Available online at www.sciencedirect.com
ScienceDirect
Journal of Phonetics 37 (2009) 374–387
Journal of Phonetics
www.elsevier.com/locate/phonetics

Production of high vowels in Canadian English and Canadian French: A comparison of early bilingual and monolingual speakers

Andrea A.N. MacLeod[a,*,1], Carol Stoel-Gammon[a], Alicia B. Wassink[b]

[a]*Department of Speech and Hearing Sciences, University of Washington, 1417 NE 42nd Avenue, Seattle, WA 98105, USA*
[b]*Department of Linguistics, Padelford Hall, Box 354340, University of Washington, WA 98195, USA*

Received 7 January 2008; received in revised form 30 June 2009; accepted 3 July 2009

Abstract

The goal of this study is to investigate how monolingual and early bilingual speakers of Canadian English and Canadian French produce high vowels. The vowels of the bilingual participants were assessed in their two languages, thus permitting the exploration of interactions between the two languages. Findings indicated that the bilinguals formed separate categories across the two languages for similar vowels, and produced monolingual-like values for these vowels. When speaking English, they produced lax vowels that were low and less dispersed (for F2); these vowels were similar to the vowels of the English-speaking monolinguals. When speaking French the bilinguals produced lax vowels that were somewhat higher and more peripheral, like the French monolinguals. The results of the present study differ from investigations of late bilinguals, whose vowel productions exhibited influences of the phonemic categories of their first language. This work contributes to a small but growing body of research of the acoustic-phonetic differences between Canadian English and Canadian French and to the understanding of acoustic-phonetic abilities of early bilingual speakers.

1. Introduction

The goal of this study is to investigate how monolingual and early bilingual speakers of Canadian English and Canadian French produce high vowels. Specifically, the study addresses whether early bilingual speakers can achieve native-like production of vowels that are similar in two languages. The study of adult bilinguals has tended to focus on adults who acquired their second language during late childhood or later; these late bilinguals have been found to produce phonemes in their second language that are influenced by phonemic categories in their first language. In contrast, this study investigates early childhood bilinguals and their capacity for producing language-specific differences in vowels that are very similar to one another in English and French. This study also investigates the acoustic-phonetic productions of bilinguals in their two languages, thus permitting the exploration of interactions between the two languages and the question of ultimate attainment for the production of vowels by bilinguals.

1.1. Background

For a number of years, researchers in bilingualism and second-language learning have suggested that there is an interaction between a speaker's first and second languages (Cook, 1992; Flege, 1999; Paradis, 2001). The direction and strength of this interaction is thought to be influenced by the number and nature of phonological categories established for two languages, the amount each language is used, the circumstances for language use, and the speaker's language dominance (Flege, 1999). Recent research investigating bilinguals' speech production in both their languages has demonstrated that not only does the first language influence the second language, but that the second language also influences the first (Guion, 2003; MacLeod & Stoel-Gammon, 2009; Sundara, Polka, & Baum, 2006). Studies of bilinguals who have acquired both

*Corresponding author. Tel.: +1 418 656 2131x2143; fax: +1 418 656 2432.
E-mail addresses: andrea.macleod@rea.ulaval.ca (A.A.N. MacLeod), csg@u.washington.edu (C. Stoel-Gammon), wassink@u.washington.edu (A.B. Wassink).
[1]Current address: Département de réadaptation, Pavillon Vandry, Université Laval, Québec, Canada G1K 7P4.

0095-4470/$ - see front matter © 2009 Elsevier Ltd. All rights reserved.
doi:10.1016/j.wocn.2009.07.001

their languages during early childhood have demonstrated that exposure to two languages does not necessarily result in merged categories for similar phonemes; instead, early childhood bilinguals and simultaneous bilinguals can maintain separate categories. The question that remains unanswered is: — How do bilinguals organize their two language systems to allow an interaction, but not a merger, of phonological categories?

1.2. Theoretical framework

To answer this question, we examined three models that might be used to explore the phonological systems of bilinguals: the Native Language Magnet model proposed by Kuhl (1993) and Kuhl and Iverson (1995); the Perceptual Assimilation model proposed by Best (1994, 1995) and Best and Tyler (2007); and the Speech Learning model (SLM; Flege, 1995). The Native Language Magnet model, and the recent revised version (Kuhl et al., 2008), were designed to understand how infants systematically organize acoustic input to create phonetic categories and can be used to better understand differences in adult speech sound perception, rather than production. The Perceptual Assimilation model was first designed to account for how naïve listeners perceive non-native phonemes; more recently this model was extended to explain how the first- and second-language systems change over the course of second-language learning in adults. The SLM was developed to account for age-related limits on second-language pronunciation among bilingual speakers who have spoken their second-language for many years. Of these three models, only the Speech Learning model provides specific hypotheses regarding the interaction between the first and second languages spoken by bilinguals. Thus, the tenets of this model are under consideration in the present study.

One of the goals of the SLM is to explain the finding that some adult bilinguals cannot perceive phonetic differences between certain pairs of phonemes in their second language (e.g., /i/ and /ɪ/). SLM proposes two main explanations for this failure in perception: either the L2 sounds have been assimilated to a single L1 phonemic category, or the phonology of the first language filters out acoustic properties of the second-language phones/phonemes that are important for phonetic discrimination. According to the SLM, to achieve native-like production in a second language, a speaker (1) must have an accurate understanding of the properties that differentiate this language's phonemes[2] from one another, and from phonemes in the speakers first language; (2) must store and structure this information in long-term memory; and (3) must learn the articulations required to reliably and accurately produce the sounds of the second language. In cases where differences between phonemes in the two languages are minimal, adult learners are hypothesized to use equivalence classification to relate sounds from the second language to their own first language categories. In cases where a large difference exists between phones/phonemes of the two languages, the speaker can create a new category for the new phone; however, the ability to create new categories decreases with age (Flege, 1995).

[2]The term "phoneme" will be used throughout the text; however, there are cases where a phoneme in one language is an allophonic variant in the other language.

1.3. Previous research

To date, little research has focused on vowels produced by childhood bilinguals or highly experienced second-language learners. Existing studies have used two approaches (Strange, 2007): intelligibility scores of second-language learners as rated by native speakers, and comparisons of acoustic parameters of second language and native speakers. Intelligibility scores have been used to determine the number of tokens produced by the second-language speakers that were correctly identified by native speakers of the second language (e.g., Flege, Bohn, & Jang, 1997; Flege, MacKay, & Meador, 1999; Munro, Flege, & MacKay, 1996); or to investigate factors that contribute to degree of accent such as age of second-language learning, and use of first and second languages (Guion, Flege, & Loftin, 2000). These scores provide information about the way in which the listener categorizes vowels produced by a second-language speaker (e.g., when a speaker attempts to produce the word "sheep," does the native listener hear the word as "sheep" or "ship"?). However, this approach does not provide information about the parameters that listeners may use to perform this categorization, or about the acoustic, segmental, and suprasegmental features of a second-language speaker's production that are associated with mis-categorization by a native listener. The intelligibility score reflects only large phonetic differences in the production of vowels by second-language speakers (Baker & Trofimovich, 2005).

The second approach, a comparison of the acoustically analyzed productions from monolingual and bilingual speakers, provides a basis for comparing productions of second-language speakers to native speakers, and yields a description of similarities and differences between the groups (e.g., Baker & Trofimovich, 2005; Flege, Schirru, & MacKay, 2003; Guion, 2003). However, acoustic analyses do not shed light on the extent to which native listeners make use of these parameters to categorize the target vowels. Previous research investigating stop consonant production has demonstrated that bilinguals exposed to two languages simultaneously (Sundara et al., 2006) or prior to 4 years of age (MacLeod & Stoel-Gammon, 2005, 2009) can achieve monolingual-like productions. A few studies have investigated the production of vowels by early childhood bilinguals; among these studies are Flege et al. (2003) and Guion (2003), both of which involved bilinguals who had a broad range of L2 age of exposure.

Flege et al. (2003) studied the productions of 72 bilingual speakers, who were born in Italy and moved to Canada