



BROWN

EFFECTS OF FOLLOWING VOICING ON PERCEIVED VOWEL DURATION

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Background

- Vowels are longer before voiced consonants than voiceless consonants in English and many other languages, though some languages lack the effect (Chen 1970; Keating 1979)
- Various explanations have been proposed, driven either by articulatory or perceptual factors (e.g. Chen 1970, Kluender et al. 1988), but the underlying cause remains in question
- The difference in vowel duration is used as a perceptual cue for coda voicing in English (e.g. Port & Dalby 1982)

This study:

- Two experiments on how coda voicing affects perception of preceding vowel duration
- The presence of voiceless codas creates a bias towards categorizing vowels as long
- The acoustic effects of voiceless codas, when the codas themselves have been removed, create a bias towards categorizing vowels as short

Methodology

- **Study 1:** Categorization of vowels in VC nonce words as 'long' or 'short' (24 listeners, native English speakers)

Voiced and voiceless stop codas
Blocks based on vowel quality (/a/, /i/, /u/)
10-step vowel duration continuum
(129 ms to 252 ms)

- **Study 2:** Categorization of isolated vowels as 'long' or 'short' (24 listeners, native English speakers)

Extracted from the same VC nonce words, with the codas and transitions into them removed
Blocks based on vowel quality (/a/, /i/, /u/)
10-step vowel duration continuum
(129 ms to 252 ms)

Summary of results: Regression models

	Estimate	Std. Error	t value	p value
(Intercept)	-2.35	0.22	-10.7	< 0.0001***
DurationStep	0.31	0.016	18.9	< 0.0001***
CodaVoicing-Voiceless	0.41	0.086	4.83	< 0.0001***
Vowel-i	0.58	0.11	5.54	< 0.0001***
Vowel-u	0.72	0.11	6.785	< 0.0001***
ResponseTime	-0.023	0.070	-0.33	0.974

Table 1: Generalized linear mixed effects model for 'long' responses in Study 1
Intercept: Voicing = Voiced, Vowel = a

	Estimate	Std. Error	t value	p value
(Intercept)	-2.21	0.17	-13.1	< 0.0001***
DurationStep	0.46	0.015	30.6	< 0.0001***
OrigCodaVoicing-Voiceless	-0.51	0.074	-6.85	< 0.0001***
Vowel-i	0.039	0.90	0.44	0.66
Vowel-u	-0.20	0.90	-2.27	0.024*
ResponseTime	-0.022	0.069	-0.32	0.74

Table 2: Generalized linear mixed effects model for 'long' responses in Study 2
Intercept: Voicing = Voiced, Vowel = a

Study 1: Vowels with codas present

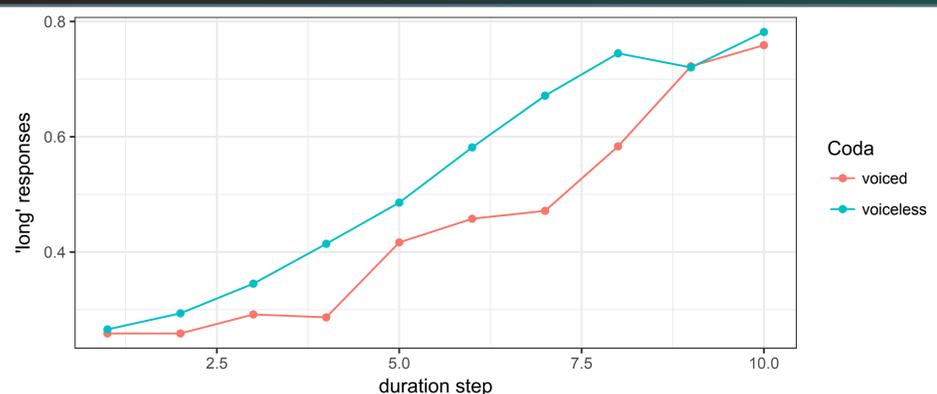


Figure 1: 'long' responses, by coda voicing

Coda voicing was a significant factor; listeners gave more responses of 'long' when the coda was voiceless than when it was voiced
This effect follows from knowledge of English phonology; shorter durations are expected in this environment, so listeners compensate in their threshold for 'long' vowels
A similar compensatory pattern for vowel qualities of different intrinsic duration (see Table 1)

Study 2: Vowels with codas spliced out

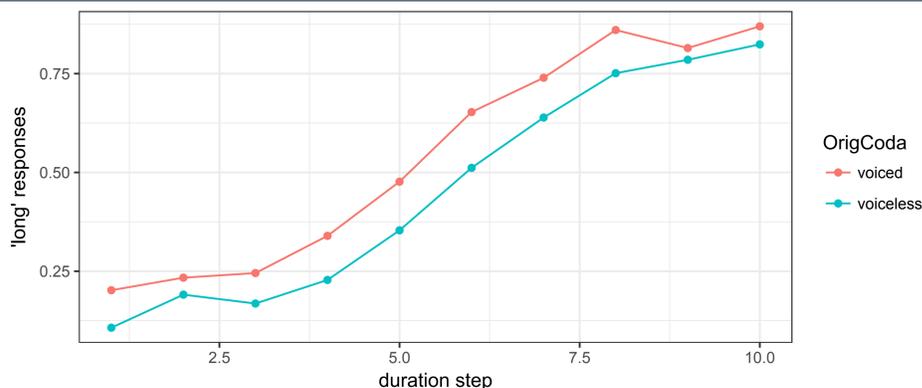


Figure 2: 'long' responses, by original coda voicing

More responses of 'long' for vowels produced before a voiced coda, when that coda was removed
Suggests an effect of acoustic differences within the vowels; note that this is the opposite of the effect when codas were present
Several acoustic characteristics of vowels are influenced by following consonants; vowels before voiced stops have a lower F0, lower F1, higher harmonics-to-noise ratio, and less jitter

Conclusions

Effects of phonologically expected duration

- Vowels are longer before voiced consonants, so their duration is used as a cue for coda voicing
- Similarly, codas set expectations about vowel duration, with longer durations anticipated before voiced codas
- Suggests that cue interaction is bidirectional, with usage depending on the task

Effects of acoustic characteristics

- Without phonological biases driven by the presence of codas, acoustic differences due to production of coda voicing make vowels from voiced environments sound longer
- Suggests a possible perceptual pathway for a voicing-conditioned vowel duration difference

Selected References

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