# Crosslinguistic Similarity and Structured Variation in Cantonese-English Bilingual Speech Production

by

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# Abstract

Bilingual speech production is highly variable. This variability arises from numerous sources, ranging from the heterogeneity of linguistic experiences to crosslinguistic influence and more. This area has historically been challenging to study, given the relative lack of high-quality bilingual speech corpora and scientific inquiry that such resources enable. This dissertation introduces the SpiCE corpus of bilingual Speech in Cantonese and English and reports on two studies with the corpus. Chapter 2 describes how SpiCE was designed, collected, transcribed, and annotated. Broadly, it comprises recordings of 34 early Cantonese-English bilinguals conversing in both languages, hand-corrected orthographic transcripts, and force-aligned phone level annotations. Chapters 3 and 4 are motivated by a desire to understand how crosslinguistic similarity shapes phonetic variation in speech production.

Chapter 3 addresses this question at the level of voice. Using 24 filter and source-based acoustic measurements over all voiced speech in the interviews, principal components and canonical redundancy analyses demonstrate that while talkers vary in the degree to which they have the same "voice" across languages, all talkers show strong similarity with themselves. To a lesser extent, talkers exhibit similarities with one another, providing further support for prototype models of voice.

Chapter 4 pivots to the level of sound categories. Prior work in this area emphasizes detecting crosslinguistic influence for phonetically distinct yet phonologically similar sounds. This chapter leverages the uniformity framework to assess underlying phonetic similarity for the long-lag stop series in

Cantonese and English. Results indicate moderate patterns of uniformity within and across languages but suggest that a slightly coarser view of uniformity is more appropriate. Additionally, there was a clear difference across languages, supporting simultaneous roles for talker and language.

Together, Chapters 3 and 4 give shape to how crosslinguistic similarity is structured and offer a solid ground for generating perceptual hypotheses for areas like multilingual talker identification. Altogether, this dissertation provides a novel resource and highlights the importance of corpus research, both for understanding production processes and for guiding perception research.

# Lay Summary

Bilingual speech is highly variable—one major source of variability arises from how bilinguals' languages influence one another. This dissertation sheds light on how languages influence each other by analyzing conversations with Cantonese-English bilinguals. In addition to contributing a new open-access data set, this dissertation examines similarity across languages. The first question deals with voice: Do bilinguals have the same voice in each language? Are voices like auditory faces? In short—yes. The second question addresses whether this same group shares P, T, and K sounds across languages—that is, do bilinguals say K the same way in English and Cantonese. The answer to this question is a murkier yes, with variability arising from the language and the person. Together, these studies offer insight into the nature of bilingual speech and give insight into how languages do and do not interact in the mind.

# Preface

This dissertation is original work, and I am the primary author of each chapter. Additionally, I am the sole author of chapters 1, 4, and 5. All work in this dissertation was covered by the Behavioural Research and Ethics Board at the University of British Columbia under certificate H18-02017.

Chapter 2 was a collaborative effort, and I conceptualized, designed, and led all parts of the corpus development process. The corpus itself was collected by Nancy Yiu, Ivan Fong, and myself. Various members of the Speech-in-Context Lab supported transcription and annotation. The writing in Chapter 2 is based on a paper published in the proceedings of the *12th Language Resources and Evaluation Conference* (Johnson et al., 2020a), for which I did the vast majority of the writing.

Chapter 3 is based on a paper published in the *Proceedings of Interspeech 2020* (Johnson et al., 2020b). Molly Babel contributed to the conceptualization, design, writing, and revisions. Robert A. Fuhrman advised on the methods and suggested the addition of the canonical correlation analyses.

Chapter 4 is based on a solo-authored paper published in the *Proceedings of Interspeech 2021* (Johnson, 2021a). Molly Babel provided early input regarding the study's design and feedback on a prior version of the paper.

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