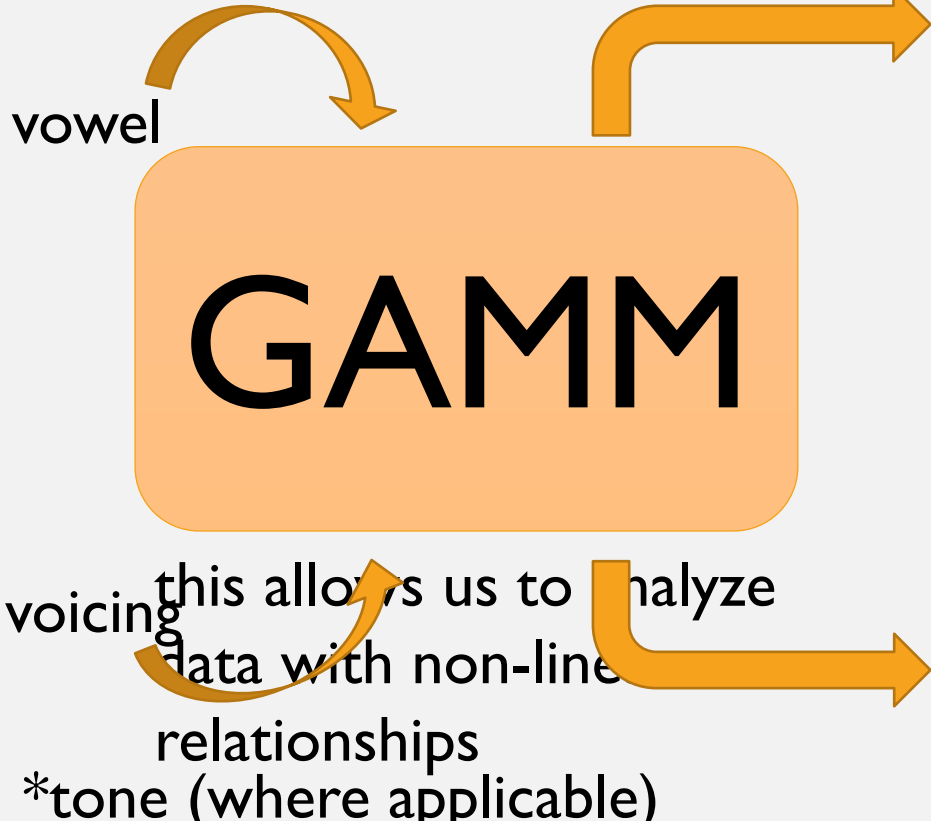
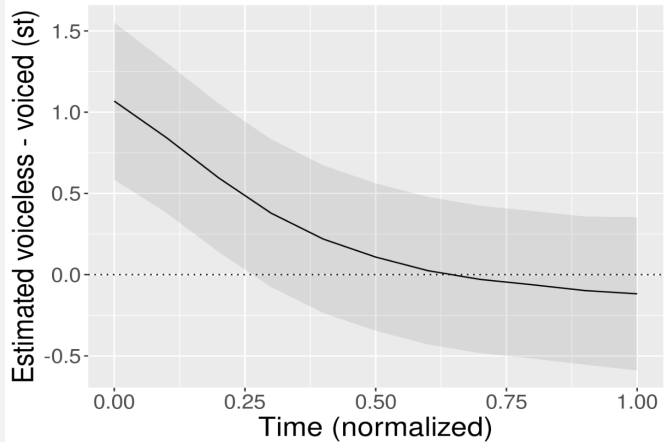
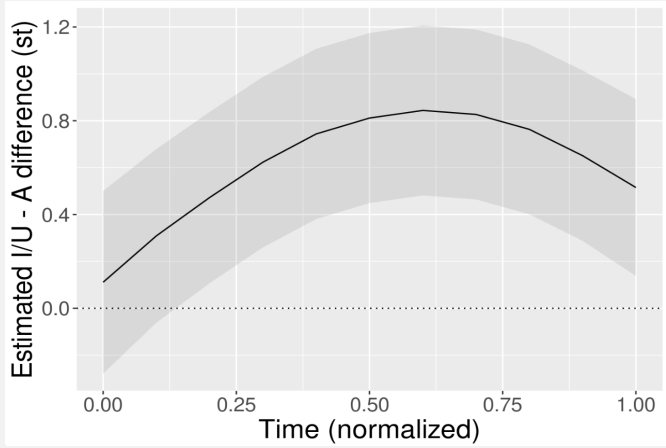
Language
Croatian
English
French
German
Hausa
Korean
Mandarin
Polish
Portuguese
Russian
Spanish
Swahili
Swedish
Turkish
Thai
Vietnamese

ANALYSIS

Empirical Data



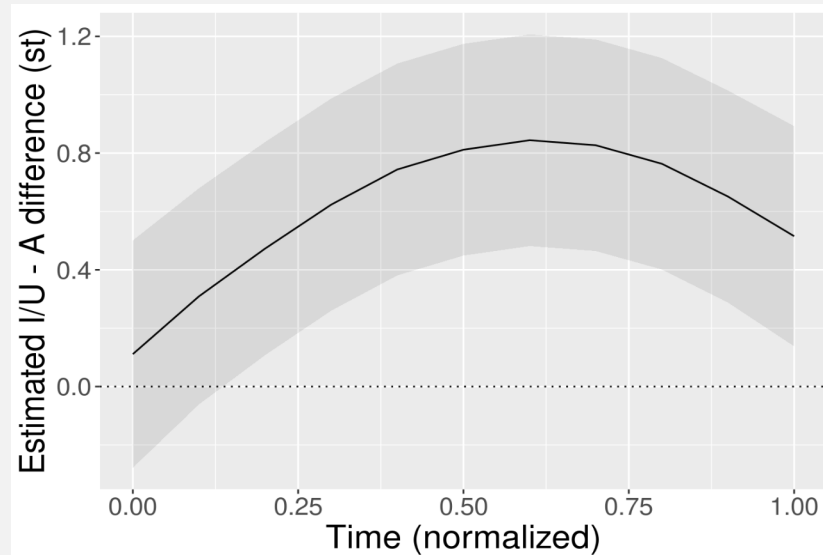
Model Predictions



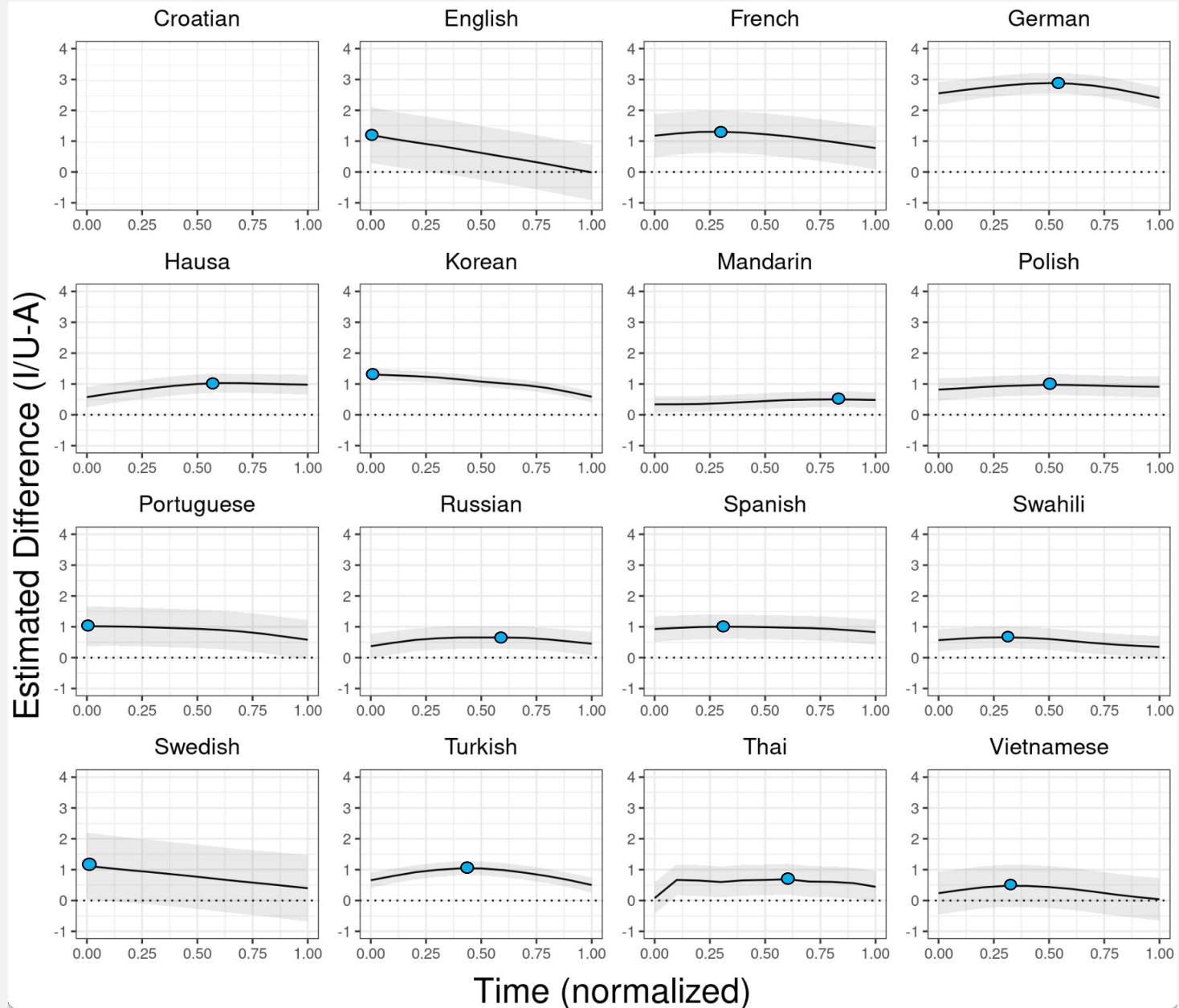
RESULTS

VF0 RESULTS

- One difference smooth per language:
- difference in F0 between High vs Low vowels, over time

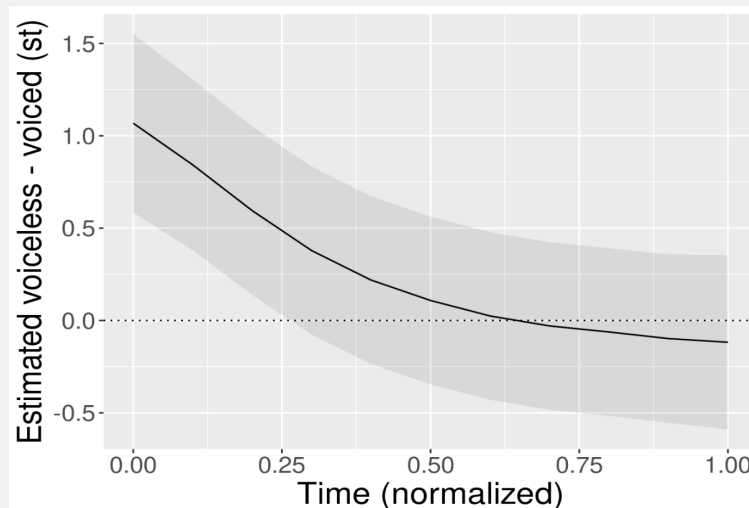


VFO RESULTS

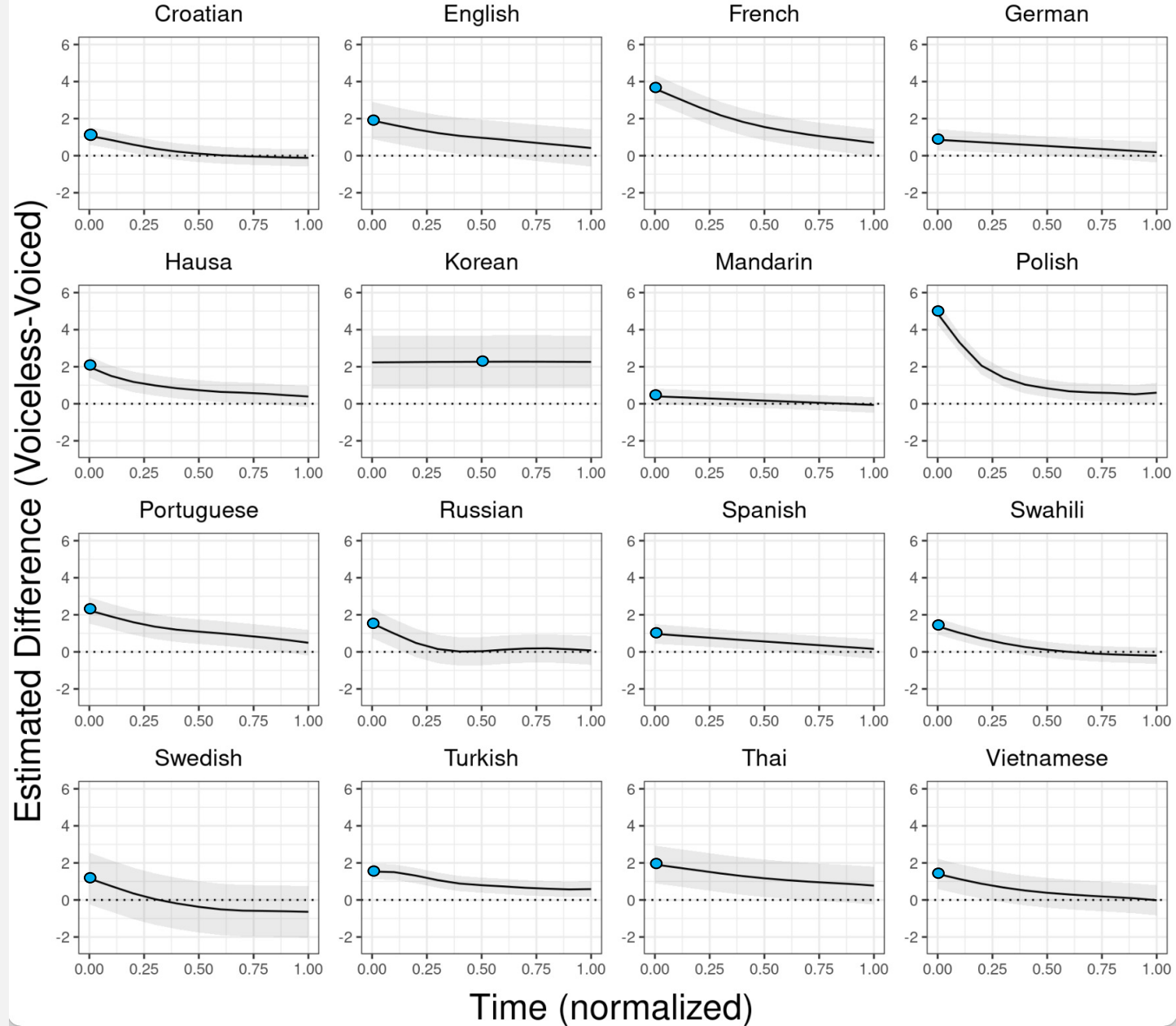


CF0 RESULTS

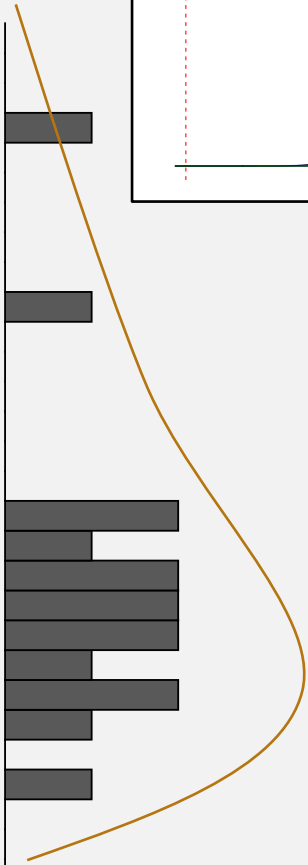
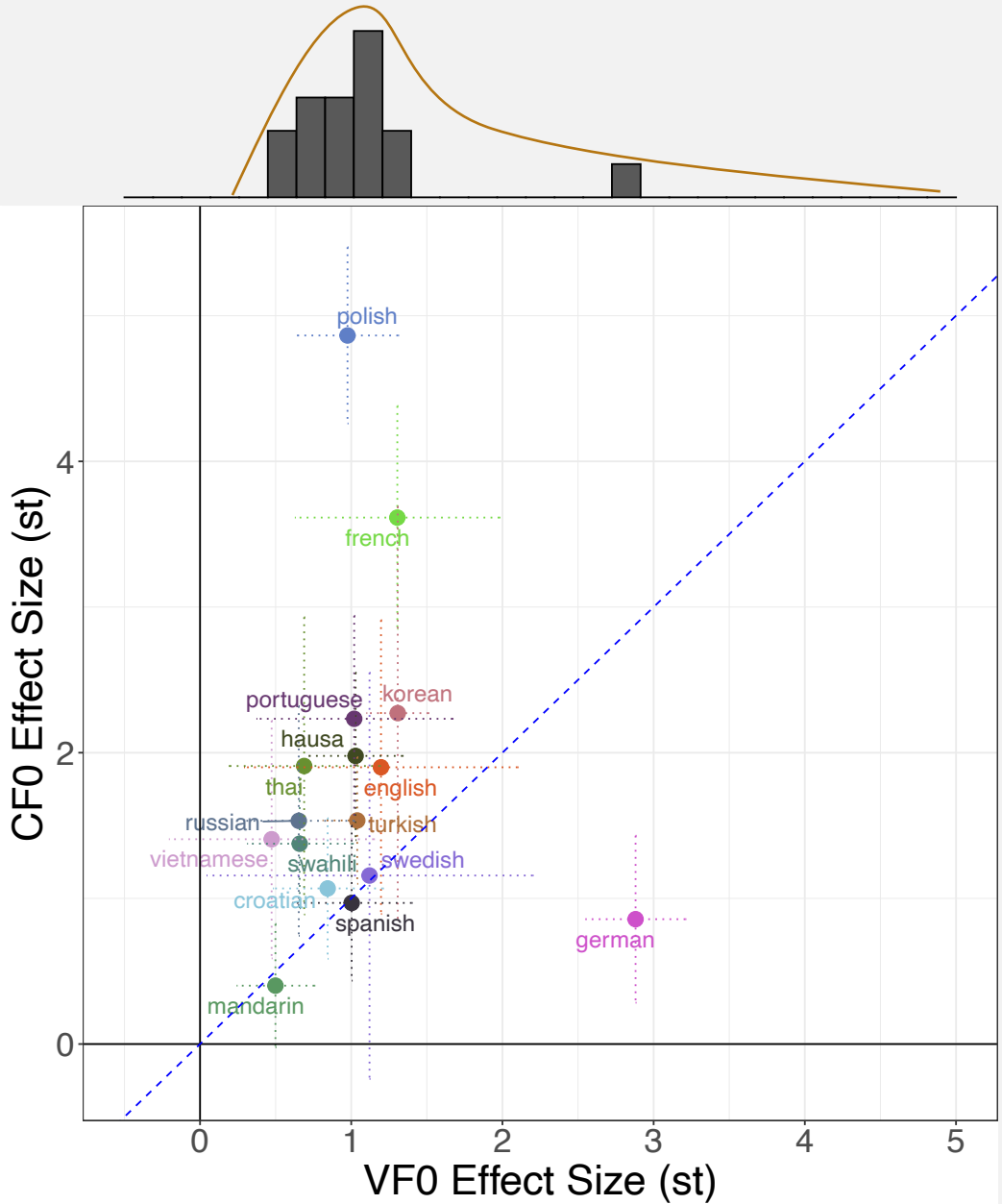
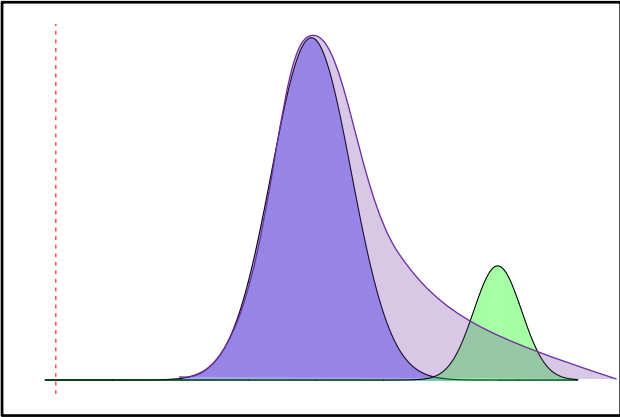
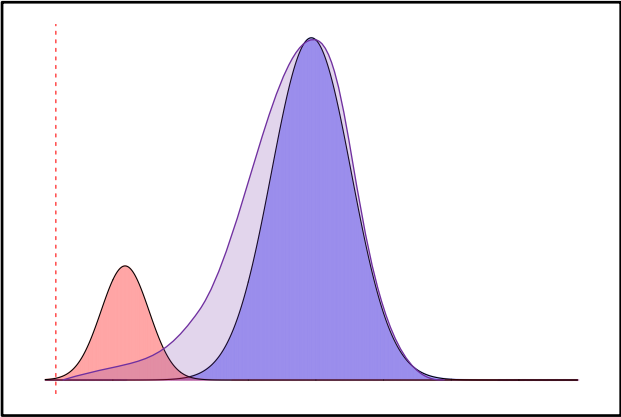
- One difference smooth per language:
- difference in F0 between voicing categories
- (“most voiceless” – “most voiced”)



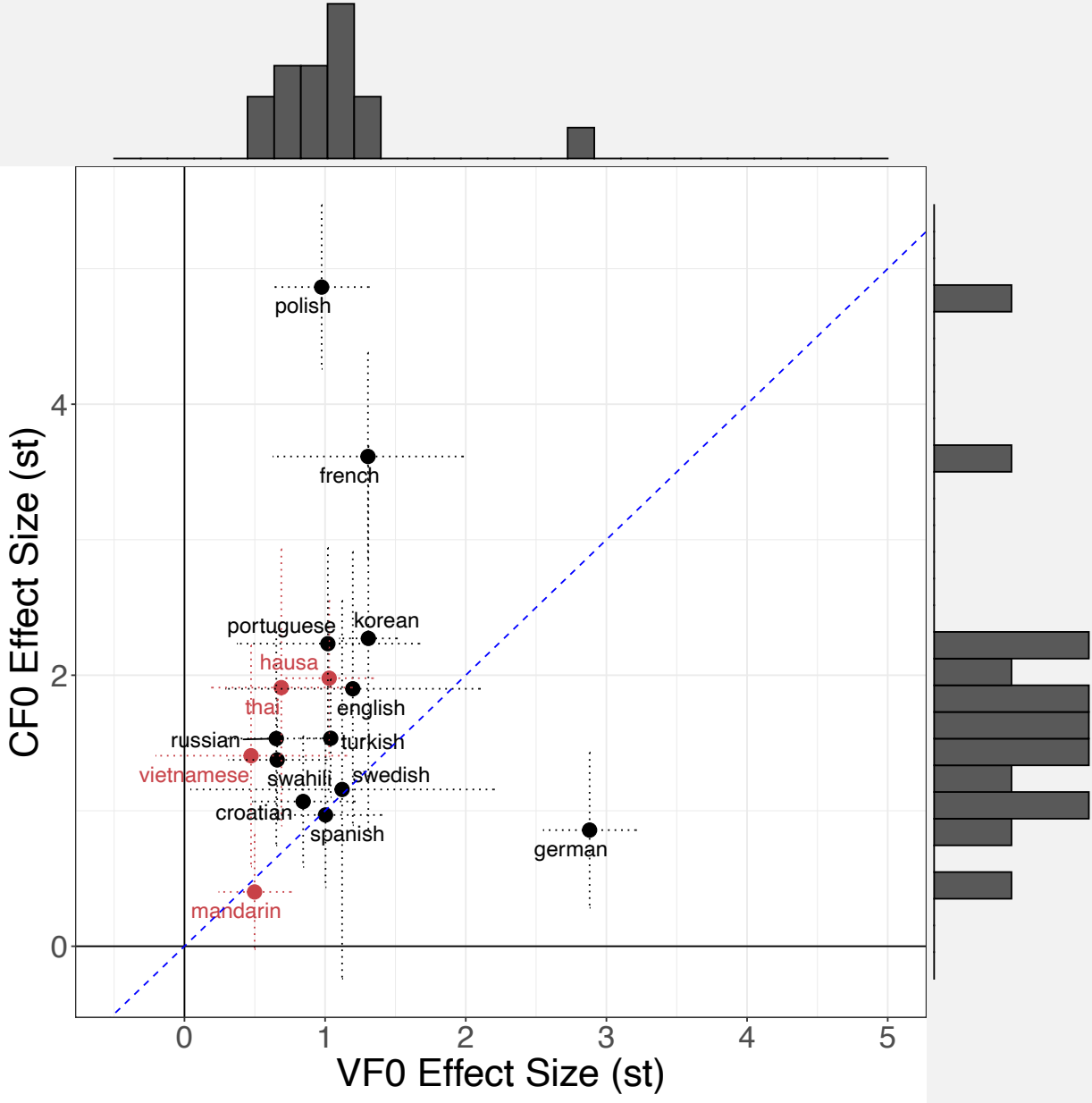
CF0 RESULTS



VF0 & CF0 DISTRIBUTION – EFFECT SIZE

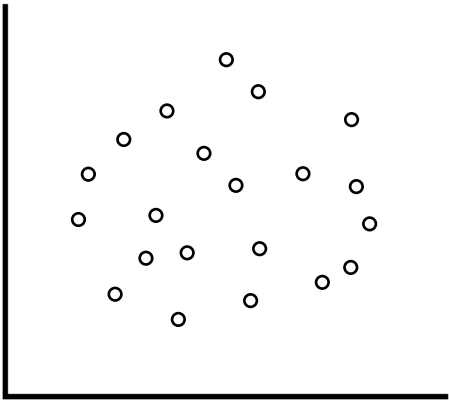


VF0 & CF0 DISTRIBUTION – EFFECT SIZE

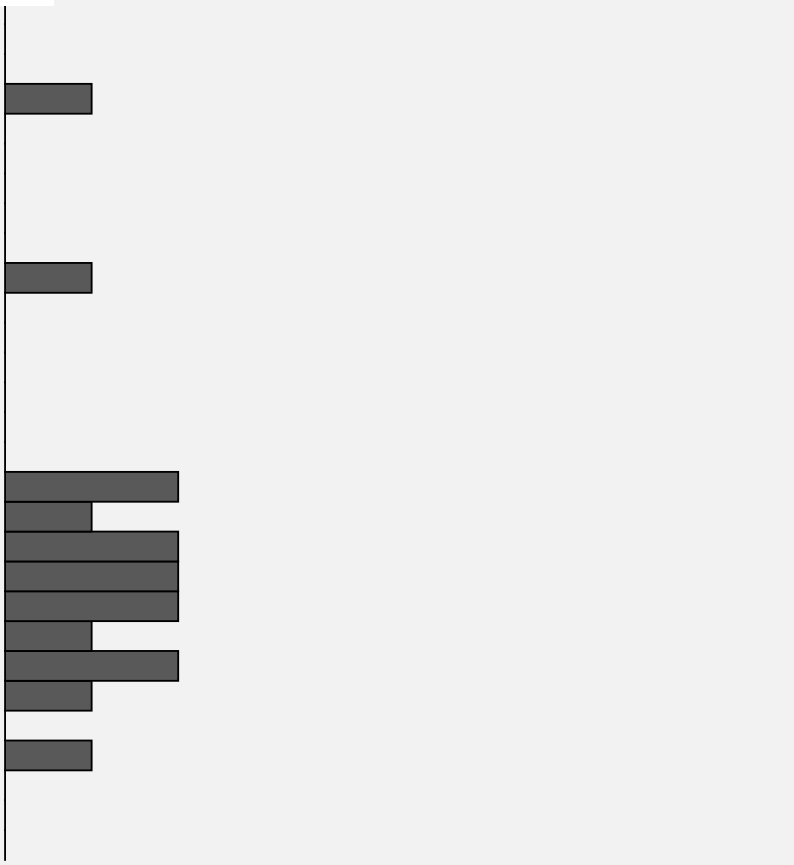
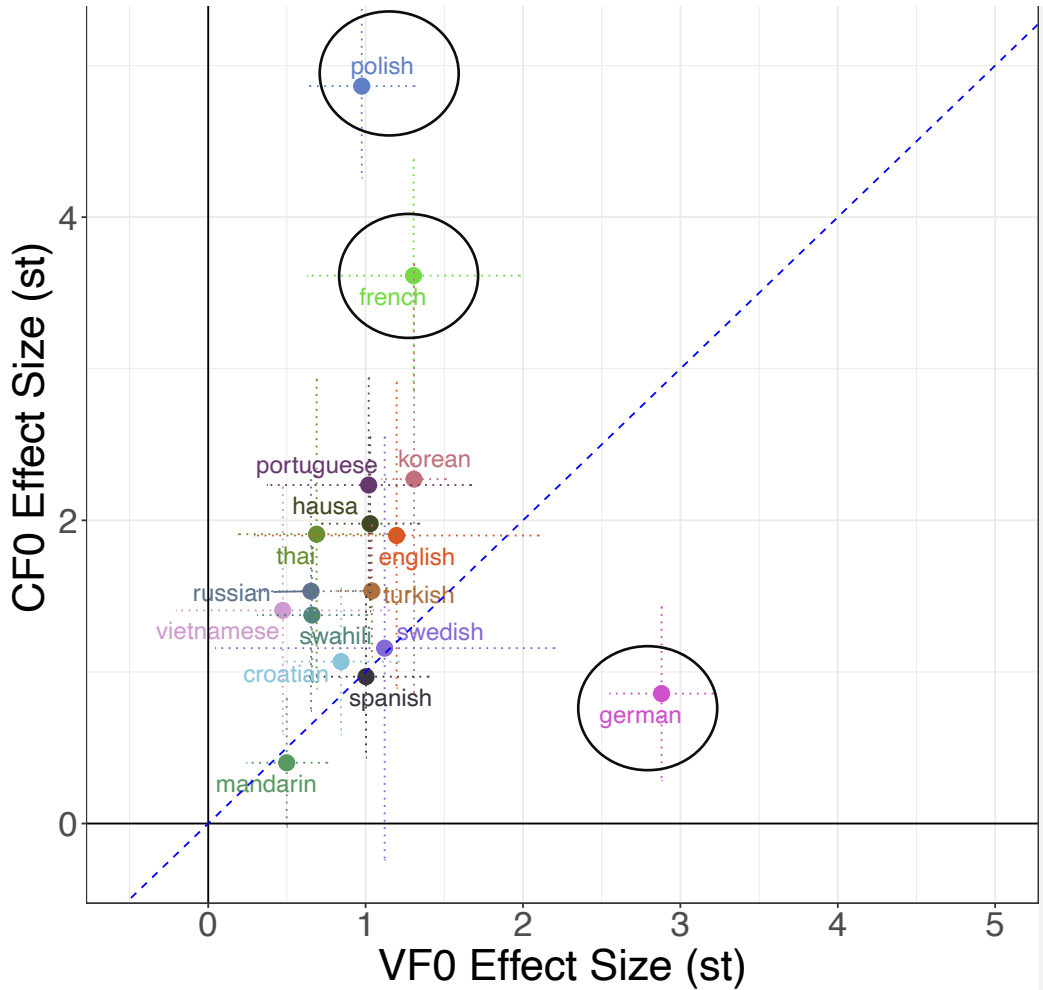
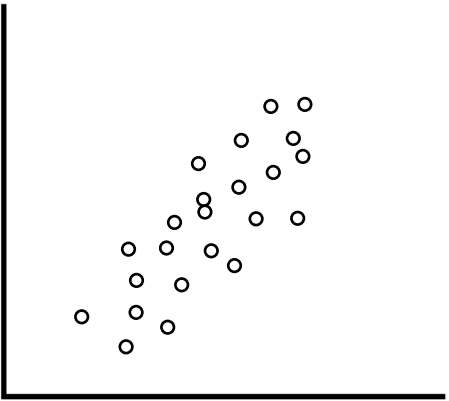


Tonal Languages

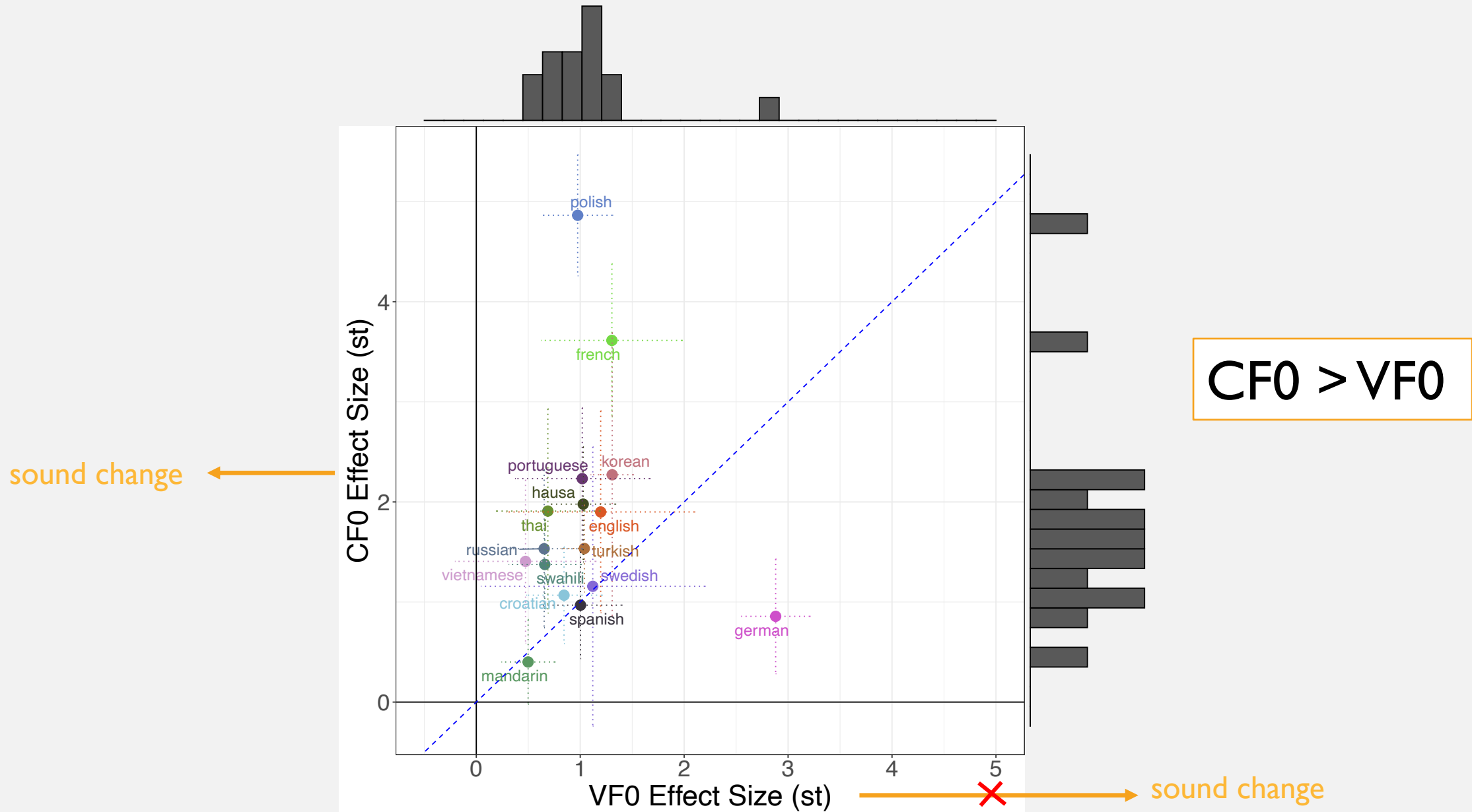
VFO



SIZE



VF0 & CF0 RELATIONSHIP – EFFECT SIZE



SUMMARY

DISCUSSION

1. Do we find VF0 and CF0 across all languages? **Yes**
2. What is the distribution of these effects across languages?

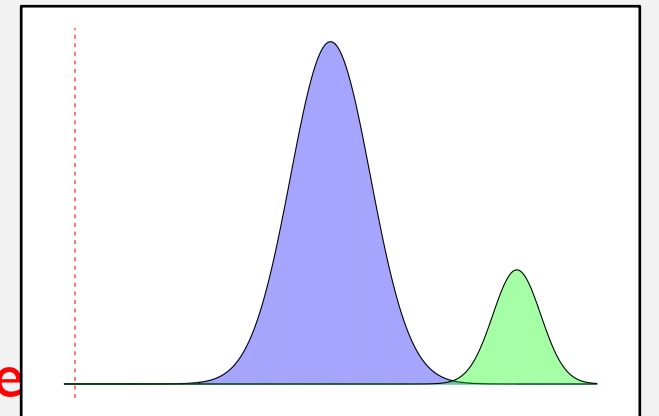
Many languages pattern together, but there are languages that show a relatively larger IF0 effect

No clear evidence that tonal languages pattern together

3. What is the relationship between VF0 and CF0 effect size?

CF0 > VF0

Positive/no correlation, but 3 languages show enhancement



DISCUSSION

Examining the relationship and distribution of intrinsic F0 effects tells us:

- enhancement of one or the other suggests separate mechanisms at play
 - these may be targeted separately for phonologization
- more about VF0 and CF0 as precursors to sound change
 - $CF0 > VF0$

THANK YOU!

SSHRC  CRSH



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