

Context effects on Voice Onset Time (VOT)

Voice Onset Time (VOT) in English voiceless stops has been shown to be sensitive to factors such as:

- place of articulation (Fischer-Jørgensen 1954)
- contextual factors:
 - height, tenseness, and duration of the following vowel (Klatt 1975)
 - voicing of coda consonants (Port and Rotunno 1979)
- prosodic factors:
 - stress and pitch (Lisker and Abramson 1967)
 - fundamental frequency (McCrea and Morris 2005)
 - speaking rate (Kessinger and Blumstein 1998, Allen et al. 2003).

We report two additional factors involving following liquids and following voiceless onsets.

Methods

- Participants: 123 Canadian English speakers in Ottawa, Ontario (85 female; age: mean=20.7, sd=3.43)
- Materials: 120 /p/- and /k/-initial words, 30 fillers
- VOTs of 14663 initial stops were measured semi-automatically and all other segment durations were measured using forced alignment and hand correction.
- First pass using Penn Phonetics Lab Forced Aligner (Yuan and Liberman 2008) (10ms time resolution) + corrected aspiration.
- Trained new segment HMMs with 5ms time resolution and separate models for plosive closure/release, affricate stop/fricative intervals, and diphthong nucleus/offglide, followed by hand correction of duration outliers.

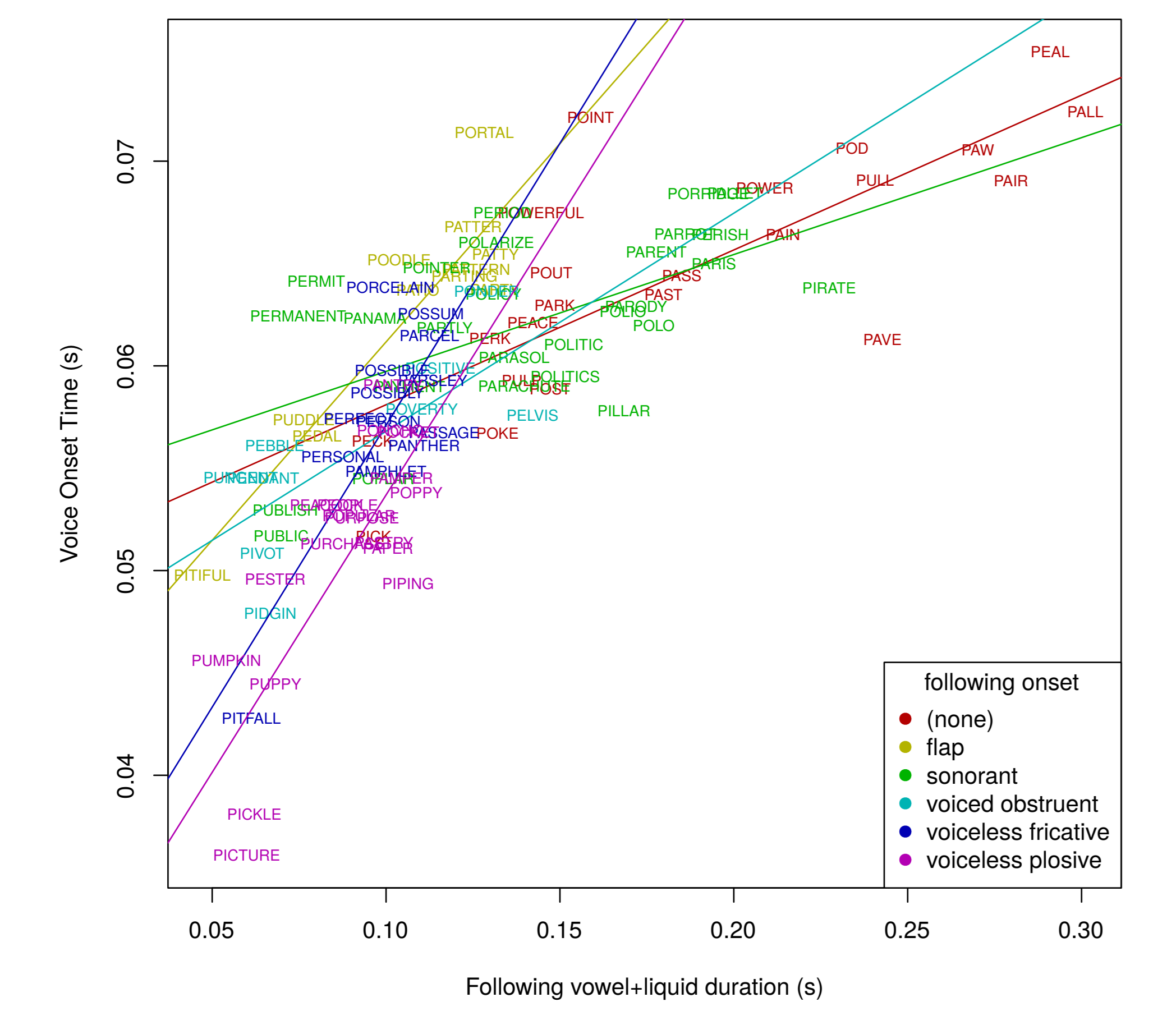


Figure 1: VOT, vowel-liquid duration, and following onset manner

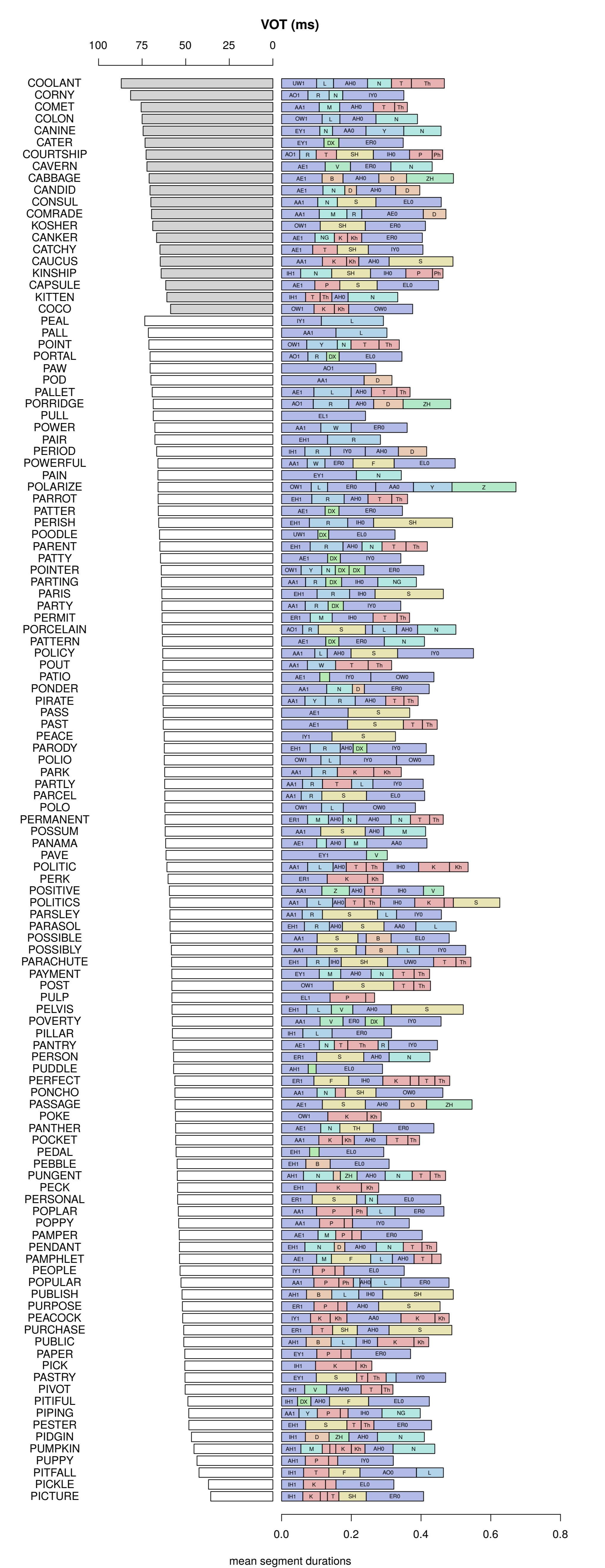


Figure 2: Mean VOT and segment duration by word

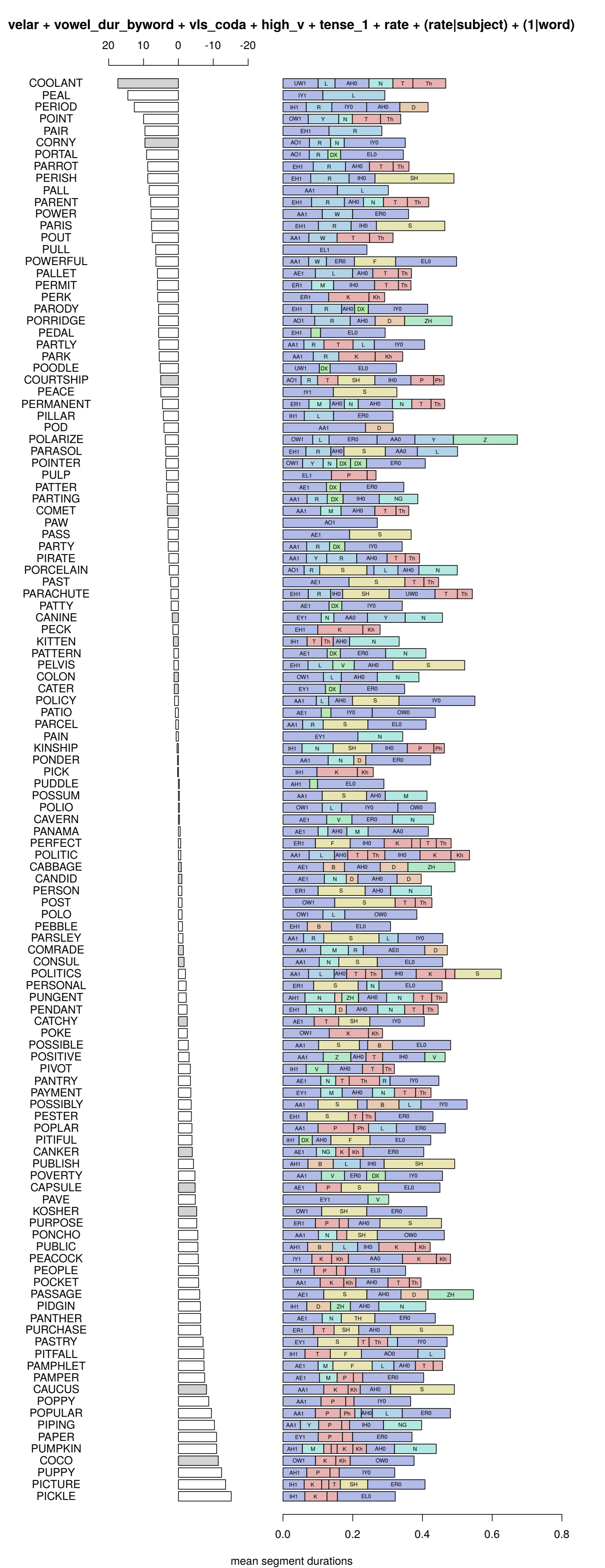


Figure 3: Random effects and segment durations: model 1

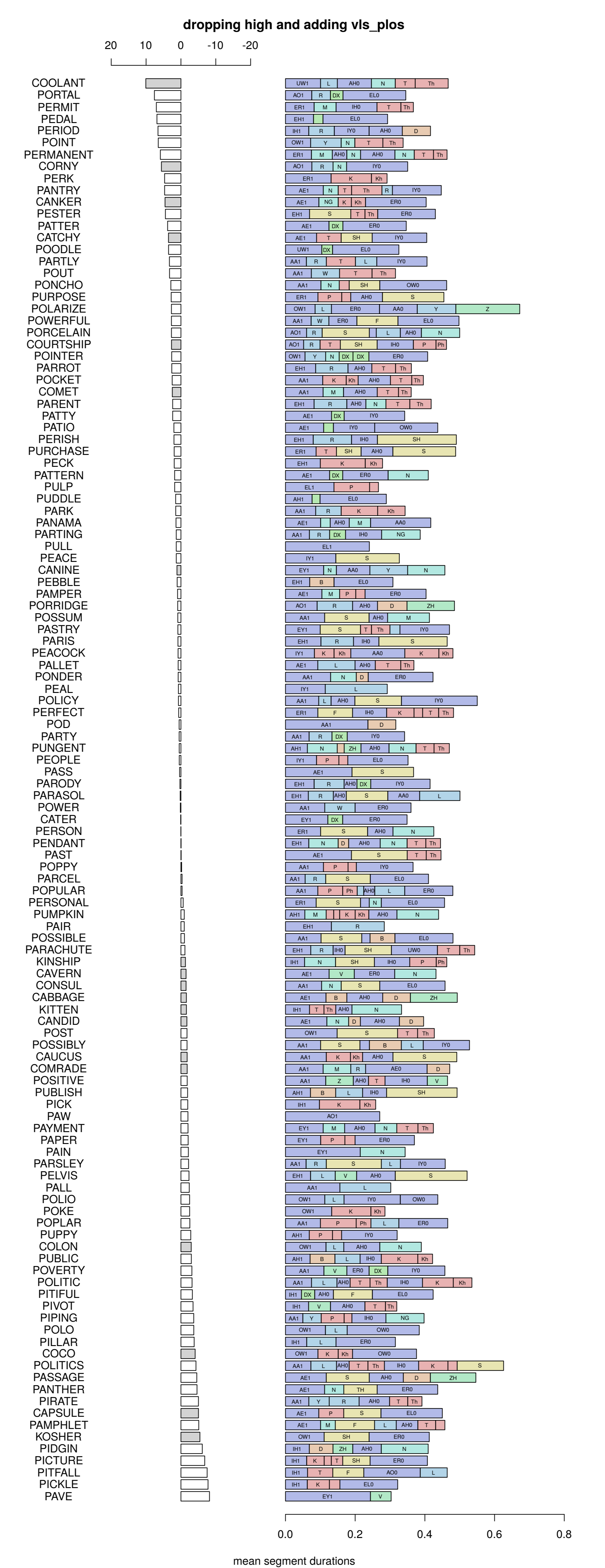


Figure 4: Random effects and segment durations: model 5

Model comparison

- **Model 1:** $vot \sim velar + vowel\text{-}dur\text{-}byword + vls\text{-}coda + high\text{-}v + tense + rate + (rate|subject) + (1|word)$ [$k = 12$, AIC=-84156, logLik=42090]
- **Model 2:** duration measure includes **entire nucleus** (vowel + following liquid or glide) [$k = 12$, AIC=-84183, logLik=42103, significant improvement]
- **Model 3:** duration measure also includes **immediately following liquid onsets** [$k = 12$, AIC=-84233, logLik=42129, significant improvement]
- **Model 4:** omitting vowel **height** factor [$k = 12$, AIC=-84233, logLik=42128, no difference]
- **Model 5:** adding **voiceless plosive onset** factor [$k = 12$, AIC=-84278, logLik=42151, significant improvement]
- Basing duration measure on **entire sonorant span** makes the model worse.
- Basing the duration measure on **tokens** instead of average by word makes the model worse.
- Adding **monosyllabicity** as a factor does not improve the model (effect is mediated by vowel/glide/liquid duration).
- Adding speaker **sex** as a factor does not improve the model

Best model (model 5)

	Estimate	Std. Error	t value
(Intercept)	0.0495217	0.0016057	30.841
velar	0.0115075	0.0009758	11.793
VL-dur-byword	0.0704126	0.0073562	9.572
voiceless coda	-0.0029835	0.0009070	-3.290
tense V	0.0036162	0.0007806	4.632
vls plosive onset	-0.0071711	0.0009521	-7.532
speaking rate	0.0066840	0.0025506	2.621

Conclusions

- The results support earlier findings that VOT is longer in /k/, directly related to following vowel duration, inversely related to speech rate, longer before tense vowels, and shorter before voiceless codas.
- VOT is shorter when the next syllable starts with a voiceless plosive.
- The most relevant measure of vowel duration includes the duration of postvocalic liquids, even those that are typically analyzed as onsets.
- Structured variation in baseline VOT may help in interpreting differences in VOT accommodation.

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Acknowledgments

- This project was funded by SSHRC grant #410-2010-0552 "Data mining sound patterns", CFI grant #15834 "Sound Patterns Laboratory/Laboratoire des structures sonores" to Jeff Mielke and Marc Brunel, and the University of Ottawa.
- Data analysis at North Carolina State University was partly funded by the NCSU Department of English and the College of Humanities and Social Sciences, and NSF grant #BCS 1451475 "Phonological implications of covert articulatory variation".
- Thanks to Sarah Jaleel, Lyra Magloughlin, Alexandra Schwabe, and Eric Wilbanks for help with data collection and analysis, and to members of the Ottawa-Carleton Phonology discussion group and Robin Dodsworth.

