

Meta-analytical estimates of the effect of voicing on vowel duration in English are biased

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Background. There is a general understanding that the duration of English vowels is affected by the voicing of the following stop and that the magnitude of such voicing effect is greater in this language compared to other languages (House & Fairbanks, 1953; Lisker, 1974; Peterson & Lehiste, 1960; Chen, 1970; Port & Dalby, 1982). However, in light of the rising concerns for statistical power and publication bias (Roettger et al., 2018), it is fundamental to obtain a meta-analytical estimate of the voicing effect based on previous work, and investigate potential biases that can affect the estimate. The results of a meta-analytical study of the voicing effect in English indicate that this widely researched phenomenon suffers from publication bias towards greater effect sizes, which challenges the accepted view of the effect being relatively greater in English.

Methods. A Bayesian meta-analysis was carried out on 19 Bayesian estimates of the effect of voicing on vowel duration obtained from a selection of 15 studies of English according to the method in Nicenboim et al. (2018). Each study's estimate of the voicing effect was obtained by fitting Bayesian linear models to the means of vowel duration before voiceless vs voiced stops provided in the studies. The Bayesian estimates of each study, with their corresponding standard error, were used to fit a Bayesian meta-analytical error model. The Bayesian estimates (with standard error) were included in the model as the outcome variable, while position of the syllable within the word (word-final vs. non-word-final) and a by-study random intercept were entered as the predictors.

Results. The Bayesian meta-analysis indicates that, based on the estimates obtained from the individual studies, the effect of voicing on vowel duration in word-final syllables is between 52.57–84.8 ms at 95% confidence (estimated mean effect $\bar{\theta} = 69.11$ ms, $SD = 8.2$). The effect of voicing in non-final syllables is 16.32–73.68 ms smaller than the effect in word-final syllables ($\bar{\theta} = -46.68$ ms, $SD = 14.31$). A funnel plot (Figure 1) of each study's estimated difference vs. the estimate precision (calculated as $1/(SD \text{ of the posterior distribution})^2$) suggests that, for the context of final syllables, there are relatively more studies with effects of greater magnitude than the meta-analytical mean estimate (in the absence of bias, the estimates are symmetrically distributed around the mean estimate).

Discussion. While the general understanding is that the effect of consonant voicing on preceding vowel duration in English is comparatively larger than the effect in other languages, a Bayesian meta-analysis indicates that there is a potential bias in the literature concerning the effect in final syllables towards larger effect sizes. This publication bias reduces our confidence in the meta-analytical estimate of the English voicing effect in final syllables and in the estimated difference in final and non-final syllables, suggesting that the true effect is probably smaller than previously thought. In the remainder of the talk, I will compare the estimates from this meta-analysis and the recent study in Coretta (2019) with those in Tanner et al. (2019) from spontaneous speech, in terms of both absolute and relative (ratio) differences in vowel duration, and I will briefly discuss the possible influence of differing speech rates across studies.

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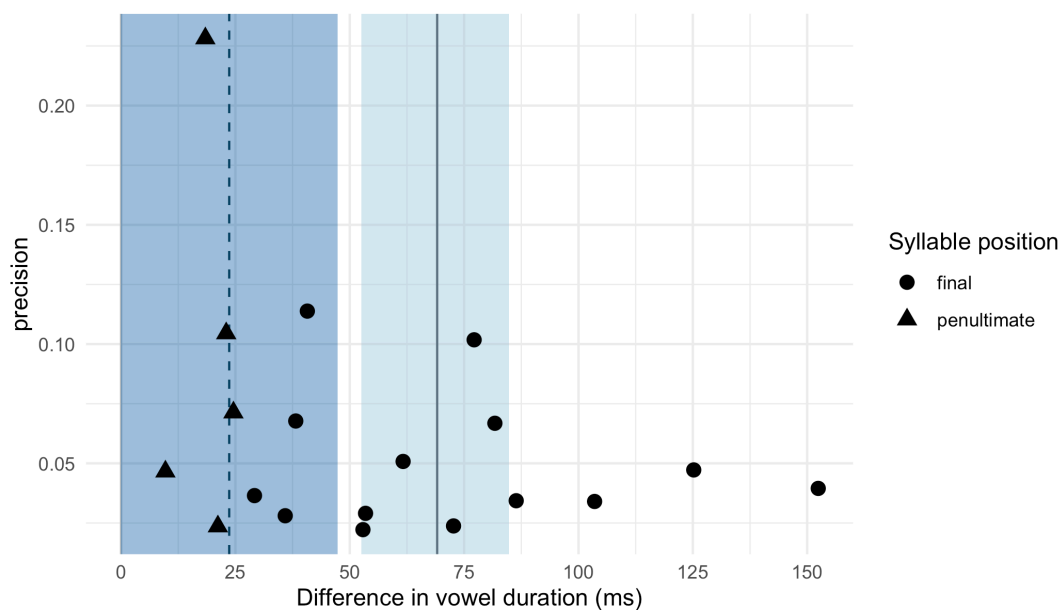


Figure 1: Funnel plot of the studies' estimated difference and estimate precision ($1/(\text{SD of the posterior distribution})^2$). The shaded areas represent the 95% credible intervals of the meta-analytical estimates of the voicing effect in syllable-final (light blue) and non-syllable-final position. The solid and dashed vertical lines are the meta-analytical mean estimates.

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