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 for 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 describes two corpus studies assessing crosslinguistic similarity. Chapter 2 describes how the SpiCE corpus 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 in the speech signal facilitates multilingual talker identification and discrimination.

Chapter 3 addresses this question at the level of voice quality. 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 phonolog-

ically 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 each language and weak patterns across languages. These weak patterns were further problematized by clear crosslinguistic differences for two of the sounds, which were apparent despite their proximity in the long-lag space. Yet, at the same time, more of the overall variation seems to derive from individual-specific differences.

Together, Chapters 3 and 4 provide evidence for talker identification and discrimination based on voice quality and category similarity. Altogether, this dissertation provides a novel resource and highlights the necessity of doing corpus phonetics research, both for understanding productive processes and in speculating about the bases of different mechanisms in perception.

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 less clear, with variability arising from the language and the person. Together, these studies clarify which aspects of speech can be used to recognize individuals speaking more than one language 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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