

1 Is vowel duration an acoustic cue for L2 speakers producing English plosives?

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8 I would like to thank Dr. Terry Kit-fong Au from the University of Hong Kong for  
9 permitting us to conduct acoustic analyses on production data from her research.

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## Abstract

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## Methods

In this study acoustic analyses were conducted on Cantonese speakers' productions of English phonological minimal word pairs with voiced (i.e. /b d g/) and voiceless (i.e. /p t k/) plosives in coda position. The production of the word "got" was excluded from this analysis as it was the only word that did not have a minimal pair. For all other productions, PRAAT was used to measure the duration of the vowel. Measuring vowel duration was motivated by evidence that vowel length is an acoustic cue that English speakers use to distinguish whether the following plosive is voiced or voiceless. For instance, the duration of the vowel preceding a voiced stop is typically longer than the duration of a vowel preceding a voiceless stop (Charles-Luce, 1985; House and Fairbanks, 1953; Peterson and Lehiste, 1960; House, 1961; Umeda, 1975; Klatt, 1976). Please note that the production data analyzed in this study was collected and generously provided by Dr. Terry Kit-fong Au, from the University of Hong Kong.

## Participants

There were a total of 36 University students from the University of Hong Kong. 18 of the participants were in the training group (33% men), and 18 of the participants were in a wait-list control group (28% men).

## Material

The following analyses are based on productions of phonological minimal word pairs with voiced and voiceless plosives in coda position. The vowel duration from the following voiced words were analyzed: /bæd, bæg, kæb, kʌb, dɔg, fæd, fid, pig, tæb/. The following voiceless words were analyzed: / bæt, bæk, kæp, kʌp, dɔk, fæt, fit, pik, tæb/. Only "post-training" productions were analyzed. For the wait-list control participants, this was the second time that they produced above words (e.g. they did receive training in between the

first and second times that they produced these words). However for trained participants, these productions represent the second time that they produced these words after they received training.

## Procedure

Participants in Terry Au's (ms) study participated in a 4 - 6 week training program compromised of comprehending and producing English phonological minimal word pairs. Not all of the words that were used in training were used in production. See *Appendix A* for full list of words, as well as which words were used in training, and which were not. The productions were then sent to our lab for acoustic analyses.

The software PRAAT was used to conduct acoustic analyses. Textgrids were created from the .wav sound files in order to mark the beginning and end of the vowel boundary. Utilizing Sennheiser HD 555 headphones, the beginning of the vowel was marked with the *wav* method (cite) and the end of the vowel was marked with the *F2* method (cite). All boundaries were marked at the zero-crossing line. Measurements at present, were only taken by one researcher. Thus, future cross-validation through concordance rates is required. PRAAT scripting was then used to export vowel duration measurements.

## Data analysis

We used R (Version 3.4.3; R Core Team, 2017) and the R-package *papaja* (Version 0.1.0.9709; Aust & Barth, 2018) for all our analyses. Data from the production task were analyzed using a general linear mixed-effects model using the lme4 package (1.1-10 in R 3.2.2). The criterion variable was *vowel duration* which was converted to milliseconds and normalized for speaker. There were two predictors which were fixed factors: (1) training *trained/untrained* and voicing (2) *voiced/unvoiced*. Both factors were categorical and were sum coded. For the training variable, *trained* was assigned a 1, and *untrained* was assigned a 0; while *voiced* was assigned a 1 and *voiceless* was assigned a 0. Two new columns in the data frame were generated to represent the sum variables of the training and the voicing

67 variables. The variable participant was treated as a random effect as each participant had  
68 multiple productions (i.e. each participant produced each of the 36 voiced and voiceless  
69 words). Visual inspection of the Q-Q plots and plots of residuals against fitted values  
70 revealed that the assumptions of normality and homoscedasticity were in tact.

71 **Results**

72 **Discussion**

## References

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