

# Stop consonant production by French-English bilingual children in Southern Alberta

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## 1 INTRODUCTION

Although Canada has two official languages, French and English, it is well-known that these languages are not used equally across the country. Quebec is French-dominant, with nearly 8 out of 10 people reporting French as their native language compared to 8.3% who are native Anglophones (Statistics Canada, 2012b). In Alberta, English is the mother tongue of 77.0% of residents, with native Francophones making up only 1.9% of the population (Statistics Canada 2012a). While quite a few studies have investigated French-English bilingualism in Francophone Canada (e.g. Caramazza et al., 1973; Fowler et al., 2008; MacLeod & Stoel-Gammon, 2008), there exists a dearth of research on this topic in Western Canada where the sociolinguistic context is the reverse. We are interested in exploring how the differing social context might impact French-English speaking children's speech production. Thus, our study is set within the city of Lethbridge in southern Alberta—where the native French population is only 0.9% (Statistics Canada, 2012a). Official language status has helped maintain Franco-Albertan culture in the region, however, and the city boasts a French public library, community centre, and K-12 school, among other services. (ACFA regionale de Lethbridge - Medicine Hat, n.d.). The present study examines French and English speech sound production in 10 grade five students attending a Francophone school in Lethbridge using analysis of voice onset time (VOT).

VOT is an acoustic parameter that measures the time lapse between stop consonant release and the voice onset of the following vowel (Lisker & Abramson, 1964). English and French both have distinct stop consonant sets that can be measured and compared using VOT: the voiced /b/, /d/, and /g/, and the voiceless /p/, /t/, and /k/. Monolingual English- and French-speakers differ in VOT measures reported for both sets, with Anglophones producing long-lag VOT (>30 ms) for voiceless stops and short-lag VOT for voiced stops (<30 ms) (Docherty, 1992). By contrast, Francophones' voiceless stops are in the short-lag VOT range, while their voiced stops exhibit negative VOT values indicative of glottal action preceding the stop burst (i.e., prevoicing) (Ryalls & Larouche, 1992). French-English bilinguals, who are the focus of this study, often exhibit different VOT patterns altogether. For example, Flege (1987) demonstrated that the English voiceless /t/ is shorter (i.e., more French-sounding) in native English-speakers who have learned French. Moreover, Fowler et al. (2008) found that adults who learned both French and English before age 3 present voiceless VOT values in both languages that are influenced bidirectionally. In other words, each language system is influenced by the other - even though a clear distinction is made between the two. Bidirectional language influence has also been demonstrated in early Korean-English bilinguals (Baker & Trofimovich, 2005).

To our knowledge, no previous study has employed VOT to study speech sound production in Albertan French-speaking children. Our research seeks (1) to determine how the VOT patterns of French-speaking children in Anglo-dominant

Lethbridge compare to those of native Quebecois and monolingual English speakers and (2) if they have developed separate language systems for English and French.

## 2 METHOD

A total of 10 grade five students (aged 9-11) took part in the study. All participants were French-English bilingual speakers enrolled in a local Francophone school in Lethbridge, Alberta.

A word repetition task was employed to assess participants' VOT production patterns of word-initial voiced and voiceless stop consonants in both French and English. Audio prompts consisted of pre-recorded natural speech from a monolingual English speaker for the English component and a native French speaker for the French component. Six initial stops were examined (/p/, /b/, /t/, /d/, /k/, /g/) immediately followed by one of three consistent vowel environments /i/, /u/, /æ/ (English) or /i/, /u/, /a/ (French). During the task, the participant was sat in front of a computer monitor in a quiet room where visual stimuli were presented one by one on the computer screen, accompanied by a matching auditory speech token. The computer program Show & Play (Edwards & Beckman, 2008) was used to couple auditory and visual stimuli. Prior to engaging in the task, the student was provided with verbal instructions where they were asked to repeat each word back into the microphone after it had finished playing over the speakers.

Participants produced 9 words for each stop in both English and French for a total of 54 words in each language. Children's speech production was recorded using a Marantz flashcard recorder (model: PMD661). The speech stream was then segmented and events such as bursts and voice onset were marked using Praat (Boersma & Weenink, 2013) to permit extraction of VOT for acoustic analysis.

## 3 RESULTS

Table 1 displays the mean VOT values of the French-English bilingual students examined in this study. In addition, the values of monolingual English and Quebec-French speaking children are reported to serve as a comparison (Netelenbos, 2013; Ryalls & Larouche, 1992). When producing French voiced stops, the students are not prevoicing to the same extent as the extreme negative VOT values produced by native French speakers in Quebec. In the bilingual students' English productions, the voiced stops are not too far off the mark when compared to monolingual English children, with the exception of /b/, which is prevoiced by the French-English bilinguals. In their voiceless stops, the bilingual children produce VOT values appropriate for each language and consistent with the two language comparison populations. Next, it was of interest to determine whether the bilingual students' two language systems are behaving independently of each other. Upon visual inspection of the bilinguals' voiced and voiceless stop productions, it can be observed that the voiceless stops /p/, /t/, and /k/ exhibit large VOT differences between English and French, in that their

duration is considerably longer in English. Conversely, the voiced stops are rather similar in both languages. This observation was confirmed by a two-way repeated measure ANOVA (language \* stop) that revealed a significant interaction between the two variables, suggesting these children only maintain two language systems for certain stop sounds. A subsequent repeated measure ANOVA for each stop consonant indicated a significant language effect for the three voiceless stops, /p/, /t/, and /k/, ( $p < 0.001$  for all three stops), but was absent for the three voiced stops ( $p = 0.07$  for /b/, and  $p > 0.1$  for /d/, and /g/).

	Bilingual English	Bilingual French	Mono-English	Quebec French
/p/	69 (22)	39 (36)	74 (27)	32 (12)
/t/	75 (23)	53 (44)	81 (20)	60 (22)
/k/	88 (27)	59 (43)	89 (25)	65 (15)
/b/	-18 (76)	-3 (56)	8 (30)	-91 (24)
/d/	-6 (53)	-12 (60)	-5 (60)	-91 (21)
/g/	3 (56)	-8 (67)	16 (48)	-88 (28)

**Table 1:** Mean VOT values (in milliseconds) of French-English bilingual children in Lethbridge (9~11 years old); monolingual English children in Lethbridge (9 years old; Netelenbos, 2013); and native French children in Quebec (9~11 years old; Ryalls & Larouche, 1992). Standard deviations are provided in brackets.

#### 4 DISCUSSION

The results of the present study suggest that the English-dominant setting in Lethbridge has an anglicizing effect on bilingual French-English speakers' French system. Compared with Francophones in Quebec (Ryalls & Larouche, 1992), Lethbridge bilinguals exhibit less negative VOT values for voiced stops, but are similar with regard to voiceless stops. The prevoicing pattern in French voiced stops requires greater vocal exertion than in English, thus French-English bilinguals in Lethbridge may be unconsciously shifting their French voiced stop set to the easier-to-master English pattern. In a longitudinal study of seven months, Simon (2010) studied the prevoicing frequency of a native Dutch-speaking child who had moved to the United States with his family. Over the course of the study, the child gradually produced fewer prevoiced VOT values in his native language as his length of exposure to the Anglo-dominant sociolinguistic setting increased. While our study is not longitudinal, we believe it provides similar insight into the environmental effects on language development in bilingual children.

Despite living in predominantly Anglophone Lethbridge, bilinguals are exhibiting moderately prevoiced values for /b/ in English. This may indicate that their French is having a gallicizing effect on their English. Sundara, Polka, & Baum (2006) found that French-English bilinguals living in Montreal produce VOT values for /d/ in English that are significantly negative; however their study took place in French-dominant Quebec, thus the sociolinguistic input is different from ours. It is important to note that there was some demographic variance within our participant sample, with 4 simultaneous bilinguals since birth, 3 native French-speakers who learned English at age five or older, 2 trilinguals with native languages of Spanish and Dutch, and 1 Anglophone who

learned French at age five. This heterogeneity may explain the high standard deviation for the English /b/. Nonetheless, our results indicate that French-English bilingual speakers residing in an Anglo-dominant environment are manifesting a bidirectional VOT pattern in the production of voiced stops. In other words, rather than keeping two completely separate language systems, an interaction is occurring between their English and French with regard to voiced (but not voiceless) stops. Namely, their French voiced stops are being coloured by their English, while their French is exerting an influence on their English /b/.

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