

VOT PRODUCTION AMONG SCHOOLCHILDREN IN FRANCOPHONE VS. FRENCH IMMERSION SCHOOLS IN ANGLO-DOMINANT SOUTHERN ALBERTA

Justin Turner^{1#}, Fangfang Li^{1§}, Nicole Rosen^{2%}, & Nicole Netelenbos^{1&}

¹Dept. Psychology, University of Lethbridge, Lethbridge, Alberta, Canada

²Dept. Linguistics, University of Manitoba, Winnipeg, Manitoba, Canada

[#]Justin.Turner@uleth.ca [§]Fangfang.Li@uleth.ca [%]NicoleRosen@umanitoba.ca [&]Nicole.Netelenbos@uleth.ca

ABSTRACT

The present study reports a speech production experiment on children who are enrolled in a Francophone K-12 school in Southern Alberta, Canada, a predominantly English-speaking region. Students from grades 1, 3, and 5 were asked to produce a series of French words beginning with one of the six stop consonants (voiced /b/, /d/, & /g/; voiceless /p/, /t/, & /k/). Results revealed no age-related difference across the three grades. Furthermore, when compared with previous research on children who are native speakers of Quebec French, these Francophone schoolchildren produced voiceless stops with native-like values but voiced stops with values closer to English. Their stop productions were also compared with a recent study on students from a local French immersion elementary school, who produced both voiced and voiceless stops with English-like values. The results thus illustrate the effects of the social as well as the educational context in bilingual children's speech production.

Keywords: French, bilingualism, minority language, speech development, stop consonant

1. INTRODUCTION

Minority language communities that are found in predominantly monolingual social settings face challenges in maintaining their linguistic abilities. As a result, many such groups take special measures to protect their language and culture. Canada presents an excellent opportunity to study this phenomenon because the status of its two official languages - French and English - varies significantly across the country. In the province of Alberta, less than 2% of people are native French speakers (i.e., Francophones) compared to 77% who speak English as a first language [18]. However, Franco-Albertans have managed to preserve their presence throughout the province via French libraries, film societies, cultural centres, and - perhaps most significant in the transmission of the language to future generations -

educational facilities [20]. The present study reports speech production data from 30 children in grades 1, 3, and 5 attending a Francophone K-12 school in the Southern Alberta city of Lethbridge.

Public primary and secondary schools in Alberta typically teach French through one of three ways [1]. First, students attending English schools can learn French in optional classes devoted specifically to the language. Second, with the objective of obtaining French fluency, students may enrol in French immersion where all core classes are taught in the French language. The third option offered is Francophone schooling, designed for children who have at least one parent who is a native French speaker. The latter program strives to uphold an authentic French environment wherein the language is used in nearly all classes, extracurricular activities, and during playtime. Nonetheless, the province's Anglo-dominant sociolinguistic setting means that virtually all students attending Francophone schools are fluent in English as well [15]. In this study, we are interested in exploring how such a social minority language context impacts these children's French at different ages.

We chose stop consonants as a window through which to inspect this group of children's speech production behaviour. Like English, French has a set of six stops that differ from each other in phonation and places of articulation [7]; these include the voiced stops /b/, /d/, /g/, and the voiceless stops /p/, /t/, and /k/. However, unlike English, the voiced stops are truly voiced, with the vocal cords adduction and vibration occurring prior to the consonantal release. Also, unlike English, the voiceless stops are barely aspirated and are perceptually confusable with the English voiced stops.

The acoustic parameter we adopted to evaluate French stop productions is voice onset time (VOT), which measures the temporal difference between a stop consonant release and the onset of vocal cord vibration. VOT values in native French are negative for voiced stops (-150 to -50 ms) and short-lag for voiceless stops (0-30 ms) [3] [4] [7] [9]. English, on the other hand, contains short-lag voiced stops (0-30

ms) and long-lag voiceless stops (>30 ms) [5] [8] [12].

Previous research has demonstrated the impact of the socially dominant language on the development and maintenance of truly voiced stops in a child's L1. In a longitudinal study, Simon [17] reported the stop production pattern of a native Dutch-speaking boy who had recently emigrated from the Netherlands to the United States. The child had already developed voiced stops with negative VOT, typical of a native Dutch speaker. The negative VOT values, however, became more positive as his length of exposure to English increased. Research on French-English bilinguals has also demonstrated cross-language influence. For example, Flege [7] found that native French speakers who had lived in Chicago for many years produced more English-like VOT values for their French voiceless /t/. Similarly, American Anglophone expatriates who were living in Paris produced French-like VOT values in their English /t/. We previously reported that grade five Francophone schoolchildren in Lethbridge produce voiced stops that are less prevoiced than Quebec French speakers [19]; however, it remains to be seen whether or not this pattern occurs across grades.

Thus, the first purpose of the present study is to determine if there is an effect of age on the speech sound production of Francophone children. As age increases, children receive greater exposure to their L2 or English majority community, which may in turn influence L1 production, as found in Simon [17]. It is equally possible that their L1 is well maintained by the authentic French-speaking environment in school and through being surrounded by Francophone peers. Previous research on minority French communities in Western Canada has focused mainly on identity development or functional aspects of language such as code-switching and vocabulary [10] [15]. Our study on children's French phonetic development fills this gap.

The second purpose of the study is to compare with previous studies on the stop production of native Francophone children in Quebec [16] and children in a local French immersion school [14]. Unlike Quebec French-speaking children whose voiced stops are truly prevoiced with negative VOT values ranging from -81 ms to -90 ms, children enrolled in the local French immersion school produce voiced stops with 0 ms VOT. It is of interest to find out whether children in the Francophone school are capable of producing the voiced stops with prevoicing. With respect to voiceless stops, French immersion students were found to exhibit VOT values comparable to their English voiceless stops. Again, it is of interest to determine whether

Francophone children display similar cross-language influence.

2. METHOD

A total of 30 children participated in the study: 10 in grade five (ages 9-11), 11 in grade three (ages 7-8), and 9 in grade one (ages 5-6). All participants were fluent speakers of English and French and had been attending the Francophone school for at least one year.

For the procedure, students were brought individually into a quiet room and seated in front of a computer to partake in a word-repetition activity. We instructed students to repeat specific words upon hearing audio prompts, which were presented along with visual stimuli using the program Show & Play [6]. Audio prompts consisted of individual words in French that had been pre-recorded by a native French speaker. Participants' speech productions were recorded using a Marantz flashcard recorder (model: PMD661).

We recorded 54 words for each child, which consisted of 9 words that started with each of the six stop consonant sounds (/b/, /d/, /g/, /p/, /t/, /k/) followed by one of three vowel sounds (/i/, /u/, /a/). Speech productions were later segmented and analysed using the program Praat [2], with bursts and voice onset marked.

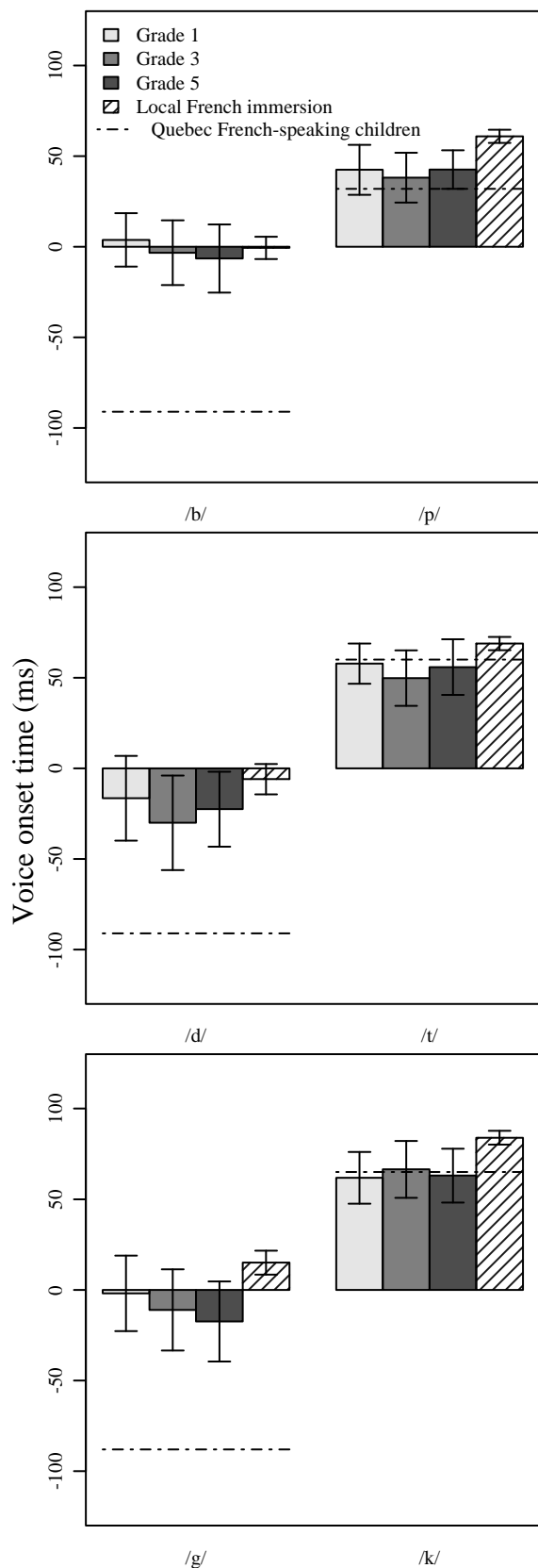
3. RESULTS

Table 1 reports the mean VOT values for each grade. There does not appear to be an age effect occurring in any stop consonants. These Francophone students are producing both voiced and voiceless VOT values that are similar across grades. A two-way repeated measure ANOVA (grade \times stop consonant) confirmed no significant interaction between stop consonant and grade ($F(10,130)=0.30$, $p=0.98$).

Table 1. Word-initial French stop consonant productions (VOT reported in milliseconds) of Francophone schoolchildren separated by grade. Standard deviation is shown in brackets.

	Grade 1	Grade 3	Grade 5	Overall
/p/	42 (44)	38 (43)	43 (34)	41 (40)
/t/	58 (35)	50 (48)	56 (49)	54 (45)
/k/	62 (45)	67 (49)	63 (47)	64 (47)
/b/	4 (47)	-3 (56)	-7 (59)	-3 (55)
/d/	-17 (74)	-30 (82)	-23 (65)	-24 (75)
/g/	-2 (66)	-11 (71)	-17 (70)	-11 (69)

Figure 1. Bar plot of VOT values for the Francophone school children in different grades as well as children enrolled in a local French immersion school.



Next, it was of interest to compare Francophone children's VOT values with both those of French-immersion students and native French-speaking

children from Quebec. We relied on published data for such a comparison. The local French immersion children's VOT values were taken from Netelenbos, Li, and Rosen [14]. The Quebec children's data were gathered from Ryalls and Larouche [16].

As shown in Table 2 and Figure 1, for the voiceless stops, participants produced values that are lower than French immersion students, and closer to the Quebec French values. The differences in voiceless stops between the Francophone school students and the French immersion students were statistically significant ($p < 0.001$ for /p/, /t/, and /k/). For the voiced stops, the Francophone school students have more negative values than the French-immersion children for /d/ ($p < 0.001$) and /g/ ($p < 0.001$), but not for /b/ ($p = 0.99$). Compared to the Quebec francophone children's voiced values, these Francophone school students produced prevoicing to a markedly less degree.

Table 2. Table 2. Word-initial French stop consonant productions (VOT reported in milliseconds) of Francophone school children in comparison with French immersion school children [14] and Quebec French speaking children [16]. Standard deviation is shown in brackets.

	French immersion students	Francophone students	Quebec Francophone children
/p/	61 (28)	41 (40)	32 (12)
/t/	70 (28)	54 (45)	60 (22)
/k/	84 (28)	64 (47)	65 (15)
/b/	-1 (48)	-3 (55)	-91 (24)
/d/	-5 (64)	-24 (75)	-91 (21)
/g/	15 (52)	-11 (69)	-88 (28)

4. DISCUSSION

Two findings from the current study are noteworthy. First, we did not find a difference in these children's French VOT values across the three grades examined. The lack of developmental change in stop production patterns has been reported previously in Harada [11] and Netelenbos et al. [14] for immersion children. Together with our results, the consistent speech pattern found in children across grades in multiple school settings and with varying degrees of authenticity of language input suggests the effect of educational context in stabilizing speech production pattern. Alternatively, school-aged children may have passed the critical period to finely modify the articulatory details of their sound production. It remains to be empirically tested whether changes in curriculum incorporating

articulation training would affect students' speech patterns.

Second, Francophone children were found to produce their voiced stops with VOT values intermediate between the Quebec native French-speaking children and the local French immersion school students. Although they are slightly better at generating the prevoicing needed for voiced stops in French than their peers in the French immersion school, the extent of their prevoicing is much less than children in Quebec. It is possible that such an intermediate prevoicing pattern reflects the input characteristics that children obtain from Francophone adults in school or at home. However, previous studies on Francophone adults in Alberta suggest that this is unlikely to be the case, as French-speaking adults do exhibit prevoicing in their voiced stop production with a negative VOT values less than -80 ms [13]. It is to be noted that in contrast to those adults who learned English as their second language after adulthood, children reported in this paper are exposed to English very early in life as English is the dominant language in the society, and therefore may be subject to more cross-language influence from their L2.

On the other hand, the English L2 or social environment has less an obvious impact on these children's French voiceless stops: their VOT values approached those of their Quebec French speaking peers. The discrepancy between their voiced and voiceless stops may suggest the inherent articulatory difficulty in producing voiced stops in French and the associated challenges in maintaining it in an English majority community.

More research is needed to examine the speech of Western Canadian French communities, as previous studies have mainly focused on the provinces of Quebec, Ontario, and New Brunswick where the majority of the country's Francophones live. One limitation of the present study is that we did not track children longitudinally, and our sample size may have been too small to glean any age-related effects. There was certainly a large amount of variation between participants, as evidenced by the standard deviations we reported. We wish to further explore the effect of various demographic factors in the future.

7. REFERENCES

- [1] Alberta Education. n.d. French language education in Alberta <http://education.alberta.ca/parents/educationsys/frenchlanguage.aspx>
- [2] Boersma, P., Weenink, D. 2013. Praat: Doing phonetics by computer, vers. 5.3.39. Amsterdam.
- [3] Caramazza, A., Yeni-Komshian, G. 1974. Voice onset time in two French dialects. *J. Phonetics* 2, 239-245.
- [4] Caramazza, A., Yeni-Komshian, G., Zurif, E., Carbone, E. 1973. The acquisition of a new phonological contrast: The case of stop consonants in French-English bilinguals. *J. Acous. Soc. Am.* 54, 421-428.
- [5] Docherty, G. 1992. *The timing of voicing in British English obstruents*. Berlin, New York: Foris.
- [6] Edwards, J., Beckman, M. 2008. Methodological questions in studying phonological acquisition. *Clin. Ling. Phon.* 22, 939-958.
- [7] Flege, J. 1987. The production of "new" and "similar" phones in a foreign language: Evidence for the effect of equivalence classification. *J. Phonetics* 15, 47-65.
- [8] Flege, J., Brown, W. 1982. The voicing contrast between English /p/ and /b/ as a function of stress and position-in-utterance. *J. Phonetics* 10, 335-345.
- [9] Fowler, C., Sramko, V., Ostry, D., Rowland, S., Halle, P. 2008. Cross language phonetic influences on the speech of French-English bilinguals. *J. Phonetics* 36, 649-663.
- [10] Gaudet, S., Clement, R. 2009. Forging an identity as a linguistic minority: Intra- and intergroup aspects of language, communication and identity in Western Canada. *Internat. J. Intercul. Rel.* 33, 213-227.
- [11] Harada, T. 2007. The production of voice onset time (VOT) by English-speaking children in a Japanese immersion program. *Internat. Rev. Appl. Ling. In Lang. Teach.* 45, 353-378.
- [12] Keating, P. 1984. Phonetic and phonological representation of stop consonant voicing. *Language* 60, 286-319.
- [13] Nearey, T., Rochet, B. 1994. Effects of place of articulation and vowel context on VOT production and perception for French and English stops. *J. IPA* 24 1-18.
- [14] Netelenbos, N., Li, F., Rosen, N. 2015. Stop consonant production of French immersion students in Western Canada: A study of voice onset time. *Internat. J. Biling.* In press.
- [15] Paradis, J., Nicoladis, E. 2007. The influence of dominance and sociolinguistic context on bilingual preschoolers' language choice. *Internat. J. Bilingual Ed. and Bilingualism* 10, 277-297.
- [16] Ryalls, J., Larouche, A. 1992. Acoustic integrity of speech production in children with moderate and severe hearing impairment. *J. Speech and Hearing Research* 35, 88-95.
- [17] Simon, E. 2009. Child L2 development: A longitudinal case study on voice onset times in word-initial stops. *J. Child Lang.* 37, 159-173.
- [18] Statistics Canada. 2012. Focus on Geography Series, 2011 Census. Statistics Canada Catalogue no. 98-310-XWE2011004. Ottawa: Author.
- [19] Turner, J., Netelenbos, N., Rosen, N., & Li, F. 2014. Stop consonant production by French-English bilingual children in Southern Alberta. *Canadian Acoustics* 42, 86-87.
- [20] Walker, D. 2003. Aperçu de la langue française en Alberta (Canada). In: Delais-Roussarie, E., Durand, J. (eds), *Corpus et variation en phonologie du français*. Toulouse: Presses Universitaires du Mirail. 279-300,