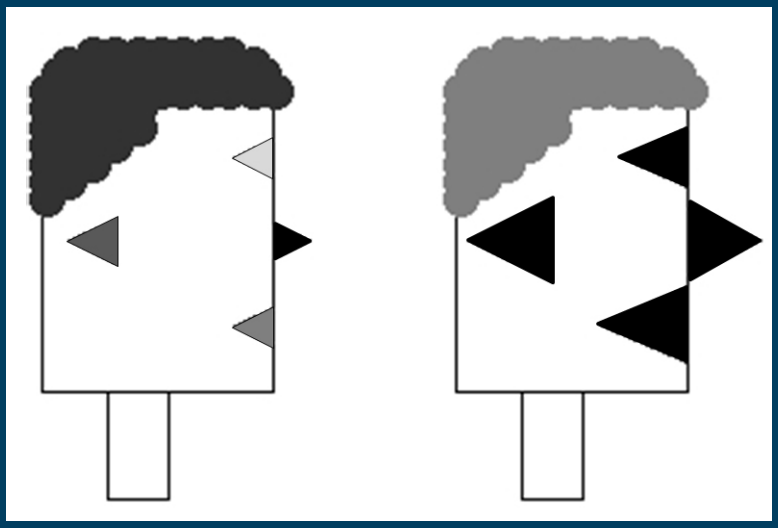
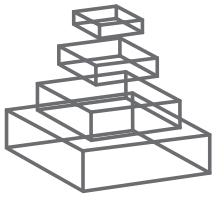
frontiers
RESEARCH TOPICS



INTERDISCIPLINARY APPROACHES TO MULTILINGUALISM

Topic Editors
Suzanne Curtin, Mary Grantham O'Brien and Rahat Naqvi

frontiers in PSYCHOLOGY



frontiers

ISSN 1664-8714
ISBN 978-2-88919-518-3
DOI 10.3389/978-2-88919-518-3

ABOUT FRONTIERS

Frontiers is more than just an open-access publisher of scholarly articles: it is a pioneering approach to the world of academia, radically improving the way scholarly research is managed. The grand vision of Frontiers is a world where all people have an equal opportunity to seek, share and generate knowledge. Frontiers provides immediate and permanent online open access to all its publications, but this alone is not enough to realize our grand goals.

FRONTIERS JOURNAL SERIES

The Frontiers Journal Series is a multi-tier and interdisciplinary set of open-access, online journals, promising a paradigm shift from the current review, selection and dissemination processes in academic publishing.
All Frontiers journals are driven by researchers for researchers; therefore, they constitute a service to the scholarly community. At the same time, the Frontiers Journal Series operates on a revolutionary invention, the tiered publishing system, initially addressing specific communities of scholars, and gradually climbing up to broader public understanding, thus serving the interests of the lay society, too.

DEDICATION TO QUALITY

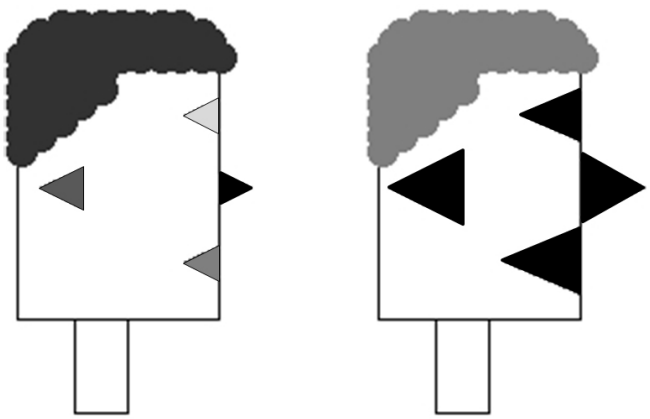
Each Frontiers article is a landmark of the highest quality, thanks to genuinely collaborative interactions between authors and review editors, who include some of the world's best academicians. Research must be certified by peers before entering a stream of knowledge that may eventually reach the public - and shape society; therefore, Frontiers only applies the most rigorous and unbiased reviews.
Frontiers revolutionizes research publishing by freely delivering the most outstanding research, evaluated with no bias from both the academic and social point of view.
By applying the most advanced information technologies, Frontiers is catapulting scholarly publishing into a new generation.

WHAT ARE FRONTIERS RESEARCH TOPICS?

Frontiers Research Topics are very popular trademarks of the Frontiers Journals Series: they are collections of at least ten articles, all centered on a particular subject. With their unique mix of varied contributions from Original Research to Review Articles, Frontiers Research Topics unify the most influential researchers, the latest key findings and historical advances in a hot research area!
Find out more on how to host your own Frontiers Research Topic or contribute to one as an author by contacting the Frontiers Editorial Office: researchtopics@frontiersin.org

INTERDISCIPLINARY APPROACHES TO MULTILINGUALISM

Topic Editors:
Suzanne Curtin, University of Calgary, Canada
Mary Grantham O'Brien, University of Calgary, Canada
Rahat Naqvi, University of Calgary, Canada



Facial profiles, a tool proposed by Libben, Curtiss, and Weber. Making use of facial profiles such as these enables researchers to account for both inter- and intra-participant variability, which is especially useful in studies of bilingual participants.

Libben, G., Curtiss, K., & Weber, S. (2014). Psychocentricity and participant profiles: Implications for lexical processing among multilinguals. Frontiers in Psychology, 5. p. 9. doi: 10.3389/fpsyg.2014.00557

This research topic stems from the "Interdisciplinary Approaches to Multilingualism" conference, which was hosted by the Language Research Centre at the University of Calgary. It was the first conference of its kind, which brought together the work of researchers, educators, and policy makers in the areas of first and second language acquisition from psycholinguistic and pedagogical perspectives. The goal was to provide an opportunity for participants to engage with the implications of multilingualism from a range of perspectives, including the effects of being bilingual from infancy to adulthood, the process and benefits of learning multiple languages, and the impact of multilingualism on society. The topic editors would like to thank Joseph Windsor and Rhonda Sim for their assistance throughout the editing process.

Table of Contents

frontiers in
PSYCHOLOGY

EDITORIAL
published: 23 December 2014
doi: 10.3389/fpsyg.2014.01464

Understanding multilingualism and its implications

***Mary G. O'Brien*[1,2]*, *Suzanne Curtin*[2,3] *and Rahat Naqvi*[2,4]**

[1] *Linguistics, Languages and Cultures, University of Calgary, Calgary, AB, Canada*
[2] *Language Research Centre, University of Calgary, Calgary, AB, Canada*
[3] *Psychology, University of Calgary, Calgary, AB, Canada*
[4] *Werklund School of Education, University of Calgary, Calgary, AB, Canada*
**Correspondence: mgobrien@ucalgary.ca*

Edited and reviewed by:
Manuel Carreiras, Basque Center on Cognition, Brain and Language, Spain

Keywords: bilingualism, language acquisition, psycholinguistic methods, language pedagogy, second langauge literacy development

The world's demographics are in a state of flux. Approximately half of the world's population is bilingual (Grosjean, 2010). Just over half of all Europeans speak a language other than the official language in a given country, and 25% of them report that they are able to hold a conversation in at least two additional languages (European Commission, 2012, p. 18). Bi- and multilingualism are also the reality in North America. Grosjean (2012) estimates that 20% of Americans are bilingual. In 2011, over 20% of Canadians reported speaking a mother tongue other than English or French, and the number of Canadians who report being bilingual is rising rapidly (Statistics Canada, 2012). While the causes of increased bi- and multilingualism vary, the repercussions of this demographic shift are wide reaching.

In August 2013 the Language Research Centre at the University of Calgary brought together a range of experts working on issues related to the acquisition of multiple languages to consider the implications of multilingualism in our society. Discussions at the conference entitled "Interdisciplinary Approaches to Multilingualism" were focused around three key areas: language acquisition, psycholinguistic research methods, and second language pedagogy and literacy development. These broad fields are represented in this issue of *Frontiers*.

ACQUISITION

Barlow's contribution investigates the role of age effects in the production of English and Spanish /l/ by early and late Spanish-English bilinguals. The results, which indicate that the sound systems of both early and late bilinguals interact, add to our understanding of the complexities of acquiring multiple languages across the lifespan. Shea's (2014) response to Barlow (2014) focuses on the complexity of understanding cross-linguistic allophonic variation and on the importance of exposing learners to conditioned variability.

The research by Bak et al. (2014) is an investigation of the so-called "bilingual advantage" on attention tests. Like Barlow, the authors wish to determine the extent to which early and late bilinguals differ. The results indicate that bilinguals—regardless of age of acquisition—show certain advantages on the Test of Everyday Attention. In her response to Bak et al. (2014), Macleod (2014) focuses on the advantages and disadvantages of making use of experimental results for clinical work with bilinguals. She points out that we must determine whether experimentally significant results truly matter in clinical settings. She extends the discussion to studies of vocabulary acquisition and concludes that rigorous testing of tools and a clear understanding of the backgrounds of bilinguals are essential in order to avoid potential misdiagnoses.

Lechner and Siemund's (2014) contribution investigates the effects of bilingualism on participants' attainment in their third language (L3) English. The participants, all of whom grew up in Germany speaking another language as a first language (L1), were from a variety of L1 and socioeconomic backgrounds. An important finding in Lechner and Siemund's (2014) work is that those participants who performed best did so across their languages: the heritage language, German, and English. The authors, who view English literacy as a type of academic achievement, couch their findings in terms of the Threshold Hypothesis. In their response to Lechner and Siemund (2014), Rolstad and MacSwan (2014) offer facilitation theory as an alternative theoretical framework to the Threshold Hypothesis. They argue that literacy skills transfer across a bilingual's languages because literacy in one language facilitates literacy in additional languages.

METHODOLOGY

The paper by Libben et al. (2014) presents a proposal for making use of Facial Profiles, a technique based on Chernoff faces, and high-density experiments in order to understand participants, perception, and production. Acknowledging the necessity to account for individual variability in reading, speaking, and listening ability among participants, Libben et al.'s (2014) contribution provides methodological tools for researchers to embrace the complexity inherent in studies of bilinguals, especially research into the mental lexicon. In their response to Libben et al. (2014), Perret and Kandel (2014) point to a common problem within psycholinguistic research generally: the difficulty of accounting for random errors that arise when researchers rely on small samples. They echo Libben et al.'s (2014) call to capture within- and between-participant variability in psycholinguistic studies.

LEARNING AND PEDAGOGY

All of the papers that focus on classroom situations (Cummins, 2014; Manterola, 2014; Naqvi et al., 2014; Ntelioglou et al., 2014) point to the need to both value and draw on the linguistic resources of bilingual students. This is in spite of the fact that students' languages are traditionally separated in bilingual and immersion schools. Naqvi et al. (2014) describe the results of three case studies that investigate translanguaging within Spanish

bilingual programs in Alberta. Naqvi et al. (2014) made use of a variety of tasks including dual language books, videos, and inquiry-based learning tasks with a range of students as a means of encouraging them to engage with the schools' two languages. In response to Naqvi et al. (2014), Manterola (2014) discusses possibilities for integrating learners' languages in Basque-Spanish and Basque-French bilingual schools in the Basque Country. Manterola (2014) cites research indicating that improvement in a minority language undergoing revitalization (Basque) may be correlated with improvement in both the L1 and the L3 (English).

The paper by Ntelioglou et al. (2014) focuses on the effectiveness of instructional tasks for improving the literacy skills of culturally and linguistically diverse grade three English Language Learners (ELLs) in a large Canadian city. The authors report on the benefits of making use of students' home languages in the completion of a writing project.

Cummins's contribution focuses on the implications of policies that deny bilingual students access to their store of languages in a variety of school settings including French immersion education in Canada, mainstream English and French education, heritage language education, and the education of Deaf and hard-of hearing students with cochlear implants.

In spite of differing foci, Manterola (2014), Naqvi et al. (2014), Ntelioglou et al. (2014) and Cummins (2014) propose the implementation of policies, programs, and practices that enable students to build connections across languages.

ACKNOWLEDGMENT

We would like to thank the Social Sciences and Humanities Research Council of Canada for generously supporting this endeavor.

REFERENCES

Bak, T. H., Vega-Mendoza, M., and Sorace, A. (2014). Never too late? An advantage on tests of auditory attention extends to late bilinguals. *Front. Psychol.* 5:485. doi: 10.3389/fpsyg.2014.00485

Barlow, J. A. (2014). Age of acquisition and allophony in Spanish-English bilinguals. *Front. Psychol.* 5:288. doi: 10.3389/fpsyg.2014.00288

Cummins, J. (2014). To what extent are Canadian second language policies evidence-based? Reflections on the intersections of research and policy. *Front. Psychol.* 5:358. doi: 10.3389/fpsyg.2014.00358

European Commission. (2012). *Europeans and Their Languages. Special Eurobarometer 386*. Available online at: http://ec.europa.eu/public_opinion/archives/ebs/ebs_386_en.pdf (Accessed November 16, 2014).

Grosjean, F. (2010). *Bilingual: Life and Reality*. Cambridge, MA: Harvard University Press.

Grosjean, F. (2012). *Bilinguals in the United States. Psychology Today*. Available online at: http://www.psychologytoday.com/blog/life-bilingual/201205/bilinguals-in-the-united-states (Accessed November 16, 2014).

Lechner, S., and Siemund, P. (2014). Double Threshold in bi- and multilingual contexts: preconditions for positive language influence in English as an additional language. *Front. Psychol.* 5:546. doi: 10.3389/fpsyg.2014.00546

Libben, G., Curtiss, K., and Weber, S. (2014). Psychocentricity and participant profiles: Implications for lexical processing among multilinguals. *Front. Psychol.* 5:557. doi: 10.3389/fpsyg.2014.00557

Macleod, A. A. N. (2014). On extending experimental findings to clinical application: "never too late? An advantage on tests of auditory attention extends to late." *Front. Psychol.* 5:1367. doi: 10.3389/fpsyg.2014.01367

Manterola, I. (2014). Bilingual education searching for promising didactic proposals. *Front. Psychol.* 5:1359. doi: 10.3389/fpsyg.2014.01359

Naqvi, R., Schmidt, E., and Krickhan, M. (2014). Evolving 50%-50% bilingual pedagogy in Alberta: What does the research say? *Front. Psychol.* 5:413. doi: 10.3389/fpsyg.2014.00413

Ntelioglou, B. Y., Fannin, J., Montanera, M., and Cummins, J. (2014). A multilingual and multimodal approach to literacy teaching and learning in urban education: a collaborative inquiry project in an urban inner city elementary school. *Front. Psychol.* 5:533. doi: 10.3389/fpsyg.2014.00533

Perret, C., and Kandel, S. (2014). Taking advantage of between- and within-participant variability? *Front. Psychol.* 5:1235. doi: 10.3389/fpsyg.2014.01235

Rolstad, K., and MacSwan, J. (2014). The facilitation effect and language thresholds. *Front. Psychol.* 5:1197. doi: 10.3389/fpsyg.2014.01197

Shea, C. E. (2014). Second language learners and the variable speech signal. *Front. Psychol.* 5:1338. doi: 10.3389/fpsyg.2014.01338

Statistics Canada. (2012). *2011 Census of Canada Linguistic Characteristics of Canadians*. Available online at: http://www12.statcan.gc.ca/census-recensement/2011/as-sa/98-314-x/98-314-x2011001-eng.pdf (Accessed September 15, 2014).

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 21 November 2014; accepted: 29 November 2014; published online: 23 December 2014.

*Citation: O'Brien MG, Curtin S and Naqvi R (2014) Understanding multilingualism and its implications. Front. Psychol. **5**:1464. doi: 10.3389/fpsyg.2014.01464*

This article was submitted to Language Sciences, a section of the journal Frontiers in Psychology.

frontiers in
PSYCHOLOGY

ORIGINAL RESEARCH ARTICLE
published: 21 April 2014
doi: 10.3389/fpsyg.2014.00288

Age of acquisition and allophony in Spanish-English bilinguals

Jessica A. Barlow*

Phonological Typologies Lab, School of Speech, Language, and Hearing Sciences, San Diego State University, San Diego, CA, USA

Edited by:
Suzanne Curtin, University of Calgary, Canada

Reviewed by:
Christine E. Shea, University of Iowa, USA
Marie King Huffman, Stony Brook University, USA

****Correspondence:***
Jessica A. Barlow, Phonological Typologies Lab, School of Speech, Language, and Hearing Sciences, San Diego State University, 5500 Campanile Drive, San Diego, CA 92182-1518, USA
e-mail: jessica.barlow@sdsu.edu

This study examines age of acquisition (AoA) in Spanish-English bilinguals' phonetic and phonological knowledge of /l/ in English and Spanish. In English, the lateral approximant /l/ varies in darkness by context [based on the second formant (F2) and the difference between F2 and the first formant (F1)], but the Spanish /l/ does not. Further, English /l/ is overall darker than Spanish /l/. Thirty-eight college-aged adults participated: 11 Early Spanish-English bilinguals who learned English before the age of 5 years, 14 Late Spanish-English bilinguals who learned English after the age of 6 years, and 13 English monolinguals. Participants' /l/ productions were acoustically analyzed by language and context. The results revealed a Spanish-to-English phonetic influence on /l/ productions for both Early and Late bilinguals, as well as an English-to-Spanish phonological influence on the patterning of /l/ for the Late Bilinguals. These findings are discussed in terms of the Speech Learning Model and the effect of AoA on the interaction between a bilingual speaker's two languages.

Keywords: bilingual, adult, allophones, acoustic, lateral approximant

INTRODUCTION

It is widely established that a bilingual's two languages interact; this interaction happens during the acquisition process for both children and adults, and continues after the languages have been mastered with native-like competence (Paradis, 2001a,b; Cook, 2003; Flege et al., 2003; Fabiano and Goldstein, 2005; Flege, 2007; Barlow et al., 2013). Such interaction has been described at numerous levels of linguistic structure, from pragmatic to syntactic to lexical to phonological (e.g., Pavlenko and Jarvis, 2002; Cook, 2003; Dussias, 2003; Flege et al., 2003; Dussias and Sagarra, 2007; Flege, 2007; Amengual, 2012). At the phonological level, interaction has been reported for prosodic and other suprasegmental structure, segmental patterns, and even subsegmental patterns that pertain to allophonic and other acoustic-phonetic phenomena (Paradis, 2001a,b; Lleó et al., 2003; Kehoe et al., 2004; Mennen, 2004; Fabiano and Goldstein, 2005; Lleó, 2006; Fabiano-Smith and Barlow, 2010; Barlow et al., 2013).

The challenge for researchers is to be able to predict if, where, and how interaction will occur. As far as speaker extrinsic factors are concerned, frequency, markedness, and similarity play a role (Lleó et al., 2003; Broselow, 2004; Fabiano-Smith and Goldstein, 2010). For instance, interaction is more likely to occur on properties that are similar or shared between two languages than those that are dissimilar or unshared (e.g., Flege, 1995, 2007; Flege et al., 1999, 2003; MacWhinney, 2004). Speaker intrinsic factors are also relevant to predicting interaction between a bilingual's two languages. Specifically, the nature and extent of interaction depends on the age of the speaker, the age at which each language was acquired, the amount of input and output in both languages, and the level of proficiency and dominance in the two languages (e.g., Flege, 1991, 2002; Flege et al., 1995, 1997, 1999, 2002; Thornburgh and Ryalls, 1998; Guion, 2003; Fowler et al., 2008; Simonet, 2010; Antoniou et al., 2011; Lee and Iverson, 2012).

In this study, we focus on Spanish-English bilinguals who represent a significant and growing population in the US, particularly Southern California (US Census Bureau, 2004). There exists a large body of research on the speech of Spanish-English bilinguals, with both child and adult populations. Allophonic variation in this language group has also been of particular interest for researchers, many of whom have focused on voice onset time (VOT) for word-initial (WI) plosive stops (e.g., Flege and Eefting, 1987; Flege, 1991; Yavaş, 1996; Thornburgh and Ryalls, 1998; Amengual, 2012; López, 2012). VOT is relevant because English has an allophonic rule that governs the distribution of long- and short-lag voiceless stops, with long-lag stops occurring word-initially, whereas Spanish has only short-lag voiceless stops. Other studies of allophonic phenomena in Spanish-English bilinguals have considered the distribution of voiced stops and spirants (Zampini, 1994; e.g., Zampini, 1996; Eckman and Iverson, 1997; Barlow, 2003). In this case, Spanish has the allophonic rule governing the distribution of the two types of sounds, whereas English does not exhibit such alternation. Not surprisingly, these prior studies have demonstrated that bilinguals show interaction between their two languages in terms of the allophonic patterns evaluated, though results vary due to factors such as age of acquisition (AoA) and dominance, as described above.

Few studies have focused on other allophonic phenomena in evaluation of interaction between Spanish-English bilinguals' two languages. Thus, to expand on our understanding of Spanish-English bilinguals' productions of allophonic phenomena, the current study focuses on an allophonic pattern of English that has received relatively little attention in prior research on bilinguals: the distribution of /l/ allophones in English. The lateral approximant /l/ is of interest here because it is a phoneme that is shared between the two languages, but is produced differently, both in terms of its acoustic-phonetic properties and its allophonic distribution.

Specifically, Spanish /l/ is typically described as "clear," in that it is perceived as more consonantal in quality, regardless of context, whereas American English /l/ is characterized as relatively "dark" in all contexts, in that it is perceived as more vowel-like in quality (Wells, 1982a,b; Huffman, 1997; Whitley, 2002; Recasens, 2004, 2012; Recasens and Espinosa, 2005). Using x-ray microbeam technology, Sproat and Fujimura (1993) determined that this darker quality for American English /l/ is attributed to two co-occurring gestures: a consonantal tongue-tip gesture and a vocalic tongue-dorsum gesture. Spanish /l/ is assumed to lack this latter vocalic gesture, given its perceptually "clearer" quality.

Furthermore, American English has an allophonic velarization rule that Spanish lacks. This rule governs the distribution of [ɫ], which occurs in the syllable rhyme (e.g., "meal" [miɫ], "milk" [mɪɫk], and "candle" [kændɫ]), and [l], which occurs in the syllable onset (e.g., "lease" [lis], "ply" [plaɪ]). The [ɫ] is perceived as even darker than onset [l] in American English[1], and this, per Sproat and Fujimura (1993), is due to the relative timing of the aforementioned consonantal and vocalic gestures. Specifically, for onset [l], the consonantal gesture precedes or occurs simultaneously with the vocalic gesture; for rhymal [ɫ], the vocalic gesture precedes the consonantal gesture (see also Browman and Goldstein, 1992; Gick, 2000, 2003). The different sequencing of these gestures is associated with syllable position: consonantal gestures tend to occur on the periphery (margins) of syllables, while vocalic gestures occur closer to the peak (rhyme) (Sproat and Fujimura, 1993; Huffman, 1997; Gick, 2000, 2003). In contrast to English, the Spanish /l/ phoneme does not vary by context; thus, the consonantal gesture associated with Spanish /l/ is assumed to be relatively consistent across contexts, though, per Gick et al. (2006), some degree of dorsal constriction in postvocalic contexts is predicted to occur.

Note that the relative timing of consonant and vocalic gestures associated with American English /l/ has been described as occurring along a continuum that is dependent on proximity to the syllable margins and peaks (Sproat and Fujimura, 1993; Gick, 2000, 2003; Gick et al., 2006). Morphological and prosodic factors also have been noted to affect the relative darkness of American English /l/ (Hayes, 2000; Oxley et al., 2007). However, for the purposes of the current study, which evaluates only two contexts – WI onset singletons and word-final (WF) coda singletons – a categorical distinction between articulations for the two /l/ allophones is assumed (see also Yuan and Liberman, 2011, for an argument in support of this categorical distinction).

These clear and dark /l/ varieties manifest acoustically via differing resonant frequencies. Clear /l/ has a high second formant (F2) value and a large difference between F2 and the first formant (F1) (Recasens, 2004; Recasens and Espinosa, 2005; Yuan and Liberman, 2009, 2011; Proctor, 2010; Simonet, 2010). Dark /l/, in contrast, is associated with lower F2 values and a smaller F2-F1 difference.

As stated above, the Spanish /l/ is described as clear in all word positions: F2 shows only subtle change by context, sometimes with slightly *higher* values in WF position. For instance, Quilis et al. (1979) reported F2 values of 1800 Hz for /l/ in the syllable [li], but 1960 Hz for the syllable [il] in adult male speakers of Castilian Spanish. Similarly, F2 values for /l/ were reported at 1400 Hz for [lu], but 1410 Hz for [ul]. In contrast, due to the allophonic velarization rule, F2 varies more substantially by context in American English, with much lower values word-finally than word-initially. For example, Lehiste (1964) reported F2 values of 1185 Hz for /l/ in [li] for adult male speakers of American English, but 740 Hz for [iɫ]. Similarly, F2 values for /l/ were reported to be 1070 Hz for [lu], but 655 Hz for [uɫ]. Collapsing across vowel contexts, these studies show an average adult male F2 value of 1587 Hz word-initially and 1630 Hz word-finally in Spanish, and 1052 Hz word-initially and 755 Hz word-finally in English. Scale factors for adult females are estimated to be 1.17–1.19 (Peterson and Barney, 1952; Hillenbrand et al., 1995; Chládková et al., 2011). Based on this, estimates of female Spanish F2 values (using the scale factor of 1.18) would be around 1873 Hz word-initially and 1923 Hz word-finally, and English values would be at around 1241 Hz word-initially and 891 Hz word-finally. Averaging across the sexes, Spanish F2 values are estimated to be 1730 Hz word-initially and 1777 Hz word-finally; English F2 values are estimated to be 1147 Hz word-initially and 823 Hz word-finally.

Prior research suggests that these phonetic and phonological differences associated with /l/ are likely areas for interaction between Spanish-English bilinguals' two languages. For instance, in a recent acoustic study of Spanish-English sequential bilingual children's productions of /l/ in both languages (Barlow et al., 2013), it was determined that even young children were distinguishing their /l/ productions by language and context, such that they produced Spanish /l/ with monolingual-like F2 and F2-F1 values that were overall higher than those for English /l/. They also demonstrated knowledge of the English velarization pattern, in that they produced a syllable-final /l/ with lower, monolingual-like F2 and F2-F1 values as compared to /l/ produced in onset contexts. One interesting finding that emerged, however, was that the bilingual children produced onset /l/ in Spanish and English with similar F2 and F2-F1 values. In both their languages, they produced a very clear /l/ in that context, with average F2 values above 1800 Hz. Thus, while they appeared to produce a distinction between Spanish and English /l/ in the context in which the velarization rule applied (in the syllable rhyme), they did not produce a distinction between Spanish and English /l/ in the onset.

These findings can be interpreted in terms of Flege's Speech Learning Model (SLM; Flege, 1995, 2007). According to the SLM, a bilingual's two linguistic systems share a "common phonological space." This shared space can cause bidirectional interaction to occur throughout the lifespan, regardless of the age at which the second language (L2) was acquired or the number of years speaking that L2, though the extent, type, and direction of interaction will be influenced by these factors as well as other factors described above, such as dominance and use (Flege, 2002, 2007; Flege and MacKay, 2004). Per the SLM, interaction may occur

[1]Note that English dialects vary by /l/ darkness. American English /l/ is described as dark in all contexts; however, many (but not all) British dialects employ a clear /l/ in onset position and a dark /l/ only in the rhyme (Hawkins and Nguyen, 2004; Carter and Local, 2007). Moreover, interspeaker variability in /l/ darkness has also been observed for American English (Huffman, 1997).

via perceptual assimilation, where a contextual allophone of the L2 is perceived as phonetically equivalent to an existing phonetic category in the first language (L1), causing the two categories to be merged into one that reflects the properties of both languages (the "Merger Hypothesis"; Flege, 1987, 1995). The more similar two phonetic categories are in the L1 and L2, the more likely such category assimilation is to occur. In this case, productions of the contextual allophones for the L1 and the L2 may occur as intermediate to those of monolinguals in the respective languages. Alternatively, interaction may also occur via perceptual dissimilation, where a new phonetic category of the L2 is created, but, due to its similarity to an already-existing category in the L1, the two categories dissimilate from each other to maintain the contrast and prevent "crowding" of the shared phonological space. In this case, productions of the contextual allophones for the L1 and the L2 may be more distinct (that is, exaggerated) as compared to those of monolinguals of the respective languages (Flege, 1987, 1995).

Applying the SLM to the findings from the study of Spanish-English bilingual children's productions of /l/ (Barlow et al., 2013), it can be assumed that the children classified the syllable-initial /l/ phones of Spanish (the L1) and English (the L2) as phonetically equivalent, and therefore merged those two categories, which resulted in the acoustically similar productions in that context. It is also assumed that the children classified the syllable-final /l/ phones of each language as more distinct from one another (as compared to the syllable-initial phones), and established separate phonetic categories for them, which resulted in the acoustically distinct productions in that context for the two languages.

This raises the question of whether these children would continue to produce the same /l/ in Spanish and English in adulthood, or if their English onset /l/ productions would gradually become more monolingual-like with added input from the surrounding linguistic community (Flege, 1987; Barlow et al., 2013). On the one hand, as children, they were still in the process of learning both languages, and fine-tuning of articulatory and acoustic properties of speech continues well into adolescence (Kent, 1976; Walsh and Smith, 2002; Oh, 2005; Vorperian et al., 2009). Thus, as they reach adulthood, the children's /l/ productions might become more monolingual-like in both languages.

Yet, there may be no motivation on the children's part to change how they articulate /l/. The use of a Spanish-like clear /l/ in English, even in syllable-final contexts where velarization would typically apply, is not likely to compromise understanding or perhaps even detection of an accent (Port and Mitleb, 1983; Flege and Eefting, 1987; MacKay et al., 2001; Flege, 2002, 2007). Indeed, clear /l/ is an acceptable variant in English, and dialectal and idiolectal variation in /l/ darkness does occur among (monolingual) native English speakers (Wells, 1982a,b; Frazer, 1996; Hayes, 2000; Hawkins and Nguyen, 2004; Carter and Local, 2007; Ladefoged and Johnson, 2011). This is unlike differences in VOT, for example, where a breakdown in communication could occur at worst, or an accent would be noticeable at best. For instance, in English, categorically voiced stops are produced with VOTs that are similar in duration to categorically voiceless stops in Spanish. Thus, if a Spanish learner of English were to pronounce the English word "park" with a short-lag Spanish VOT, instead of the long-lag VOT (aspiration) that is typical of a native English speaker, this might be perceived by native English speakers as "bark." Given that no such phonemic overlap occurs for the /l/ allophones, it stands to reason that Spanish-English bilinguals might be more likely to maintain this merged phonetic category for /l/ in the two languages, via assimilation.

As mentioned above, the age at which bilinguals acquire their two languages plays an important role in the extent and type of interaction that can occur between their languages. Converging evidence suggests that there may be multiple critical (or sensitive) periods for acquisition of different domains of language. Accordingly, there is a higher (older) upper age limit for acquisition of morphosyntax and semantics, which is around 16 years of age, as compared to that for phonology, which is around the age of 5 years (Flege et al., 1999; Scovel, 2000; Newport et al., 2001). The L1 effects on the L2 are more likely to be observed if L2 acquisition occurs after these cutoff ages. Nevertheless, fine-tuning of articulatory aspects of the sound system continues into adolescence, as mentioned above, as does phonemic category formation (Hazan and Barrett, 2000).

Whether phonetic category assimilation or dissimilation occurs in L2 acquisition is also dependent on whether L1 category formation has occurred, and the extent to which it has occurred (Hazan and Barrett, 2000; Flege, 2007). If category formation has already occurred, or has developed well in advance of that for the L2, then the L2 learner is more likely to exhibit category assimilation, because the L1 categories serve as "strong attractors" for phonetically similar sounds in the L2 (Flege and MacKay, 2011). In contrast, if L1 category formation has not yet occurred, or is not far in advance of that of the L2, then the learner is more likely to establish separate phonetic categories for the two languages. In turn, dissimilation is more likely to occur, motivated by the avoidance of a crowded phonological space (Flege, 1995, 2002; Flege and MacKay, 2011).

Related to this is the observation that the later the AoA of the L2, the greater the use of the L1; conversely, the earlier the AoA of the L2, the greater the use of the L2 (Flege et al., 1997; Flege and MacKay, 2011). Further, studies of perception and production that manipulate the factors of AoA and L1 use have indicated that early bilinguals who exhibit low L1 use are the most likely to establish a new L2 category, as evidenced by exaggerated differentiation of the phonetically similar sounds (Flege et al., 1997, 2003; Flege and MacKay, 2004).

The purpose of the current study was to add to our understanding of Spanish-English bilinguals' knowledge and use of /l/ in their two languages, by considering the productions of adult bilinguals who acquired Spanish from birth and acquired English either simultaneously or sometime before adulthood. Further, because AoA is known to impact the extent of interaction between a bilingual's two languages (Flege, 1991; Flege et al., 1995, 1999; MacLeod and Stoel-Gammon, 2010), a second goal was to determine if – when dominance and extent of language use were held constant – the age at which bilinguals learned English impacted their productions of /l/ in their two languages.

Toward this end, we acoustically analyzed /l/ productions of Early Bilinguals, Late Bilinguals, and English Monolinguals in

English and Spanish in terms of their relative darkness as indicated by F2 and F2-F1 measurements in onset (WI) and rhyme (WF) contexts. It was predicted that Early and Late Bilinguals would have phonological systems that are comparable to those of English Monolinguals with respect to the patterning of /l/. That is, they would show knowledge of the allophonic velarization rule in English by producing a darker /l/ word-finally as compared to initially. Given that sequential bilingual children evidence knowledge of this phonological pattern (Barlow et al., 2013), it stands to reason that adult bilinguals who acquired both languages before adulthood would as well.

Similarly, it was predicted that Early and Late Bilinguals would have phonological systems that are comparable to those of Spanish monolinguals (as described in prior research) with respect to the patterning of /l/. That is, they would show little to no difference in their /l/ productions in word-initially vs. finally. Once again, given the prior evidence that sequential bilingual children show knowledge of how Spanish /l/ patterns (Barlow et al., 2013), it stands to reason that the adult bilinguals would do so as well.

It was also predicted that Early and Late Bilinguals would produce a phonetic distinction between their Spanish and English /l/ sounds. That is, independent of the allophonic velarization rule in English, the bilinguals would produce a clearer /l/ in Spanish than in English. However, it was predicted that the Late Bilinguals, whose Spanish phonetic categories for /l/ were further developed when they began acquiring English, would produce English and Spanish /l/s in both contexts that were intermediate in clearness to those of monolinguals in both languages, which would be indicative of category assimilation (Flege, 1995, 2002). In contrast, the Early Bilinguals, who were still in the process of forming Spanish phonetic categories for /l/ when acquiring English, were predicted to produce /l/s in both languages as distinct from one another in each context, which would be indicative of category formation for both languages (Flege, 1995, 2002). Dissimilation was not predicted to occur for the Early Bilinguals, because the /l/ variants in the two languages do not overlap with other existing phonetic categories within either language, as discussed above.

MATERIALS AND METHODS

PARTICIPANTS

Thirty-eight college students participated in the study. This included 11 Early Spanish-English Bilinguals with a mean age of 20.6 years (SD = 1.8 years), seven of whom were female; 14 Late Spanish-English Bilinguals with a mean age of 20.4 years (SD = 1.2 years), 12 of whom were female; and 13 English Monolinguals with a mean age of 20.5 years (SD = 1.6 years), eight of whom were female. The groups did not differ significantly in terms of age, $F(2,35) = 0.05$, $p = 0.95$.

Eligible participants were required to have normal or corrected-to-normal vision, normal hearing and oro-motor function, as well as no history of developmental, cognitive, speech, or language difficulties. These restrictions were necessary for completion of the tasks associated with the study and for controlling for interspeaker differences as much as possible.

All participants completed a detailed questionnaire regarding their language background, use, and proficiency (adapted from Gutiérrez-Clellen and Kreiter, 2003). They answered specific questions regarding languages and dialects spoken, where they grew up, specific regions of the US and Mexico in which they resided, the age(s) at which they learned their language(s), and how many hours per day they used each language and with whom and in what context. In order to control for language and dialect effects, only participants who spoke varieties of Spanish and/or English from the Southern California (US) and Baja California (Mexico) region were included in the study.

Participants also self-rated their receptive and expressive abilities in English and Spanish on a scale from "0" (unable to understand/speak the language) to "4" (native-like ability to understand/speak the language). Participants were classified as Spanish-English bilingual if they rated themselves at 3 or 4 for receptive and expressive abilities in both English and Spanish. Participants were classified as English monolingual if they reported that they knew English from birth, they rated themselves with a 3 or 4 for English and a 0 for Spanish, and they did not report knowledge of any other spoken language. Chi-square tests revealed no significant differences between the three participant groups in terms of ratings for receptive and expressive abilities for English, or between the Early and Late Bilinguals in terms of receptive and expressive abilities for Spanish (all $ps > 0.05$).

Based on their responses on the questionnaire, participants were characterized as "Early Bilinguals" if they learned Spanish from birth and acquired English before the age of 5 years, or as "Late Bilinguals" if they learned Spanish from birth and acquired English after the age of 6 years. This criterion was determined *a priori*, and was based on prior research findings that show the age of 5 years as the upper limit for the critical period for native- or monolingual-like phonological acquisition, as described above (McLaughlin, 1978; Flege, 1991; Flege et al., 1995; Hamers and Blanc, 2000; Scovel, 2000; Genesee et al., 2004; Gildersleeve-Neumann and Wright, 2010; Lee and Iverson, 2012)[2]. The Early Bilinguals had a mean AoA of English of 2.4 years (SD = 1.7 years), and the Late Bilinguals had a mean AoA of 8.3 years (SD = 2.0 years). This difference in AoA between the two groups was significant, $t(23) = -7.71$, $p < 0.001$.

Responses to the portion of the questionnaire that addressed language speaking and listening contexts were quantified in order to compare participants in terms of amount of input and output in their language(s). A "1" was scored for use of English only in a given speaking/listening context, and a "5" was scored for use of Spanish only. The scores were then averaged across the listening (input) and speaking (output) contexts. Thus, a score closer to 1 would reflect greater input/output in English, while a score closer to 5 would reflect greater input/output in Spanish. In contrast, a score of 3 would reflect a more or less balanced bilingual in so far as language input/output was concerned. Not surprisingly, the English monolinguals' scores were 1.04 (SE = 0.04)

[2]For expository purposes, the term "Late Bilingual" is used. These bilinguals are often referred to as "sequential bilinguals" or "heritage speakers" (Valdés, 2005). The term "sequential" is intentionally avoided here, because some of the Early Bilinguals are arguably characterized as sequential as well, having learned English later than Spanish (e.g., at age 3 years; Meisel, 2001; Genesee et al., 2004).

for input and 1.03 (SE = 0.03) for output[3]. The Early Bilinguals' mean input was 2.38 (SE = 0.24) and their mean output was 2.41 (SE = 0.27). The Late Bilinguals' mean input was 2.51 (SE = 0.20) and their mean output was 2.56 (SE = 0.21). Analyses of variance (ANOVAs) showed an effect of background for input, $F(2,35) = 21.8$, and for output, $F(2,35) = 19.9$, $p < 0.001$. *Post hoc* tests using Bonferroni correction revealed that, for both input and output, the monolinguals had significantly lower scores than did the Early and Late Bilinguals ($p < 0.001$), consistent with their monolingual status. The Early and Late Bilinguals did not significantly differ from one another on any single speaking or listening context, or on their overall input or output scores ($p = 1.00$). The scores indicate that both groups of bilinguals showed slightly greater input/output for English, which is not surprising given that they are students at a predominately English-speaking university. Nevertheless, both groups maintain high usage of Spanish as well, which is supported by the Southern California community which boasts a large Spanish-speaking population (US Census Bureau, 2003).

STIMULI AND RECORDING PROCEDURES

To evaluate the participants' /l/ productions by language and context, a 177-item list was created for each language using 59 words sampled three times each in random order. These words were similar in phonetic form across the two languages and balanced for adjacent vowels. Of these 59 words, there were five mono- or di-syllabic WI /l/ words and five mono- or di-syllabic WF /l/ words for each language. An additional five intervocalic /l/ words and five WI plosive + /l/ cluster words were also included, but are not analyzed herein[4]. The remaining words included voiceless stop consonants, which were targeted as part of a separate study. Of relevance to the current study were the 10 /l/ words for each language, sampled three times each per participant, yielding 30 attempts per participant per language. Refer to **Table 1** for a list of the stimuli analyzed in this study and their corresponding phonetic representations based on the Southern California and Baja California dialects. Broad transcription is used except in the case of the representation of the /l/ phoneme (Hualde, 2005).

Participants were seated in a quiet room, with a SONY electret condenser MS907 microphone placed approximately 6 inches in front of them. All utterances were digitally recorded onto an Edirol R-09HR MP3 digital recorder. Participants were asked to read each word from the 177-item list in a carrier phrase ["Say ___ again," or *Di* __ *ahora* ("Say __ now")]. To control for order effects and to aid in separation of language modes for the bilinguals, the Spanish and English tasks were presented in random order across participants and were separated in time by completion of the language questionnaire described above. The digital recording files were then transferred to a computer for the purpose of acoustic analysis.

Table 1 | English and Spanish stimuli.

English	Spanish
WI	
lease [lis]	*liso* [liso] "flat, smooth"
lay [leɪ]	*ley* [lei] "law"
loss [lɑs]	*laso* [laso] "weary"
load [loʊd]	*lodo* [lodo] "mud"
loose [lus]	*luz* [lus] "light"
WF	
meal [miɬ]	*mil* [mil] "thousand"
mail [meɪɬ]	*miel* [miel] "honey"
mall [mɑɬ]	*mal* [mal] "bad"
soul [soɬ]	*sol* [sol] "sun"
tool [tuɬ]	*tul* [tul] "tulle"

As stated, there were 30 target /l/ productions per participant per language, yielding a total of 1140 productions in English (for the 38 participants from all three groups) and 750 productions in Spanish (for the 25 participants from the two bilingual groups). Some items were excluded due to extraneous noise in the signal (e.g., the participant bumped against the table) or because the participant mispronounced the target word (e.g., "load" pronounced as [laʊd]). With these forms excluded, the number of items analyzed was reduced to 1135 words in English and 747 words in Spanish.

ANALYSES

In order to compare productions of /l/ by language and context, formant measurements were required in order to compare F2 values and the F2-F1 differences. To do this, the digital recordings were acoustically analyzed with Praat software (v. 5.0.26; Boersma and Weenink, 2008) by student research assistants who were trained extensively in the use of the software and in the analysis of formants of vowels and approximants. To make the formant measurements, the midpoint of each /l/ production was identified both visually (from waveform and spectrogram displays) and perceptually (via headphones). Then, the mouse cursor on the computer was placed at the identified midpoint of each target /l/ production and the "Get Formants" command was used to obtain values for F1 and F2. From these values the raw F2-F1 difference was calculated. F2 values for the vowels /i/ and /o/ in the above word list were also determined for the purpose of normalization (as described below) using the same procedure within Praat.

Because this method of acoustic analysis is somewhat subjective, interjudge reliability was calculated in the following two ways.

[3]The standard errors for the monolinguals reflect a common situation in a bilingual context. Spanish is prevalent in this community and can be heard in marketplaces, in restaurants, and on television and radio.

[4]Intervocalic forms were excluded because English and Spanish differ in terms of how intervocalic /l/ is syllabified, particularly in post-tonic contexts. Thus, in the English word "solo," the /l/ is often assumed to occur in coda position of the first syllable, as with [ˈsoˑ.o], due to stress-based (re-)syllabification, though lexical and morphological factors also play a role (Borowsky, 1986; Hayes, 2000; Yuan and Liberman, 2011; Lee-Kim et al., 2013). Whereas, in the Spanish word *solo*, the /l/ is assumed to occur in onset position, as [ˈso.lo] (Harris, 1983; Colina, 1997). This is an "interlanguage structural ambiguity" (Paradis, 2001b) that would be of interest for future studies on Spanish-English bilinguals. Plosive + /l/ forms were also excluded due to inherent differences in VOT that occur on the so-called voiced and voiceless plosives, which in turn can affect characteristics and subsequent identification of the formants for the following /l/ (Flege and Eefting, 1987; Flege, 1991; Yavaş, 2008).

First, correlation analyses were conducted for 15% of the stimuli analyzed. Correlation between the F1 measures for the two judges for 283 items was $r(281) = 0.777$, $p < 0.001$. Correlation between the F2 measures was $r(281) = 0.894$, $p < 0.001$. Second, the absolute difference in measures was determined (following Shriberg et al., 1997). This is calculated by finding the mean of the first judge's measures, calculating the mean of the absolute value of the difference between the first judge's mean and that of the second judge's measures, and then dividing the absolute mean by the original mean. Based on the same 283 items, the mean absolute difference for F1 and F2 was 10 and 8%, respectively.

The raw F2 and F2-F1 values were averaged across all productions per context for each speaker. To account for individual and sex-based differences attributed to vocal tract size and length, all raw F2 measures were normalized using the S-procedure of Watt and Fabricius (2002), following Simonet (2010). Comparisons of vowel normalization methods (Adank et al., 2004; Flynn and Foulkes, 2011) indicate that, for conducting language variation research such as with the present study, normalization procedures that are category extrinsic, formant intrinsic, and speaker intrinsic are best for reducing interspeaker variation that is attributed to anatomical and physiological differences and for preserving interspeaker variation that is attributed to language and dialect differences (Flynn and Foulkes, 2011). Because the focus of the current study was on the lateral approximant, the vowel sounds /i/ and /o/ were taken into consideration in the normalization procedure, thereby making the process category extrinsic. These two vowels were selected to represent the front and back extremes of the vowel space for the purposes of this study. The vowel /o/ was selected instead of /u/, which in the California English dialect is known to be fronter in the vowel space than is /o/ (Hagiwara, 1995, 1997; Labov et al., 2006; Grijalva et al., 2013)[5]. In the Spanish spoken in this area, /o/ and /u/ have similar degrees of backness (Grijalva et al., 2013). The normalization procedure also included the lateral approximant formant values (formant intrinsic) for each speaker (speaker intrinsic). The S-procedure of Watt and Fabricius (2002) as described by Simonet (2010) and by Flynn and Foulkes (2011) involves determining the centroid F2 value for a given speaker's vowel space. To do this, the mean F2 values for the /i/ vowel and the /o/ vowel were obtained (based on the productions in the word list discussed above); then, a grand mean of those two vowels was determined which served as the centroid F2 value (Simonet, 2010). The normalized F2 value for each /l/ production was determined by dividing the raw F2 value by the centroid F2 value.

Separate repeated measures ANOVAs with follow-up analyses using the Bonferroni procedure compared mean normalized F2 values and raw F2-F1 difference values across all /l/ tokens by background (Monolingual vs. Early vs. Late Bilingual), and context (WI vs. WF) for each language (English and Spanish). Additional separate repeated ANOVAs also were conducted for within-group comparisons of Spanish and English productions for the Early and Late Bilinguals.

[5]An earlier draft of this paper included a normalization process that used the /i/ and /u/ vowels. Given the fronter quality of California English /u/, a normalization process using the vowels /i/ and /o/ was recommended as an alternative by an anonymous reviewer. The results of this prior analysis were similar to the findings presented here, which strengthens the findings observed here.

RESULTS

The means and standard errors of the means for the raw F1 and F2 values of /l/ productions are shown in **Table 2**, organized by language, background, and context. Compared to monolingual data reported in prior research (as discussed in the Introduction), the raw F2 values are notably high across groups, closer to the estimated female values for each language, and this is attributed to the fact that the current study includes more females than males (Peterson and Barney, 1952; Hillenbrand et al., 1995). The one exception is WF position in Spanish, which for both Early and Late Bilinguals is lower than what is reported in prior studies.

The following sections present the results of the between-group comparisons for English and Spanish as well as the within-group comparisons for the Early and Late Bilinguals for normalized F2 and raw F2-F1 differences.

ENGLISH

First, a between-groups analysis compared English /l/s produced by the Monolinguals and the Early and Late Bilinguals in order to test the prediction that bilinguals have an English phonological system comparable to that of monolinguals. Support for this would be evident from the occurrence of higher mean normalized F2 and raw F2-F1 values in WI as compared to WF contexts, as predicted by the allophonic velarization rule in English.

Figure 1 shows the means and standard errors for the normalized F2 values of English /l/ productions, organized by background and context. Results of the English normalized F2 analysis revealed a main effect for context, $F(1,35) = 47.3$, $p < 0.001$. WI /l/s had significantly higher F2 values than WF /l/s, consistent with the allophonic patterning of /l/ in English. There was also a main effect for background, $F(2,35) = 7.5$, $p = 0.002$. Pairwise comparisons revealed that the Late Bilinguals produced /l/ with significantly higher F2 values compared to the Monolinguals. The Early Bilinguals did not significantly differ from the Late Bilinguals or the Monolinguals. Moreover, there was no significant interaction between context and background ($p = 0.15$).

Table 2 | Means (and standard errors) of raw F1 and F2 values for English and Spanish.

	F1		F2	
	WI	**WF**	**WI**	**WF**
English				
Late Bilinguals	407 (21)	520 (28)	1508 (64)	1161 (46)
Early Bilinguals	403 (24)	509 (23)	1420 (77)	1123 (30)
Monolinguals	391 (12)	505 (16)	1235 (48)	1055 (32)
Spanish				
Late Bilinguals	385 (20)	399 (17)	1838 (43)	1698 (47)
Early Bilinguals	386 (19)	405 (10)	1716 (41)	1644 (51)

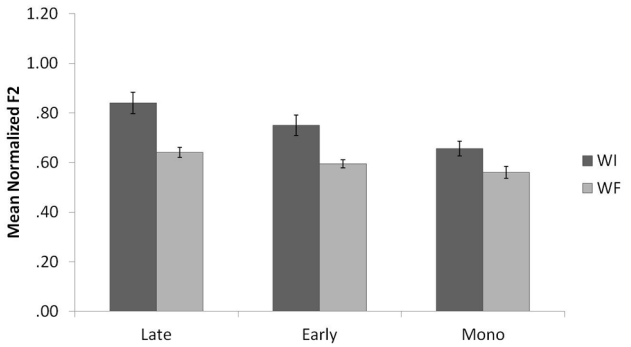


FIGURE 1 | Mean normalized F2 values by context for Late Bilinguals, Early Bilinguals, and Monolinguals for English. Error bars refer to standard errors; WI refers to word-initial, and WF refers to word-final.

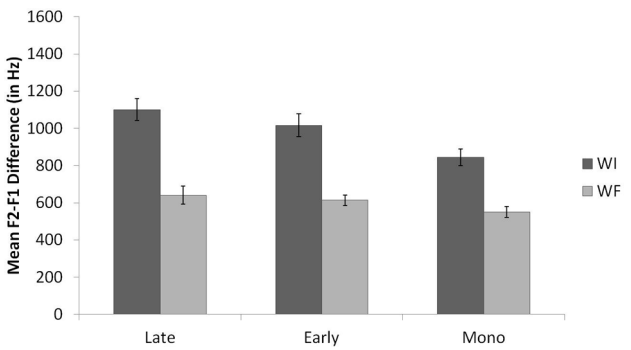


FIGURE 2 | Mean raw F2-F1 values by context for Late Bilinguals, Early Bilinguals, and Monolinguals for English. Error bars refer to standard errors.

Figure 2 displays the means and standard errors for the raw F2-F1 differences for English /l/ productions, organized by background and context. Similar to the results of the normalized F2 analysis, results of the English F2-F1 analysis revealed a main effect for context, $F(1,35) = 102.0$, $p < 0.001$. WI /l/s had significantly higher F2-F1 values than WF /l/s, consistent with the allophonic patterning of /l/ in English. There was also a main effect for background, $F(2,35) = 6.8$, $p = 0.003$. Pairwise comparisons revealed that the Late Bilinguals produced /l/ with significantly higher F2 values compared to the Monolinguals ($p = 0.003$). The difference between Early Bilinguals and Monolinguals approached significance ($p = 0.08$), with the Early Bilinguals producing higher F2-F1 values than the Monolinguals. The Early Bilinguals and Late Bilinguals did not differ significantly from each other. Additionally, the interaction between context and background was not significant ($p = 0.19$).

Thus, the results support the prediction: both groups of bilinguals demonstrated phonological knowledge of the allophonic velarization rule in English by producing a lower normalized F2 and a smaller F2-F1 difference in WF as compared to WI position. However, the findings also illustrate that the Late Bilinguals differ from the Monolinguals given their production of overall higher F2 and F2-F1 values. These higher F2 and F2-F1 values are assumed to be due to interference from the Late Bilinguals' knowledge of Spanish, which has a clearer /l/.

SPANISH

Next, a between-groups analysis evaluated the bilinguals' Spanish /l/ productions in order to test the prediction that Early and Late Bilinguals would have phonological systems that are comparable to those of Spanish monolinguals with respect to the patterning of /l/ (as described in prior research). Support for this would be evidenced by a lack of difference by context for normalized F2 and raw F2-F1 values for both groups.

Figure 3 shows the means and standard errors for the normalized F2 values of Spanish /l/ productions, organized by background and context. Results of the Spanish normalized F2 analysis revealed a main effect for context, $F(1,23) = 20.5$, $p < 0.001$. WI /l/s had significantly higher F2 values than WF /l/s, which was unexpected, given that prior research reports WFs /l/s that are similar to or slightly higher than WI /l/s in Spanish. There was no main effect for background ($p = 0.15$), nor was there a significant interaction between context and background ($p = 0.18$).

Figure 4 shows the means and standard errors for the raw F2-F1 differences for Spanish /l/ productions, organized by background and context. Results of the Spanish F2-F1 analysis also revealed a main effect for context, $F(1,23) = 14.7$, $p = 0.001$. Once again, WI /l/s had significantly higher F2-F1 values than WF /l/s. The

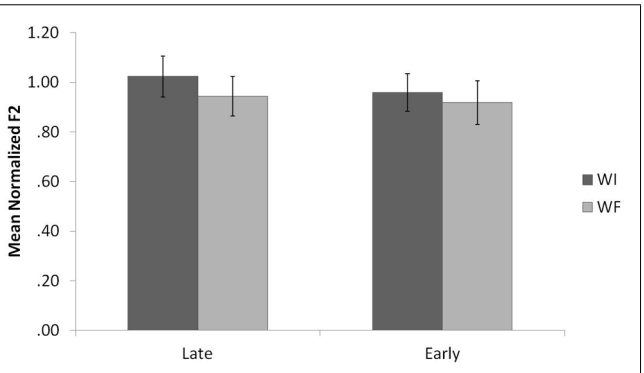


FIGURE 3 | Mean normalized F2 values by context for Late Bilinguals and Early Bilinguals for Spanish. Error bars refer to standard errors.

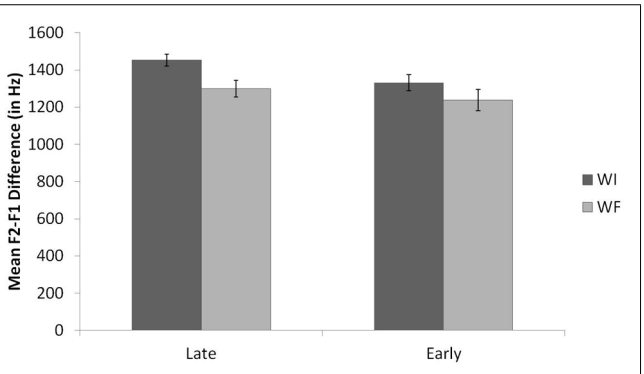


FIGURE 4 | Mean raw F2-F1 values by context for Late Bilinguals and Early Bilinguals for Spanish. Error bars refer to standard errors.

main effect of background approached significance ($p = 0.10$), with Late Bilinguals producing higher F2-F1 values than Early Bilinguals. There was no significant interaction between context and background ($p = 0.34$).

These findings go against the original prediction. The effect of context indicates that, generally speaking, the Bilinguals in this study in fact produced a difference by context for /l/ in Spanish by producing a darker /l/ in WF position, which is inconsistent with prior descriptions of the Spanish language (see Introduction), and is suggestive of an effect of the English phonological system on the Spanish. However, the marginally significant effect of background for F2-F1 values suggests that Late Bilinguals may in fact be driving this contextual pattern. To further evaluate this possibility, we consider our within-group comparisons next.

BILINGUALS: ENGLISH vs. SPANISH

Separate repeated measures ANOVAs were also completed to make within-group comparisons by language and context for the Early and Late Bilinguals, respectively. This tested the prediction that Early and Late Bilinguals would produce a phonetic distinction between their English and Spanish /l/ phonemes, and allowed for further determination of whether Early and Late Bilinguals showed different profiles with respect to this phonetic distinction.

Figure 5 displays the means and standard errors for the normalized F2 values of Spanish and English /l/ productions once again, organized by language, background, and context. Results of the normalized F2 analyses revealed, not surprisingly, a significant difference across the four measures for Late Bilinguals, $F(3,39) = 37.4$, $p < 0.001$, and for Early Bilinguals, $F(3,30) = 58.7$, $p < 0.001$.

Post hoc tests using Bonferroni correction for normalized F2 values for the Late Bilinguals revealed that Spanish WI /l/s were significantly higher than Spanish WF, English WI, and English WF /l/s. In addition, Spanish WF /l/s were significantly higher than English WF /l/s, and English WI /l/s were significantly higher than English WF /l/s. (All ps < 0.01.) Spanish WF and English WI /l/s were not significantly different ($p = 0.39$).

Post hoc tests for the Early Bilinguals revealed that Spanish WI and WF /l/s were significantly higher than English WI and WF /l/s. Moreover, English WI /l/s were higher than English WF /l/s. (All ps ≤ 0.01.) Spanish WI and WF /l/s were not significantly different ($p = 0.42$).

Figure 6 shows the means and standard errors for the raw F2-F1 differences for Spanish and English /l/ productions once again, organized by language, background, and context. Results of the F2-F1 analyses revealed, once again, a significant difference across the four measures for Late Bilinguals, $F(3,39) = 58.9$, $p < 0.001$, and for Early Bilinguals, $F(3,30) = 49.5$, $p < 0.001$.

Post hoc tests using Bonferroni correction for F2-F1 values for the Late Bilinguals revealed that Spanish WI /l/s were significantly higher than Spanish WF, English WI, and English WF /l/s. In addition, Spanish WF /l/s were significantly higher than English WF /l/s, and English WI /l/s were significantly higher than English WF /l/s. (All ps < 0.02.) Spanish WF and English WI /l/s were not significantly different ($p = 0.18$).

Post hoc tests for the Early Bilinguals revealed that Spanish WI /l/s were significantly higher than English WI and WF /l/s. Moreover, English WI /l/s were higher than the English WF /l/s. (All ps ≤ 0.01.) The difference between Spanish WF and English WI /l/s approached significance ($p = 0.08$), with Spanish WF /l/s higher than English WI /l/s, whereas Spanish WI and WF /l/s were not significantly different ($p = 0.52$).

These findings aid in interpretation of the results of the between-groups analysis for Spanish. The difference by context for Spanish /l/ productions is attributed to the productions of the Late Bilinguals. That is, the Late Bilinguals' Spanish WI /l/s are clearer than their Spanish WF /l/s; in contrast, the Early Bilinguals' Spanish /l/s do not differ significantly by context (though there is a trend in the same direction).

Taken together, these findings also show support for the prediction that the Bilinguals would produce a phonetic distinction between their English and Spanish productions; however, the two groups showed different profiles for these distinctions. Specifically, the Early Bilinguals produced both contextual /l/s in Spanish with higher normalized F2 and raw F2-F1 values than those in English. The Late Bilinguals, in contrast, only distinguished Spanish WI /l/s from the English /l/s. They did not produce a significant difference between their Spanish WF and English WI /l/s (though, once again, there was a trend in that direction).

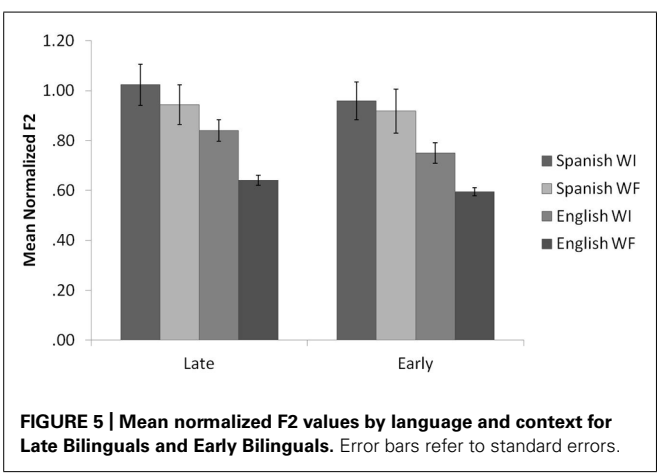


FIGURE 5 | Mean normalized F2 values by language and context for Late Bilinguals and Early Bilinguals. Error bars refer to standard errors.

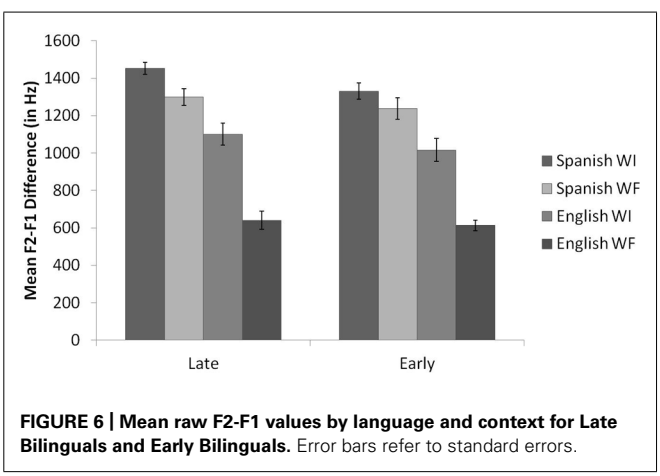


FIGURE 6 | Mean raw F2-F1 values by language and context for Late Bilinguals and Early Bilinguals. Error bars refer to standard errors.

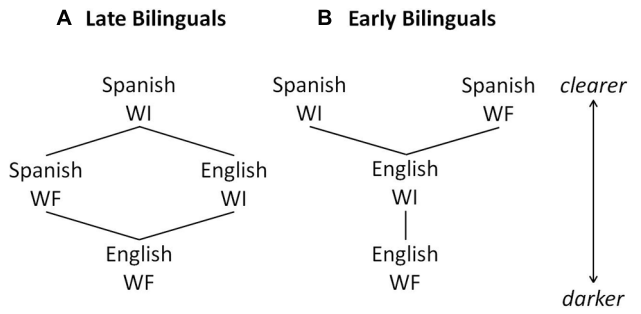


FIGURE 7 | Schematic of /l/ clearness by language and context for Late (A) and Early (B) Bilinguals.

The results point to two distinct profiles for the Early and Late Bilingual groups, which are depicted in **Figure 7**, with **Figure 7A** representing Late Bilinguals and **Figure 7B** representing Early Bilinguals. Each /l/ variant by language and context is ranked according to clearness, based on the analyses of normalized F2 and raw F2-F1 values. Note that the profile represented by the Early Bilinguals (**Figure 7B**), is identical to comparisons of the two languages. That is, Spanish WI and WF /l/s show little to no difference in clearness, and are clearer than English WI /l/s, which in turn are clearer than English WF /l/s. The Late Bilingual profile (**Figure 7A**) thus differs from the monolingual pattern. Thus these combined results show us that the Early and Late Bilinguals both have knowledge of the phonological patterning of /l/ in English that is comparable to those of monolinguals. In Spanish, however, only the Early Bilinguals show monolingual-like knowledge of how /l/ patterns. The Late Bilinguals, in producing a difference by context, show a different type of phonological knowledge.

The combined results additionally support the prediction that Early and Late Bilinguals would differ from one another in their phonetic implementation of the Spanish and English /l/s. And though the two groups do differ from one another, they do not differ exactly as expected. Recall, it was predicted that the Late Bilinguals would show evidence of category assimilation, given that their Spanish phonetic categories were more established before acquisition of English began. The results do support this prediction, given that their English /l/s are clearer than those of the monolinguals, and their Spanish WF /l/s are not significantly different from their English WI /l/s. Yet, it was also predicted that the Early Bilinguals would show evidence of separate category formation due to the fact that Spanish phonetic categories were developing simultaneously (or nearly so) with English phonetic categories. Though the Early Bilinguals did distinguish their Spanish /l/s from their English /l/s, which is suggestive of category formation, their English /l/s were clearer than those of the monolinguals, which is suggestive of category assimilation, per Flege (1995).

DISCUSSION

The goal of this study was to evaluate the phonetic and phonological characteristics of Spanish and English /l/ productions by two groups of bilinguals who differed in their AoA of English. The results are discussed in light of the hypotheses proposed in the Introduction.

It was predicted that Early and Late Bilinguals would show knowledge of the phonological systems of both English and Spanish. For English, they were expected to show knowledge of the allophonic velarization rule by producing darker /l/s in WF vs. WI position. Both the Early and Late Bilinguals showed this pattern of production in English, indicating that, despite differences in AoA of English, acquisition of the allophonic rule occurred. This pattern is consistent with English phonology, and was expected to occur given that even young bilingual children demonstrate knowledge of this allophonic pattern (Barlow et al., 2013). It was also not surprising given the high receptive and expressive abilities in English as reported by all participants in the study.

For Spanish, the bilinguals were expected to produce little to no difference by context for /l/ productions, since Spanish /l/s are similar across contexts. In fact, the Late Bilinguals produced darker /l/s in WF than in WI position. This would suggest that the Late Bilinguals show influence of the English phonological rule on their Spanish phonological system. That is, the English allophonic velarization rule has transferred into their Spanish phonological system. Unfortunately, there was not a Spanish monolingual group in the current study to further support this claim. (See below for further discussion of this limitation.) However, assuming that prior reports of the facts about Spanish /l/ are correct, it appears that knowledge of the English allophonic rule has influenced the Late Bilinguals' productions of Spanish /l/.

It was also predicted that the bilinguals would produce a phonetic distinction between their Spanish and English /l/s, independent of the allophonic velarization pattern. This finding was generally supported: Spanish /l/s were clearer than English /l/s. However, the two groups differed from one another in terms of contextual variants. As depicted in **Figure 7**, the Early Bilinguals produced both Spanish WI and WF /l/s as clearer than both English WI and WF /l/s. This would suggest that the Early Bilinguals have formed separate phonetic categories for Spanish and English /l/s in each context, as was predicted, since they began to acquire the English phonetic categories before or at the same time as the Spanish phonetic categories were established (McLaughlin, 1978; Flege, 1991, 2007; Flege et al., 1995; Hamers and Blanc, 2000; Genesee et al., 2004; Lord, 2008; Gildersleeve-Neumann and Wright, 2010; Lee and Iverson, 2012). There was no evidence of category dissimilation for the Early Bilinguals, consistent with study predictions (Flege et al., 1995; Flege, 2002). That is, the Early Bilinguals' Spanish /l/s were not clearer than those reported for Spanish monolinguals, nor were they clearer than those of the Late Bilinguals. Moreover, their English /l/s were not darker than those of the Monolinguals. In fact, their English WI /l/s were somewhat clearer than those of the Monolinguals, which would suggest category assimilation. Still, this difference was only marginally significant, so it is assumed that the Early Bilinguals did form separate phonetic categories for their Spanish and English /l/s.

For the Late Bilinguals, only Spanish WI /l/s were clearer than English /l/s. The Spanish WF /l/s did not differ from English WI /l/s (again, refer to **Figure 7**). Thus, the phonetic categories for the Spanish and English /l/s have not been formed in the same

way as for the Early Bilinguals, since Spanish WF and English WI /l/s are not distinct. That is, their Spanish WF /l/s were produced as darker than Spanish WI /l/s (and darker than what is reported for monolingual Spanish WF /l/s in the literature), and their English WI /l/s were produced as clearer than those produced by Monolinguals. This is consistent with the prediction that the Late Bilinguals would show evidence of category assimilation by producing Spanish and English /l/s that were intermediate to those of monolinguals. Because the Late Bilinguals' phonetic categories for Spanish were more established prior to acquisition of English (Flege, 1991; Flege et al., 1995; Lee and Iverson, 2012), they may have been less likely to establish separate phonetic categories for the English and Spanish /l/ phones, and therefore merged them, leading to some /l/ productions that were not distinct.

Taking the results together, these show that there is a bidirectional influence between a bilingual's two languages, as predicted by the SLM (Flege, 1995), but this only seems apparent for the Late Bilinguals. That is, it appears that the Early Bilinguals show a slight Spanish-to-English *phonetic* influence, making the /l/s clearer. The Late Bilinguals also show this Spanish-to-English phonetic influence, and to a greater degree; however, they also show an English-to-Spanish *phonological* influence, given that the English allophonic rule also applies in their Spanish productions.

Documentation of L2-to-L1 interactions has been of particular focus in recent research on bilinguals and L2 learners (Cook, 2003; Kecskes, 2008). Such interaction has been reported for both children and adults and for a variety of linguistic structures, including but not limited to use of narrative structures (Pavlenko and Jarvis, 2002), processing relative clauses (Dussias and Sagarra, 2007), the use of PRO-drop (Satterfield, 2003), intonational patterns (Mennen, 2004), stress (Paradis, 2001a,b), vowel formants (Chang, 2012), and of course VOT (Flege, 1987; Thornburgh and Ryalls, 1998; Riney and Okamura, 1999; Whitworth, 2000; Zampini and Green, 2001; Kehoe et al., 2004; Lord, 2008; López, 2012).

Thus, the finding that the L2 (in this case, English) influences the L1 (Spanish) is not novel; however, the findings presented herein add to the body of research on L2-to-L1 influences, particularly for adults who acquired their L2 prior to adulthood. Interestingly, this influence was only apparent in the Late Bilinguals, and specifically in terms of the *phonological* system. Granted, the Early Bilinguals showed a similar, though non-significant, trend in the same direction. Possibly, with greater numbers of speakers a similar pattern would have been observed for that group as well.

The fact that a phonological pattern transferred from the Late Bilinguals' L2 to the L1 is surprising, given the proposed cutoff age of 5 years for the critical period for phonology, as discussed in the Introduction (Flege et al., 1999; Scovel, 2000; Newport et al., 2001). Recall, effects of the L1 on the L2 are greater after this age; prior research has not implicated the effects of the L2 on the L1. In this particular case, a new phonological rule of the L2 was not only acquired, it also impacted the L1. This suggests that both phonetic and phonological learning (and change) can continue past the age of 5 years, and can impact the L1. Nevertheless, the Late Bilinguals showed a greater degree of interaction between their two languages than did the Early Bilinguals, which suggests that the difference in AoA for English was a distinguishing factor. Perhaps acquiring a L2 after the critical period for phonology makes the learner less able to accommodate "competing" phonological patterns of their two languages. Acquisition of a phonological rule in the L2 was successful, but came at a cost to the L1.

The novel contribution of this study is that it focuses not only on the phonetic differences between bilinguals' productions of speech sounds that are shared between their two languages, but also on the knowledge and application of a phonological rule that affects those sounds in a particular context. Future studies that evaluate bilinguals' acquisition and use of an allophonic pattern should consider not only the allophones in those contexts that are affected by the allophonic rule (as with syllable-final /l/ for English), but also those contexts where the rule does not apply (as with syllable-initial /l/), because bilinguals may exhibit interaction between their two languages in those contexts as well, either in terms of category assimilation or, perhaps, dissimilation.

For instance, future research should evaluate bilinguals' productions of other allophonic patterns for phonemes that are shared between their two languages. Consider the comparison of VOT measures of voiceless oral stops in English and Spanish. As mentioned above, VOT in Spanish-English bilinguals is often studied because English has an allophonic rule that governs the distribution of long- and short-lag voiceless stops, whereas Spanish has only short-lag voiceless stops. It would be important to evaluate the English allophones in both long- and short-lag contexts, and to also evaluate Spanish stops in those same contexts. Given the findings from the present study, we might predict that both Early and Late Bilinguals would show a Spanish-to-English phonetic influence, by causing the English stops to have shorter lags. In addition, we might also predict that the Late Bilinguals would show an English-to-Spanish phonetic influence, such that the rule of aspiration also affects their Spanish stops, making them longer in the same context as in English.

Moreover, such studies should also take into consideration whether the allophonic pattern in question is part of the L1 or the L2 in the case of late bilinguals. For instance, an evaluation of /l/ contextual phones as produced by English-Spanish bilinguals (whose L1 is English) would be of particular interest, given the findings of the current study. We might still predict that the early English-Spanish bilinguals would show influence of English on Spanish. However, for English-Spanish late bilinguals, evaluating their suppression of the English /l/-velarization pattern in Spanish would be of particular interest. Perhaps their use of the allophonic rule would be diminished in English, due to influence of Spanish. Or perhaps the velarization pattern would extend to their Spanish productions, just as with the Late Bilinguals in the current study.

An obvious limitation to the current study is the absence of data from Spanish monolinguals. Such information would have provided additional support for the claim that the bilinguals' Spanish /l/ productions were influenced by their knowledge of English. Finding such participants would be a challenge, at least for this particular region of the US and Mexico. Recall that all participants in the current study were college students. It would

be difficult, if not impossible, to find college students in Baja California (let alone Southern California) regions who are monolingual Spanish speakers, because English language classes are common in many private and some public school curricula in Mexico, and are compulsory at the university level (Sierra and Padilla, 2003; O'Donnell, 2010; Torres-Olave, 2012). Of course, similar-aged monolingual Spanish participants who do not attend university could have been included in the current study, but their inclusion might have introduced production patterns associated with sociolinguistic factors other than their monolingual status (Lippi-Green, 1997; Lipski, 2008; Coloma, 2011). Future studies should include a larger and more diverse group of adult Spanish- and/or English-speakers to allow for an in-depth comparison of Spanish /l/ as spoken by Spanish-English bilinguals vs. Spanish monolinguals in order to determine the extent to which knowledge of English influences pronunciation of Spanish /l/. Moreover, it may be necessary to further evaluate Spanish and English regional dialect features. Perhaps phonetic and phonological characteristics of Spanish are in the process of changing due to contact with English and vice versa (Goebl et al., 1996). Consider that Chicano English is characterized as having a clearer /l/ than other dialects of English, though this varies across generations (Frazer, 1996; Van Hofwegen, 2009). This too presents a challenge, because it would be difficult to tease apart effects of a given Spanish-Chicano English bilingual speaker's knowledge of Spanish from the effects of the Chicano English dialect, since the dialect has numerous properties that are attributed to Spanish influence (Fought, 2003).

It may be that differences between the Early and Late Bilinguals are attributable to greater variability in Spanish proficiency for the former group and in English proficiency for the latter group. Despite the balanced ratings for expressive and receptive abilities and for input and output across the groups, it is possible that Early Bilinguals were more balanced bilinguals because of their earlier acquisition of English, and were also more homogeneous in terms of their abilities in their two languages as compared to the Late Bilinguals. It is well-documented that the later a language is acquired, the more variability there will be in the extent to which that language is acquired (Birdsong, 2006). Indeed, the Late Bilinguals did have a larger English AoA range, as evidenced by a larger AoA standard deviation.

Future studies should also compare Spanish-English bilinguals who learned Spanish first with those who learned English first, and should also compare differences in language dominance, given that dominance can change over time and is not necessarily dependent on which language was acquired first. As stated previously, language dominance is a critical factor in determining the direction of influence between the L1 and L2 (Flege and Eefting, 1987; Flege, 1991; Flege et al., 1995, 2002; Simonet, 2010; Antoniou et al., 2011). Generally speaking, early bilinguals tend to be dominant in the L2, whereas late bilinguals tend to remain dominant in the L1 (Flege et al., 2002). It is difficult to determine what the L1 and the L2 are in the case of the Early Bilinguals in the present study, given that the children were exposed to both languages from a very young age. Moreover, both groups appeared to be dominant in English based on their input and output scores, yet both also showed a phonetic influence of Spanish on their English productions. The direction of this influence would implicate Spanish as the dominant language for *both* groups, despite their input and output scores on the questionnaire, which may not have been sensitive enough. Otherwise, we might have expected the reverse pattern of phonetic influence, at least for the Early Bilinguals. On the other hand, the Late Bilinguals showed the unexpected impact of English (their L2) on the Spanish phonological system; this is suggestive of English dominance.

Though an attempt was made to match the Early and Late Bilinguals in terms of input, output, and proficiency, the language use questionnaire employed for this study did not document the extent to which code-switching was employed by the two groups, and this too could have impacted the results. Perhaps the Early Bilinguals code-switched more regularly, and may have done so since early childhood. The Late Bilinguals may have code-switched less at the time of the study, and also during the process of acquiring English. Though there is conflicting evidence regarding the cross-language phonetic and phonological influence of one language on the other during code-switched utterances (Grosjean and Miller, 1994; Bullock et al., 2004), the current study attempted to prevent opportunities to code-switch by separating the tasks in the two languages and requiring the participants to read the word lists in their carrier phrases. However, the long-term impact of different levels of code-switching that may have distinguished the two groups was not controlled for (Balukas and Koops, in press). Perhaps regular code-switching is more likely to lead to category assimilation, whereas less frequent code-switching might serve to maintain separate phonetic categories. This too would be an interesting direction for future research.

In summary, the results of the foregoing study indicate that AoA does impact bilinguals' production of sounds that are shared between their two languages. Although there was a *phonetic* influence from Spanish to English regardless of the age at which English was acquired, this was stronger for those bilinguals who learned English at a later age. Moreover, the effects of English *phonology* on Spanish were only apparent for those bilinguals who acquired English at a *later* age. The findings raise a number of questions regarding AoA, dominance, and the direction of influence that would be fruitful directions for continued study of bilingual phonology.

ACKNOWLEDGMENTS

I wish to thank those past and present members of the Phonological Typologies Lab at San Diego State University for their assistance with data collection and analysis. Thanks in particular to Courtney Lagus, Jamie Kylstad, and Danielle Torrez, who assisted with preliminary analyses that they presented at the 2013 San Diego State University Student Research Symposium. Thanks also to Ignatius Nip, Philip Combiths, and two anonymous reviewers who provided very helpful comments on earlier drafts of this paper.

REFERENCES

Adank, P., Smits, R., and van Hout, R. (2004). A comparison of vowel normalization procedures for language variation research. *J. Acoust. Soc. Am.* 116, 3099–3107. doi: 10.1121/1.1795335

Amengual, M. (2012). Interlingual influence in bilingual speech: cognate status effect in a continuum of bilingualism. *Biling. Lang. Cogn.* 15, 517–530. doi: 10.1017/S1366728911000460

Antoniou, M., Best, C. T., Tyler, M. D., and Kroos, C. (2011). Inter-language interference in VOT production by L2-dominant bilinguals: asymmetries in phonetic code-switching. *J. Phon.* 39, 558–570. doi: 10.1016/j.wocn.2011.03.001

Balukas, C., and Koops, C. (in press). Spanish-English bilingual voice onset time in spontaneous code-switching. *Int. J. Biling.* doi: 10.1177/1367006913516035

Barlow, J. A. (2003). The stop-spirant alternation in Spanish: converging evidence for a fortition account. *Southwest J. Linguist.* 22, 51–86.

Barlow, J. A., Branson, P. E., and Nip, I. S. B. (2013). Phonetic equivalence in the acquisition of /l/ by Spanish-English bilingual children. *Biling. Lang. Cogn.* 16, 68–85. doi: 10.1017/S1366728912000235

Birdsong, D. (2006). Age and second language acquisition and processing: a selective overview. *Lang. Learn.* 56, 9–49. doi: 10.1111/j.1467-9922.2006.00353.x

Boersma, P., and Weenink, D. (2008). *Praat: Doing Phonetics by Computer*, v. 5.0.26. Retrieved June 16, 2008, from http://www.praat.org

Borowsky, T. (1986). *Topics in the Lexical Phonology of English.* Doctoral dissertation, University of Massachusetts, Amherst.

Broselow, E. (2004). Unmarked structures and emergent rankings in second language phonology. *Int. J. Biling.* 8, 51–65. doi: 10.1177/13670069040080010401

Browman, C., and Goldstein, L. (1992). Articulatory phonology: an overview. *Phonetica* 49, 155–180. doi: 10.1159/000261913

Bullock, B. E., Toribio, A. J., Davis, K. A., and Botero, C. G. (2004). "Phonetic convergence in bilingual Puerto Rican Spanish," in *WCCFL 23: Proceedings of the 23rd West Coast Conference on Formal Linguistics*, eds V. Chand, A. Kelleher, A. J. Rodríguez, and B. Schmeiser (Somerville, MA: Cascadilla Proceedings Project), 113–125.

Carter, P., and Local, J. (2007). F2 variation in Newcastle and Leeds English liquid systems. *J. Int. Phon. Assoc.* 37, 183–199. doi: 10.1017/S0025100307002939

Chang, C. B. (2012). Rapid and multifaceted effects of second-language learning on first-language speech production. *J. Phon.* 40, 249–268. doi: 10.1016/j.wocn.2011.10.007

Chládková, K., Escudero, P., and Boersma, P. (2011). Context-specific acoustic differences between Peruvian and Iberian Spanish vowels. *J. Acoust. Soc. Am.* 130, 416–428. doi: 10.1121/1.3592242

Colina, S. (1997). Identity constraints and Spanish resyllabification. *Lingua* 103, 1–23. doi: 10.1016/S0024-3841(97)00011-9

Coloma, G. (2011). Valoración socioeconómica de los rasgos fonéticos dialectales de la lengua española [Socio-economic assessment of dialectal phonetic features of the Spanish language]. *Lexis* 35, 91–118.

Cook, V. (ed.). (2003). *Effects of the Second Language on the First.* Buffalo, NY: Multilingual Matters Ltd.

Dussias, P. E. (2003). Syntactic ambiguity resolution in L2 learners: some effects of bilinguality on L1 and L2 processing strategies. *Stud. Second Lang. Acquis.* 25, 529–557. doi: 10.1017/S0272263103000238

Dussias, P. E., and Sagarra, N. (2007). The effect of exposure on syntactic parsing in Spanish-English bilinguals. *Biling. Lang. Cogn.* 10, 101–116. doi: 10.1017/S1366728906002847

Eckman, F. R., and Iverson, G. K. (1997). "Structure preservation in interlanguage phonology," in *Focus on Phonological Acquisition*, eds S. J. Hannahs and M. Young-Scholten (Philadelphia: John Benjamins), 183–208.

Fabiano, L. C., and Goldstein, B. A. (2005). Phonological cross-linguistic effects in bilingual Spanish-English speaking children. *J. Multiling. Commun. Disord.* 3, 56–63. doi: 10.1080/14769670400027316

Fabiano-Smith, L., and Barlow, J. A. (2010). Interaction in bilingual phonological acquisition: evidence from phonetic inventories. *Int. J. Biling. Educ. Biling.* 13, 81–97. doi: 10.1080/13670050902783528

Fabiano-Smith, L., and Goldstein, B. A. (2010). Phonological acquisition in bilingual Spanish-English speaking children. *J. Speech Lang. Hear. Res.* 53, 160–178. doi: 10.1044/1092-4388(2009/07-0064)

Flege, J., Frieda, E., and Nozawa, T. (1997). Amount of native language (L1) use affects the pronunciation of an L2. *J. Phon.* 25, 160–186. doi: 10.1006/jpho.1996.0040

Flege, J., and MacKay, I. (2004). Perceiving vowels in a second language. *Stud. Second Lang. Acquis.* 26, 1–34. doi: 10.1017/S0272263104026117

Flege, J. E. (1987). The production of 'new' and 'similar' phones in a foreign language: evidence for the effect of equivalence classification. *J. Phon.* 15, 47–65.

Flege, J. E. (1991). Age of learning affects the authenticity of voice onset time (VOT) in stop consonants produced in a second language. *J. Acoust. Soc. Am.* 89, 395–411. doi: 10.1121/1.400473

Flege, J. E. (1995). "Second language speech learning: theory, findings and problems," in *Speech Perception and Linguistic Experience: Theoretical and Methodological Issues*, ed. W. Strange (Baltimore: York Press), 233–277.

Flege, J. E. (2002). "Interactions between native and second-language phonetic subsystems," in *An Integrated View of Language Development: Papers in Honor of Henning Wode*, eds P. Burmeister, T. Piske, and A. Rohde (Trier: Wissenschaftlicher Verlag), 217–244.

Flege, J. E. (2007). "Language contact in bilingualism: phonetic system interactions," in *Laboratory Phonology*, Vol. 9, eds J. Cole and J. I. Hualde (Berlin: Mouton de Gruyter), 353–382.

Flege, J. E., and Eefting, W. (1987). Production and perception of English stops by native Spanish speakers. *J. Phon.* 15, 67–83.

Flege, J. E., and MacKay, I. (2011). "What accounts for "age" effects on overall degree of foreign accent?," in *Achievements and Perspectives in the Acquisition of Second Language Speech: New Sounds 2010*, eds M. Wrembel, M. Kul, and K. Dziubalska-Koˢaczyk (Bern: Peter Lang), 65–82.

Flege, J. E., MacKay, I. R. A., and Piske, T. (2002). Assessing bilingual dominance. *Appl. Psycholinguist.* 23, 567–598. doi: 10.1017/S0142716402004046

Flege, J. E., Munro, M. J., and MacKay, I. R. A. (1995). Effects of age of second-language learning on the production of English consonants. *Speech Commun.* 16, 1–26. doi: 10.1016/0167-6393(94)00044-B

Flege, J. E., Schirru, C., and MacKay, I. R. A. (2003). Interaction between the native and second language phonetic subsystems. *Speech Commun.* 40, 467–491. doi: 10.1016/S0167-6393(02)00128-0

Flege, J. E., Yeni-Komshian, G. H., and Liu, S. (1999). Age constraints on second-language acquisition. *J. Mem. Lang.* 41, 78–104. doi: 10.1006/jmla.1999.2638

Flynn, N., and Foulkes, P. (2011). "Comparing vowel formant normalization methods," in *Proceedings of the 17th International Congress of Phonetic Sciences (ICPhS XVII)*, eds W.-S. Lee and E. Zee (Hong Kong: City University of Hong Kong), 683–686.

Fought, C. (2003). *Chicano English in Context.* New York: Macmillan.

Fowler, C. A., Sramko, V., Ostry, D. J., Rowland, S. A., and Hallé, P. (2008). Cross language phonetic influences on the speech of French–English bilinguals. *J. Phon.* 36, 649–663. doi: 10.1016/j.wocn.2008.04.001

Frazer, T. C. (1996). Chicano English and Spanish interference in the Midwestern United States. *Am. Speech* 71, 72–85. doi: 10.2307/455470

Genesee, F., Paradis, J., and Crago, M. B. (2004). *Dual Language Development and Disorders: A Handbook on Bilingualism and Second Language Learning.* Baltimore: Brookes.

Gick, B. (2003). "Articulatory correlates of ambisyllabicity in English glides and liquids," in *Phonetic Interpretation (Papers in Laboratory Phonology VI)*, eds J. Local, R. Ogden, and R. Temple (Cambridge: Cambridge University Press), 222–236.

Gick, B., Campbell, F., Oh, S., and Tamburri-Watt, L. (2006). Toward universals in the gestural organization of syllables: a cross-linguistic study of liquids. *J. Phon.* 34, 49–72. doi: 10.1016/j.wocn.2005.03.005

Gick, B. W. (2000). *The Articulatory Basis of Syllable Structure: A Study of English Glides and Liquids.* Doctoral dissertation, Yale University, New Haven.

Gildersleeve-Neumann, C. E., and Wright, K. L. (2010). English speech acquisition in 3- to 5-year-old children learning Russian and English. *Lang. Speech Hear. Serv. Sch.* 41, 429–444. doi: 10.1044/0161-1461(2009/09-0059)

Goebl, H., Nelde, P. H., Stary, Z., and Woelck, W. (1996). *Kontaktlinguistik/Contact Linguistics/Linguistique de Contact: Ein Internationales Handbuch Zeitgenoessischer Forschung/An International Handbook of Contemporary Research/Manuel International Des Recherches Contemporaines.* New York: Walter de Gruyter.

Grijalva, C., Piccinini, P. E., and Arvaniti, A. (2013). The vowel spaces of Southern Californian English and Mexican Spanish as produced by monolinguals and bilinguals. *J. Acoust. Soc. Am.* 33, 3340. doi: 10.1121/1.4800752

Grosjean, F., and Miller, J. L. (1994). Going in and out of languages: an example of bilingual flexibility. *Psychol. Sci.* 5, 201–206. doi: 10.1111/j.1467-9280.1994.tb00501.x

Guion, S. G. (2003). The vowel systems of Quichua-Spanish bilinguals: age of acquisition effects on the mutual influence of the first and second languages. *Phonetica* 60, 98–128. doi: 10.1159/000071449

Gutiérrez-Clellen, V. F., and Kreiter, J. (2003). Understanding child bilingual acquisition using parent and teacher reports. *Appl. Psycholinguist.* 24, 267–288. doi: 10.1017/S0142716403000158

Hagiwara, R. (1995). *Acoustic Realizations of American /r/ as Produced by Women and Men.* Doctoral dissertation, University of California, Los Angeles.

Hagiwara, R. (1997). Dialect variation and formant frequency: the American English vowels revisited. *J. Acoust. Soc. Am.* 102, 655–658. doi: 10.1121/1.419712

Hamers, J. F., and Blanc, M. H. A. (2000). *Bilinguality and Bilingualism*. Cambridge: Cambridge University Press. doi: 10.1017/CBO9780511605796

Harris, J. W. (1983). *Syllable Structure and Stress in Spanish.* Cambridge, MA: MIT Press.

Hawkins, S., and Nguyen, N. L. (2004). Influence of syllable-coda voicing on the acoustic properties of syllable-onset /l/ in English. *J. Phon.* 32, 199–231. doi: 10.1016/S0095-4470(03)00031-7

Hayes, B. P. (2000). "Gradient well-formedness in optimality theory," in *Optimality Theory: Phonology, Syntax, and Acquisition*, eds J. Dekkers, F. Van Der Leeuw, and J. Van De Weijer (New York: Oxford), 88–120.

Hazan, V., and Barrett, S. (2000). The development of phonemic categorization in children aged 6–12. *J. Phon.* 28, 377–396. doi: 10.1006/jpho.2000.0121

Hillenbrand, J., Getty, L. A., Clark, M. J., and Wheeler, K. (1995). Acoustic characteristics of American English vowels. *J. Acoust. Soc. Am.* 97, 3099–3111. doi: 10.1121/1.411872

Hualde, J. I. (2005). *The Sounds of Spanish*. New York: Cambridge University Press.

Huffman, M. K. (1997). Phonetic variation in intervocalic onset /l/'s in English. *J. Phon.* 25, 115–141. doi: 10.1006/jpho.1996.0038

Kecskes, I. (2008). The effect of the second language on the first language. *Babylonia* 2, 30–34.

Kehoe, M. M., Lleó, C., and Rakow, M. (2004). Voice onset time in bilingual German-Spanish children. *Biling. Lang. Cogn.* 7, 71–88. doi: 10.1017/S1366728904001282

Kent, R. D. (1976). Anatomical and neuromuscular maturation of the speech mechanism: evidence from acoustic studies. *J. Speech Hear. Res.* 19, 421–447. doi: 10.1044/jshr.1903.421

Labov, W., Ash, S., and Boberg, C. (2006). *Atlas of North American English: Phonetics, Phonology, and Sound Change*. New York: Mouton de Gruyter.

Ladefoged, P., and Johnson, K. (2011). *A Course in Phonetics.* Boston, MA: Cengage Learning.

Lee, S. A. S., and Iverson, G. K. (2012). Stop consonant productions of Korean–English bilingual children. *Biling. Lang. Cogn.* 15, 275–287. doi: 10.1017/S1366728911000083

Lee-Kim, S.-I., Davidson, L., and Hwang, S. (2013). Morphological effects on the darkness of English intervocalic /l/. *Lab. Phonol.* 4, 475–511. doi: 10.1515/lp-2013-0015

Lehiste, I. (1964). *Some Acoustic Characteristics of Selected English Consonants.* Bloomington, IN: Indiana University Research Center in Anthropology, Folklore, and Linguistics.

Lippi-Green, R. (1997). *English with an Accent: Language, Ideology, and Discrimination in the United States.* New York: Routledge.

Lipski, J. M. (2008). Varieties of Spanish in the United States. Washington, DC: Georgetown University Press.

Lleó, C. (2006). The acquisition of prosodic word structure in Spanish by monolingual and Spanish-German bilingual children. *Lang. Speech* 49, 205-229. doi: 10.1177/00238309060490020401

Lleó, C., Kuchenbrandt, M., Kehoe, M., and Trujillo, C. (2003). "Syllable final consonants in Spanish and German monolingual and bilingual acquisition," in *(In)vulnerable Domains in Multilingualism*, ed. N. Müller (Philadelphia: John Benjamins), 191–220.

López, V. G. (2012). Spanish and English word-initial voiceless stop production in code-switched vs. monolingual structures. *Second Lang. Res.* 28, 243–263. doi: 10.1177/0267658312439821

Lord, G. (2008). "Second language acquisition and first language phonological modification," in *Selected Proceedings of the 10th Hispanic Linguistics Symposium*, eds J. Bruhn De Garavito and E. Valenzuela (Somerville, MA: Cascadilla Proceedings Project), 184–193.

MacKay, I., Flege, J., Piske, T., and Schirru, C. (2001). Category restructuring during second-language (L2) speech acquisition. *J. Acoust. Soc. Am.* 110, 516–528. doi: 10.1121/1.1377287

MacLeod, A. A. N., and Stoel-Gammon, C. (2010). What is the impact of age of second language acquisition on the production of consonants and vowels among childhood bilinguals? *Int. J. Biling.* 14, 400–421. doi: 10.1177/1367006910370918

MacWhinney, B. (2004). "A unified model of language acquisition," in *Handbook of Bilingualism: Psycholinguistic Approaches*, eds J. Kroll and A. De Groot (New York: Oxford University Press), 49–67.

McLaughlin, B. (1978). *Second-Language Acquisition in Childhood.* Mahwah, NJ: Lawrence Erlbaum Associates.

Meisel, J. M. (2001). "The simultaneous acquisition of two languages: early differentiation and subsequent development of grammars," in *Trends in Bilingual Acquisition*, eds J. Cenoz and F. Genesee (Philadelphia: John Benjamins), 11–42.

Mennen, I. (2004). Bi-directional interference in the intonation of Dutch speakers of Greek. *J. Phon.* 32, 543–563. doi: 10.1016/j.wocn.2004.02.002

Newport, E. L., Bavelier, D., and Neville, H. J. (2001). "Critical thinking about critical periods: perspectives on a critical period for language acquisition," in *Language, Brain and Cognitive Development: Essays in Honor of Jaques Mehler*, ed. E. Dupoux (Cambridge, MA: MIT Press), 481–502.

O'Donnell, J. L. (2010). The indigenous, national, and international language in higher education: students' academic trajectories in Oaxaca, Mexico. *Int. J. Appl. Linguist.* 20, 386–416. doi: 10.1111/j.1473-4192.2010.00254.x

Oh, S. (2005). *Articulatory Characteristics of English /l/ in Speech Development.* Doctoral dissertation, University of British Columbia, Vancouver.

Oxley, J., Roussel, N., and Buckingham, H. W. (2007). Contextual variability in American English dark-l. *Clin. Linguist. Phon.* 21, 523–542. doi: 10.1080/02699200701356485

Paradis, J. (2001a). "Beyond 'one system or two?': degrees of separation between the languages of French–English bilingual children," in *Cross-Linguistic Structures in Simultaneous Bilingualism*, ed. S. Döpke (Amsterdam: John Benjamins), 175–200.

Paradis, J. (2001b). Do bilingual two-year-olds have separate phonological systems? *Int. J. Biling.* 5, 19–38. doi: 10.1177/13670069010050010201

Pavlenko, A., and Jarvis, S. (2002). Bidirectional transfer. *Appl. Linguist.* 23, 190–214. doi: 10.1093/applin/23.2.190

Peterson, G. E., and Barney, H. L. (1952). Control methods used in a study of the identification of vowels. *J. Acoust. Soc. Am.* 24, 175–185. doi: 10.1121/1.1906875

Port, R. F., and Mitleb, F. M. (1983). Segmental features and implementation of English by Arabic speakers. *J. Phon.* 11, 219–229.

Proctor, M. (2010). *Gestural Characterization of a Phonological Class: The Liquids.* Doctoral dissertation, Yale University, New Haven.

Quilis, A., Esgueva, M., Gutiérrez Araus, M. L., and Cantarero, M. (1979). Características acústicas de las consonantes laterales españoles. *Lingüíst. Esp. Actual.* 1, 233–343.

Recasens, D. (2004). Darkness in [l] as a scalar phonetic property: implications for phonology and articulatory control. *Clin. Linguist. Phon.* 18, 593–603. doi: 10.1080/02699200410001703556

Recasens, D. (2012). A cross-language acoustic study of initial and final allophones of /l/. *Speech Commun.* 54, 368–383. doi: 10.1016/j.specom.2011.10.001

Recasens, D., and Espinosa, A. (2005). Articulatory, positional and coarticulatory characteristics for clear /l/ and dark /l/: evidence from two Catalan dialects. *J. Int. Phon. Assoc.* 35, 1–25. doi: 10.1017/S0025100305001878

Riney, T. J., and Okamura, K. (1999). Does bilingualism affect the first language? *ICU Lang. Res. Bull.* 14, 101–113.

Satterfield, T. (2003). "Economy of interpretation: patterns of pronoun selection in transitional bilinguals," in *Effects of the Second Language on the First*, ed. V. Cook (Buffalo, NY: Multilingual Matters Ltd), 214–233.

Scovel, T. (2000). A critical review of the critical period research. *Annu. Rev. Appl. Linguist.* 20, 213–223. doi: 10.1017/S0267190500200135

Shriberg, L., Austin, D., Lewis, B. A., McSweeny, J., and Wilson, D. (1997). The speech disorders classification systems (SDCS): extensions and lifespan reference data. *J. Speech Lang. Hear. Res.* 40, 723–740.

Sierra, A. M., and Padilla, A. (2003). "United States' hegemony and purposes for learning English in Mexico," in *Language: Issues of Inequality*, eds P. M. Ryan and R. Terborg (Mexico, DF: Universidad Nacional Autónoma de México), 215–232.

Simonet, M. (2010). Dark and clear laterals in Catalan and Spanish: interaction of phonetic categories in early bilinguals. *J. Phon.* 38, 663–678. doi: 10.1016/j.wocn.2010.10.002

Sproat, R., and Fujimura, O. (1993). Allophonic variation in English /l/ and its implications for phonetic implementation. *J. Phon.* 21, 291–311.

Thornburgh, D. F., and Ryalls, J. H. (1998). Voice onset time in Spanish-English bilinguals: early versus late learners of English. *J. Commun. Disord.* 31, 215–229. doi: 10.1016/S0021-9924(97)00053-1

Torres-Olave, B. M. (2012). Imaginative geographies: identity, difference, and English as the language of instruction in a Mexican university program. *High. Educ.* 63, 317–335. doi: 10.1007/s10734-011-9443-x

US Census Bureau. (2003). *Table 1. Language Use, English Ability, and Linguistic Isolation for the Population 5 Years and Over by State: 2000* [Online]. Available at: http://www.census.gov/population/cen2000/phc-t20/tab01.pdf [accessed on September 12, 2004].

US Census Bureau. (2004). *Table 6a. California – Ability to Speak English by Language Spoken at Home for the Population 5 Years and Over: 2000* [Online]. Available at: http://www.census.gov/population/cen2000/phc-t37/tab06a.pdf [accessed September 12, 2004].

Valdés, G. (2005). Bilingualism, heritage language learners, and SLA research: opportunities lost or seized? *Mod. Lang. J.* 89, 410–426. doi: 10.1111/j.1540-4781.2005.00314.x

Van Hofwegen, J. (2009). Cross-generational change in /l/ in Chicano English. *English World Wide* 30, 302–325. doi: 10.1075/eww.30.3.04van

Vorperian, H. K., Wang, S., Chung, M. K., Schimek, E. M., Durtschi, R. B., Kent, R. D., et al. (2009). Anatomic development of the oral and pharyngeal portions of the vocal tract: an imaging study. *J. Acoust. Soc. Am.* 125, 1666–1678. doi: 10.1121/1.3075589

Walsh, B., and Smith, A. (2002). Articulatory movements in adolescents: evidence for protracted development of speech motor control processes. *J. Speech Lang. Hear. Res.* 45, 1119–1133. doi: 10.1044/1092-4388(2002/090)

Watt, D., and Fabricius, A. (2002). Evaluation of a technique for improving the mapping of multiple speakers' vowel spaces in the F1–F2 plane. *Leeds Work. Pap. Linguist.* 9, 159–163.

Wells, J. C. (1982a). *Accents of English 1: An Introduction.* Cambridge: Cambridge University Press.

Wells, J. C. (1982b). *Accents of English 2: The British Isles.* Cambridge: Cambridge University Press.

Whitley, M. S. (2002). *Spanish/English Contrasts.* Washington, DC: Georgetown University Press.

Whitworth, N. (2000). Acquisition of VOT and vowel length by English–German bilinguals: a pilot study. *Leeds Work. Pap. Linguist. Phon.* 8, 229–243.

Yavaş, M. (2008). "Factors influencing the VOT of English long lag stops and interlanguage phonology," in *New Sounds 2007: Proceedings of the Fifth International Symposium on the Acquisition of Second Language Speech*, eds A. S. Rauber, M. A. Watkins, and B. O. Baptista (Florianópolis: Federal University of Santa Catarina), 492–498.

Yavaş, M. S. (1996). "Differences in voice onset time in early and later Spanish-English bilinguals," in *Spanish in Contact: Issues in Bilingualism*, eds A. Roca and J. B. Jensen (Somerville, MA: Cascadilla Press), 131–141.

Yuan, J., and Liberman, M. (2009). "Investigating /l/ variation in English through forced alignment," in *Proceedings of Interspeech 2009*, Brighton, 2215–2218.

Yuan, J., and Liberman, M. (2011). /l/ variation in American English: a corpus approach. *J. Speech Sci.* 1, 35–46.

Zampini, M. L. (1994). The role of native language transfer and task formality in the acquisition of Spanish spirantization. *Hispania* 77, 470–481. doi: 10.2307/344974

Zampini, M. L. (1996). Voiced stop spirantization in the ESL speech of native speakers of Spanish. *Appl. Psycholinguist.* 17, 335–354. doi: 10.1017/S0142716400007979

Zampini, M. L., and Green, K. P. (2001). "The voicing contrast in English and Spanish: the relationship between perception and production," in *One Mind, Two Languages*, ed. J. L. Nicol (Boston: Blackwell), 23–48.

Conflict of Interest Statement: The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 08 January 2014; accepted: 20 March 2014; published online: 21 April 2014.
*Citation: Barlow JA (2014) Age of acquisition and allophony in Spanish-English bilinguals. Front. Psychol. **5**:288. doi: 10.3389/fpsyg.2014.00288*
This article was submitted to Language Sciences, a section of the journal Frontiers in Psychology.

frontiers in PSYCHOLOGY

OPINION ARTICLE
published: 20 November 2014
doi: 10.3389/fpsyg.2014.01338

Second language learners and the variable speech signal

Christine E. Shea*

Department of Spanish and Portuguese, University of Iowa, Iowa City, IA, USA
**Correspondence: christine-shea@uiowa.edu*

Edited by:
Mary Grantham O'Brien, University of Calgary, Canada

Reviewed by:
Marie King Huffman, Stony Brook University, USA

Keywords: allophones, second language acquisition, phonetic variability, bilingualism, L2 phonology

In the article "Age of acquisition and allophony in Spanish-English bilinguals" Barlow (2014) presents production data of /l/ from two groups of Spanish-English bilinguals, who differ on age of acquisition of English (before 5 years or after 6 years of age). Barlow's contribution is a welcome addition to the relatively understudied field of allophone acquisition by second language learners. In what follows I expand upon issues touched upon by Barlow in her article and comment more generally on why the issue of variability in the speech stream (of which allophones in complementary distribution is but one type) must be addressed differently for L2 learners than for infants acquiring a first language. I restrict the discussion to perception and will primarily address issues key to adult (i.e., individuals who began to acquire their second language after the sound system of their first language is in place) second language acquisition.

Research on how adults perceive non-native sounds has received considerable attention over the past thirty years (see work by Flege and Best for the most influential models of L2 perception) and the vast majority of this work has looked at the way in which non-native sounds assimilate into native-language sound categories, independent of the context in which they occur (for an exception, see Levy and Strange, 2008). In a certain sense, it can be said that much of this research abstracts away from speech perception as it unfolds in real time (McMurray and Jongman, 2011). Part of the challenge real-time speech perception represents for L2 learners involves dealing with the way co-occurring sounds (or abstract contexts such as stress, see Shea and Curtin, 2011) affect each other or lead to variability, whether predictable or indexical in nature.

The study of allophone acquisition represents an effort to break away from this tradition and can be included in the broader research program that examines how learners deal with the variability found in the input. Indeed, variability itself is "highly variable" and can be due to individual speaker differences, dialect differences, speech rate, and formality. These kinds of variability are often distinguished from allophonic variability that is the result of phonetic or phonological factors and tend to occur in a more across-the-board fashion in speech.

In terms of L1 acquisition, part of learning a language's sound system necessarily involves learning which sounds contrast and which do not. Research suggests that distributional knowledge and phonetic similarity play a key role in guiding infants toward identifying non-phonemic sounds in their language (see Seidl and Cristia, 2012 for an excellent overview; see Yeung and Werker, 2009, for work showing that a lack of lexical contrast can be used by infants to acquire allophones in non-contrastive distributions as well). For example, in a recent study, Seidl et al. (2009) examined the role of phonemic vs. allophonic contrasts in infant speech perception. They familiarized French-learning 11-month-old and English-learning 11- and 4-month-old infants to syllables in which the final consonants conditioned the nasality of the previous vowel. In French, nasality is phonemic while in English it is allophonic. The results showed that French-learning 11-month-olds and English-learning 4-month- olds had a reliable pattern of preference while English 11-month-olds were insensitive to the patterning, orienting equally to syllables following and violating the familiarized patterns. The authors conclude that language-specific sensitivity to context-driven allophonic contrasts emerges as early as 11 months of age.

In contrast, adult native listeners distinguish allophonic contrasts at a phonetic level less accurately than phonemic contrasts. For example, Pegg and Werker (1997), using an AX discrimination task, showed that native English-speaker adults' performance on the allophonic contrast between voiced [d] and the voiceless unaspirated [t] was better than chance, but nonetheless worse than that on a phonemic contrast (for similar results see Whalen et al., 1997).

In addition to perceiving the difference between two different phones, there is another important component to allophonic acquisition: its context-driven nature. Specifically, allophonic perception cannot be truly categorized as such unless the sounds occur in the context in which they are expected (or not, see Shea and Curtin, 2011 for details; Key, 2014). For example, Peperkamp et al. (2001), using the French [χ] - [ʁ] alternations showed that French listeners could discriminate between allophonic segments in CV syllables but as soon as the CV syllables were put into their allophonic contexts, such discrimination disappeared. Thus, to truly speak of "allophone perception" listeners must be aware of the contrast but also the context in which it occurs.

The mechanism by which infants build their sound categories is based upon tracking distributional frequencies across the speech stream (Maye et al., 2002). A number of laboratory studies reveal that such learning is possible in both infants and

adults (Maye and Gerken, 2001; Hayes-Harb, 2007). Nonetheless, a recent study by Wanrooij et al. (2014) suggests that there may be differences between infants and adults in terms of the capacity each group has for making use of distribution-based learning. Wanrooij et al. use MMN imaging and the odd-ball paradigm to show that Dutch infants can be trained on a bimodal distribution to distinguish non-Dutch vowels whereas adult learners do not show such sensitivity. This suggests that a distribution-based learning mechanism is indeed weaker in adults than in infants.

For adult second language learners, neither phonetic similarity nor distributional knowledge is necessarily available for allophone acquisition. Distributions may be objectively present in the speech stream but adult L2 listeners will not necessarily perceive them in a faithful fashion (see extensive work by Flege and colleagues on how L2 speech categorization may be impeded, depending upon the phonetic proximity of the target sound to native sound categories). Thus, the raw input that infants use to create their phonetic categories does not get processed in the same way by adult L2 learners and as a consequence, phonetic similarity is also judged differently: two sounds that are similar to native ears may not be at all similar to L2 ears. This raises questions regarding how the input is processed and stored by adult second language learners in the creation of these new categories.

All is not lost for adults, however. While distribution-based learning relies upon implicit learning mechanisms, adult learners (as compared to infant and child learners) can use explicit learning mechanisms to at least become aware of allophonic alternations. Whether in the second language classroom or in naturalistic learning contexts, adults can be taught where to expect variability in their target language or they can express an explicit awareness when exposed to it. This does not mean that production/perception will necessarily follow, but it does mean that the adult learner can be explicitly aware of an alternation that infants must acquire implicitly and this explicit awareness may serve to initiate perceptual tuning to the L2 input.

For literate learners, spelling is another factor that may influence how variability is processed. Many L2 learners acquire the target language in classroom contexts where, from the first day of class, they are encouraged to read and write in their second language. Thus, target language literacy begins prior to the establishment of phonological and phonetic categories and may result in an overreliance on L1 sound-spelling correspondences, particularly at the earliest stages of L2 acquisition. In the case of allophones, this may be especially problematic. Allophones that belong to the same category often share an orthographic symbol that corresponds to the phonemic category. The shared orthographic symbol encourages the learner to ignore the phonetic variants in the input and build one category for both allophones. Orthography may also hinder the development of L2 allophonic categories when native language allophones correspond to different orthographic symbols in the target language, inadvertently encouraging the learner to think they need to create a new category all together. An example of this latter situation occurs with the flap in English (as in "water") and the tap in Spanish (as in "pero"). These two sounds are acoustically and articulatorily very similar but in English the flap is an allophone while in Spanish, the tap is a phoneme. In spite of their similarity along acoustic and articulatory dimensions, the sounds are represented by different orthographic symbols in each language, hindering recognition and encouraging the creation of a totally new category. In sum, orthography can help or hinder the acquisition of allophones in a second language, depending upon the L1-L2 categories involved.

Another issue related to input is whether the bimodal distribution listeners are claimed to use to establish allophonic categories is truly bimodal in naturally-occurring contexts. Many allophonic relationships that were previously characterized as involving complementary distribution are better conceived of as existing on a continuum, with binary distribution as a tendency, rather than an absolute. This may particularly hold for learners who are exposed to cross-dialectal variability. For example, Recasens and Espinosa (2005) show that the degree of darkness found in /l/ allophones varies across dialects of Catalan. Carrasco et al. (2012) found a similar degree of variability in the voiced stops across different dialects of Spanish. Thus, what has often been understood as complementary distribution may in fact be better explained as dialect-dependent in degree and extension.

It is important that future research consider more closely how adult second language learners deal with variability in the speech stream and how language experience, proficiency and use interact with this. As Barlow's study reveals, it is not enough to simply predict how L2 sounds will assimilate into native language categories based upon target language and native language categories. It is necessary to consider the context of the sounds and the experience language learners bring to the task. Related to this is a need for research on how variability affects word processing, rather than merely perception of individual sounds. Indeed, recent work on cross-linguistic phonemic perception has revealed an important effect for task demands on L2 speech perception (Sebastián-Gallés and Díaz, 2012), and speech segmentation (Shea and Renaud, 2014). Further work is necessary to determine precisely how allophonic information is represented by L2 learners. For example, we might ask if lexical processing by second language learners is slowed down by mismatched allophones, or do they merely ignore it and consider it to be noise? Research shows that L2 learners are sensitive to context when hearing target-language allophones and when L2 listeners are exposed to allophonic variants outside of their expected contexts, processing is interrupted (Shea and Curtin, 2011).

In native language acquisition, researchers have been addressing issues of variability for quite some time and we need more research to help us understand how adult second language learners confront the same challenges. Evidence seems to be accumulating that outside the laboratory, the same distributional learning mechanism that allows infants to create phonetic categories during the first year of life may not afford adults acquiring a second language the same degree of success (Wanrooij et al., 2014). However, as stated above, adult learners can benefit from explicit instruction that can help them

learn from regular, conditioned variability in the speech stream.

REFERENCES

Barlow, J. A. (2014). Age of acquisition and allophony in Spanish-English bilinguals. *Front. Psychol.* 5:288. doi: 10.3389/fpsyg.2014.00288

Carrasco, P., Hualde, J. I., and Simonet, M. (2012). Dialectal differences in Spanish voiced obstruent allophony: costa Rican versus iberian Spanish. *Phonetica* 69, 149–179. doi: 10.1159/000345199

Hayes-Harb, R. (2007). Lexical and statistical evidence in the acquisition of second language phonemes. *Second Lang. Res.* 23, 65–94. doi: 10.1177/0267658307071601

Key, M. (2014). Positive expectation in the processing of allophones. *J. Acoust. Soc. Am.* 135, EL350–EL356. doi: 10.1121/1.4879669

Levy, E. S., and Strange, W. (2008). Perception of French vowels by American English adults with and without French language experience. *J. Phon.* 36, 141–157. doi: 10.1016/j.wocn.2007.03.001

Maye, J., and Gerken, L. A. (2001). "Learning phonemes: how far can the input take us?," in *BUCLD 25 Proceedings,* eds A. H.-J. Do, L. Dominguez, and A. Johansen (Somerville, MA: Cascadilla Press), 480–490.

Maye, J., Werker, J. F., and Gerken, L. (2002). Infant sensitivity to distributional information can affect phonetic discrimination. *Cognition* 82, B101–B111. doi: 10.1016/S0010-0277(01)00157-3

McMurray, B., and Jongman, A. (2011). What information is necessary for speech categorization? Harnessing variability in the speech signal by integrating cues computed relative to expectations. *Psychol. Rev.* 118, 219. doi: 10.1037/a0022325

Pegg, J. E., and Werker, J. F. (1997). Adult and infant perception of two English phones. *J. Acoust. Soc. Am.* 102, 3742–3753. doi: 10.1121/1.420137

Peperkamp, S., Pettinato, M., and Dupoux, E. (2001). "Allophonic variation and the acquisition of phoneme categories," in *Proceedings of BUCLD 27*. (Sommerville, MA: Cascadilla Press).

Recasens, D., and Espinosa, A. (2005). Articulatory, positional and coarticulatory characteristics for clear/l/and dark/l: evidence from two Catalan dialects. *J. Int. Phon. Assoc.* 35, 1–25. doi: 10.1017/S0025100305001878

Sebastián-Gallés, N., and Díaz, B. (2012). First and second language speech perception: graded learning. *Lang. Learn.* 62, 131–147. doi: 10.1111/j.1467-9922.2012.00709.x

Seidl, A., and Cristia, A. (2012). Infants' learning of phonological status. *Front. Psychol.* 3:448. doi: 10.3389/fpsyg.2012.00448

Seidl, A., Cristià, A., Bernard, A., and Onishi, K. H. (2009). Allophonic and phonemic contrasts in infants' learning of sound patterns. *Lang. Learn. Dev.* 5, 191–202. doi: 10.1080/15475440902754326

Shea, C. E., and Curtin, S. (2011). Experience, representations and the production of second language allophones. *Second Lang. Res.* 27, 229–250. doi: 10.1177/0267658310375753

Shea, C., and Renaud, J. (2014). L2 perception of Spanish palatal variants across different tasks. *Bilingualism Lang. Cogn.* 17, 203–221. doi: 10.1017/S1366728913000047

Wanrooij, K., Boersma, P., and van Zuijen, T. L. (2014). Distributional vowel training is less effective for adults than for infants. A study using the mismatch response. *PLoS ONE* 9:e109806. doi: 10.1371/journal.pone.0109806

Whalen, D. H., Best, C. T., and Irwin, J. R. (1997). Lexical effects in the perception and production of American English/p/allophones. *J. Phonet.* 25, 501–528. doi: 10.1006/jpho.1997.0058

Yeung, H. H., and Werker, J. F. (2009). Learning words' sounds before learning how words sound: 9-month-olds use distinct objects as cues to categorize speech information. *Cognition* 113, 234–243. doi: 10.1016/j.cognition.2009.08.010

Conflict of Interest Statement: The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 08 September 2014; accepted: 03 November 2014; published online: 20 November 2014.

*Citation: Shea CE (2014) Second language learners and the variable speech signal. Front. Psychol. **5**:1338. doi: 10.3389/fpsyg.2014.01338*

This article was submitted to Language Sciences, a section of the journal Frontiers in Psychology.

frontiers in PSYCHOLOGY

ORIGINAL RESEARCH ARTICLE
published: 26 May 2014
doi: 10.3389/fpsyg.2014.00485

Never too late? An advantage on tests of auditory attention extends to late bilinguals

Thomas H. Bak[1]*, Mariana Vega-Mendoza[1] and Antonella Sorace[2]

[1] Department of Psychology, School of Philosophy, University of Edinburgh, Edinburgh, UK
[2] Linguistics and English Language, School of Philosophy, University of Edinburgh, Edinburgh, UK

Edited by:
Mary Grantham O'Brien, University of Calgary, Canada

Reviewed by:
Debra Titone, McGill University, Canada
Andrea A. N. MacLeod, Université de Montréal, Canada

***Correspondence:**
Thomas H. Bak, Department of Psychology, School of Philosophy, University of Edinburgh, 7 George Square, Edinburgh EH8 9JZ, UK
e-mail: thomas.bak@ed.ac.uk

Recent studies, using predominantly visual tasks, indicate that early bilinguals tend to outperform monolinguals on attention tests. It remains less clear whether such advantages extend to those bilinguals who have acquired their second language later in life. We examined this question in 38 monolingual and 60 bilingual university students. The bilingual group was further subdivided into early childhood (ECB), late childhood (LCB), and early adulthood bilinguals (EAB). The assessment consisted of five subtests from the clinically validated Test of Everyday Attention (TEA). Overall, bilinguals outperformed monolinguals on auditory attention tests, but not on visual search tasks. The latter observation suggests that the differences between bilinguals and monolinguals are specific and not due to a generally higher cognitive performance in bilinguals. Within the bilingual group, ECB showed a larger advantage on attention switching, LCB/EAB on selective attention. We conclude that the effects of bilingualism extend into the auditory domain and are not confined to childhood bilinguals, although their scope might be slightly different in early and late bilinguals.

Keywords: bilingualism, cognition, attention, auditory attention, age of acquisition

INTRODUCTION

For many decades, the study of bilingualism focused on the linguistic differences between monolingual and bilingual children and adults, such as vocabulary size, lexical access, and morphosyntactic development (see De Houwer, 2009, for a review). However, from the 1990s onward the idea emerged that the experience of bilingualism might also influence cognitive functions other than language. Studies comparing mono- and bilingual children suggested a bilingual advantage in non-verbal problem-solving tasks such as the dimensional change card sort task, cardinal quantity tasks, and, with particular relevance to the present study, in the control of attention (Frye et al., 1995; Zelazo et al., 1996; Zelazo and Frye, 1997; Bialystok, 1999; Bialystok and Martin, 2004).

Recent studies demonstrate that these differences persist well-beyond childhood (Bialystok et al., 2004, 2006, 2008, 2012). Using the Simon task (Simon and Small Jr, 1969), Bialystok et al. (2004) found that although the bilingual advantage was consistent between the ages of 30 and 60, after the age of 60 response times began to decrease in both monolinguals and bilinguals but this decline was significantly slower in the latter group. These cognitive advantages of bilingualism in older adults can be of considerable practical relevance, leading to a slower cognitive aging and a later onset of dementia (Bialystok et al., 2007). Indeed, studies from different countries, with radically different populations, cultures, and languages arrived at a remarkably similar estimate of a 4–5 years delay in the onset of dementia in bilingual patients when compared to monolinguals (Alladi et al., 2013). Thus, bilingualism is starting to play an increasingly important role in the current debates about cognitive reserve and the factors influencing cognitive aging and dementia (Bak and Alladi, 2014).

Different explanations have been put forward to account for these apparent cognitive differences between bilinguals and monolinguals. Kroll and De Groot (1997) postulate that the bilingual advantage results from a greater cognitive flexibility due to the need to select appropriate language options from one common conceptual store, which contains a large number of mappings of words and concepts. In contrast, Green (1998) argues that bilinguals have better inhibitory control because, in order to prevent ongoing interference, they must inhibit the language not in use. Indeed, a study by Treccani et al. (2009) demonstrates that the very efficiency of inhibitory processes in bilinguals can turn into a disadvantage when a new task requires activation of previously inhibited material. Other studies (Hilchey and Klein, 2011; Hernández et al., 2013) have recently questioned explanations of the bilingual advantage in terms of inhibitory control, calling for more in-depth research on different components of executive function and on the different operations of the central executive system. Some researchers have also questioned the generalizability of results showing a bilingual advantage, based on the heterogeneity of the bilingual population, the instability of these results and a number of failed attempts to replicate them (Paap and Greenberg, 2013; see Kroll and Bialystok, 2013 as response). While this debate is still open, the field is engaged in finding exactly how specific factors affecting the bilingual experience relate to specific components of executive control (Paap, 2014). The present study is a contribution to this wider aim.

One of the factors that might influence the nature of cognitive processing in bilinguals is the age of acquisition of the second language. Early studies of cognition in bilinguals focused on simultaneous or early successive bilinguals who acquired both languages in their first years of life and it is in this group

that bilingual cognitive advantages have been best documented (Bialystok, 2007). However, recent studies suggest that both early and late bilingualism might have significant, yet different influence on frontal-executive functions, with early bilinguals being better at switching, late at inhibiting (Tao et al., 2011). Indeed, early and late bilingualism could be associated with different patterns of brain development (Klein et al., 2014). Given that the acquisition of a second language in adulthood is arguably becoming more common than the ideal case of early simultaneous bilingualism, it is important to determine whether the effects of bilingualism—advantageous or disadvantageous—extend to this population.

The identification of bilingualism as a potential factor delaying dementia (Bak and Alladi, 2014) brings a new set of challenges to the researchers working in this field. In order to explore the impact of bilingualism on healthy and on pathological aging, we need large studies, including healthy elderly population as well as patients suffering from different brain diseases. These types of participants require brief, easily applicable tests, ideally those already in use in clinical populations. In contrast, the majority of studies exploring cognitive differences between monolinguals and bilinguals so far have been using complex experimental paradigms applied in laboratory settings. Such procedures cannot be easily used in large cohorts of elderly participants, let alone in patients with dementia, stroke, head injury or other disorders affecting nervous system. What is needed, therefore, is a brief clinical instrument sensitive to potential cognitive differences between mono- and bilinguals.

The Test of Everyday Attention (TEA) (Robertson et al., 1994) offers a particularly suitable tool to address this problem. Firstly, it is a well-established and widely used clinical test, with large sets of normative data collected in healthy elderly Western (Robertson et al., 1996) and Asian (Chan et al., 2006) populations. Secondly, it has been successfully applied in a wide range of neurological diseases, including stroke, head injury, dementia, and other neurodegenerative conditions (Robertson et al., 1996; Chan, 2000; Chen et al., 2013). This means that the tasks are clear enough to be understood by those patient groups but, at the same time, sensitive enough to detect impairments. Thirdly, the TEA consists of different subtests, assessing different components of the attentional system: sustained attention, selective attention, and attentional switching (Robertson et al., 1996). It allows, therefore, a separate assessment of different forms of attention. Finally, while most cognitive test batteries tend to use predominantly visual material, which is generally easier to administer (Bak and Mioshi, 2007), the TEA has several auditory subtests based on tone counting (so called "Elevator tasks").

The last aspect seemed to us to be of special interest in the context of bilingualism. In comparison with the wealth of studies examining the visual domain, much less is known about possible differences in auditory processing between mono- and bilinguals, despite the importance of the auditory domain in language acquisition and use. Moreover, the results of auditory studies of bilinguals and monolinguals have so far produced conflicting results. Bialystok and DePape (2009) did not find an advantage of bilinguals over monolinguals on an auditory Stroop task, while other authors reported a better performance in bilinguals on dichotic listening (Hamalainen and Hugdahl, 2011) and sound encoding (Krizman et al., 2012). Interestingly, the first study was based on non-linguistic stimuli (pitch), while the last two used as experimental material syllables such as "da" or "ba," which form part of the sound repertoire of the languages in question. It is conceivable, therefore, that the linguistic nature of the stimuli provides an advantage for bilinguals. Hence, in order to establish whether the cognitive effects of bilingualism extend into the auditory domain, it is necessary to use tasks that minimize verbal elements as much as possible.

Based on these considerations, we have selected for our study five TEA subtests measuring different aspects of attention. Initially (Experiment 1), we selected the so-called Elevator Tasks 1–3, measuring in the auditory domain sustained attention (Elevator Task 1), selective attention (Elevator Task 2), and attentional switching (Elevator Task 3). Extending the results from the first experiment, we have added in Experiment 2 two further subtests (Telephone Search and Telephone Search while counting). These tasks assess visual search, an aspect of attention which, although demanding, does not require processing of conflicting information (e.g., switching, inhibition). Accordingly, we did not expect it to be influenced by bilingualism. These subtests can help, therefore, to determine whether possible differences between mono- and bilingual groups are due to general, differences in cognitive performance, or to specific aspects of attention. In Experiment 1, we examined early childhood bilinguals (ECB) (those who acquired both languages before the age of 4) and late childhood bilinguals (LCB) (who acquired the second language between the ages of 4 and 15 years). In Experiment 2, we extended the study to early adulthood bilinguals (EAB) (whose second language acquisition took place between the ages of 15 and 19).

METHODS

PARTICIPANTS

Experiment 1

All 60 subjects were students at the University of Edinburgh, who understood and spoke English fluently. Based on the results of the Language Ability Questionnaire (see Appendix 1 in Supplementary Material), 19 were classified as monolinguals (ML), 23 as ECB, and 18 as LCB (see Appendix 2 for a detailed list of languages spoken by each participant). There were no significant differences in age or gender distribution between the groups—age: ML: 22.2 $\pm$ 1.6; ECB: 21.3 $\pm$ 1.7; LCB: 23.6 $\pm$ 4.3 and gender (percentage females): ML: 73%, ECB: 44%, LCB: 50%.

Experiment 2

All 38 subjects were also students at the University of Edinburgh with fluent command of English. None of them had participated in the Experiment 1. Based on the results of the same Language Ability Questionnaire as in Experiment 1, the group was split into 19 monolinguals (ML) and 19 EAB, who acquired their second language between the ages of 15 and 19 years. There were no significant differences in age or gender distribution between the groups—age: ML: 21.5 $\pm$ 1.0; EAB: 22.9 $\pm$ 3.3 and gender (percentage females): ML: 36%; EAB: 36%. The study has been approved by the Ethics Committee of the University of Edinburgh, Psychology Department.

ASSESSMENT OF ATTENTIONAL FUNCTIONS

Both experiments consisted of subtests for the TEA, a standardized test battery to assess attentional functions (Robertson et al., 1994). Experiment 1 consisted of three TEA subtests (Elevator Tasks 1–3). In Experiment 2 we have used identical procedure for the tests TEA 1–3, but continued with two further subtests (Telephone Search and Telephone Search Dual Task). The test was conducted in a quiet laboratory space, with instructions and tones presented from a tape using headphones.

Elevator counting (Elevator task 1)

Subjects are asked to count simple tones of the same pitch and duration presented at irregular intervals; used as a measure of sustained attention.

Elevator counting with distraction (Elevator task 2)

Subjects hear low and high tones and count the number of low tones while ignoring the high ones; used as a measure of selective attention.

Elevator counting with reversal (Elevator task 3)

Subjects hear a sequence of three different tones: a middle-pitched, high, and low tone, they are asked to count the middle-pitched tones, upwards if preceded by a high, downwards if preceded by a low tone; used as a measure of attentional switching.

Telephone search

Subjects are given a telephone book directory page and a cue-book illustrating the target symbols. The task consists of circling all entries with a given combination of symbols.

Telephone search dual task

Same instructions as above, with the additional difficulty that the subjects had to conduct the task while at the same time counting auditorily presented tones (simple tones of the same pitch, as in the Elevator Task 1).

RESULTS

EXPERIMENT 1

First, a comparison was conducted between the bilingual group as a whole (ECB and LCB) on one hand and the monolingual group on the other (see **Figure 1** and **Table 1**). The Mann–Whitney test, used since the data were not normally distributed, revealed that bilinguals scored significantly higher than monolinguals in Elevator Task 2 ($U = 466$, $p < 0.05$) and Elevator Task 3 ($U = 414.50$, $p < 0.05$). No significant difference was observed on Elevator Task 1.

Subsequently, a Mann–Whitney test was performed to compare separately both bilingual groups with the monolingual one (see **Table 2** and **Figure 2**). There were no significant differences between the groups in Elevator Task 1. In Elevator Task 2, LCB scored significantly higher than ML ($U = 99.50$, $p < 0.05$, $r = -0.40$), but no significant difference was observed between ECB and ML. In Elevator Task 3, in contrast, ECB scored significantly higher than ML ($U = 103.50$, $p < 0.05$, $r = -0.35$), while no significant difference was found between LCB and ML.

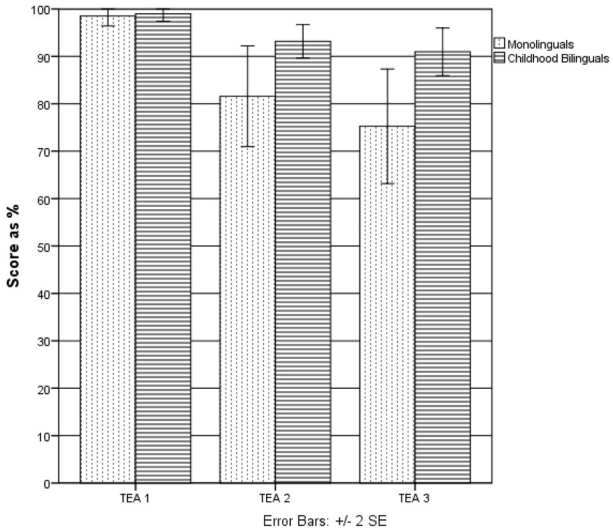


FIGURE 1 | Difference between the monolingual and childhood bilingual groups on TEA sub-tests (Experiment 1).

Table 1 | Experiment 1—Comparison of the number of correct answers in Monolinguals vs. Childhood bilinguals.

	Monolinguals ($N = 19$)	Childhood bilinguals ($N = 41$)
Elevator task	6.89 ± 0.3	6.93 ± 0.2
Elevator task with distraction	8.16 ± 2.3	9.32 ± 1.0*
Elevator task with reversal	7.53 ± 2.6	9.09 ± 1.6*

*$p < 0.05$ vs. ML (Mann–Whitney-U-test).

Table 2 | Experiment 1—Comparison of the number of correct answers in Monolinguals vs. Early and vs. Late childhood bilinguals.

	Monolinguals ($N = 19$)	Early childhood bilinguals ($N = 23$)	Late childhood bilinguals ($N = 18$)
Elevator task	6.89 ± 0.3	7.00 ± 0.0	6.83 ± 0.5
Elevator task with distraction	8.16 ± 2.3	9.00 ± 1.4	9.72 ± 0.5*
Elevator task with reversal	7.53 ± 2.6	9.17 ± 1.5*	9.00 ± 1.8

*$p < 0.05$ vs. ML (Mann–Whitney-U-test).

EXPERIMENT 2

Since, as in Experiment 1, the data was not normally distributed, Mann–Whitney *U*-test was performed (see **Table 3** and **Figure 3**). No significant differences were found on Elevator Task 1. On Elevator Task 2, EAB performed significantly better than ML ($U = 109$, $p < 0.05$). Although the EAB performed also slightly better than monolinguals also on Elevator Task 3, the difference did not reach significance level ($U = 129$, $p = 0.13$). No differences between the groups were observed in the Telephone

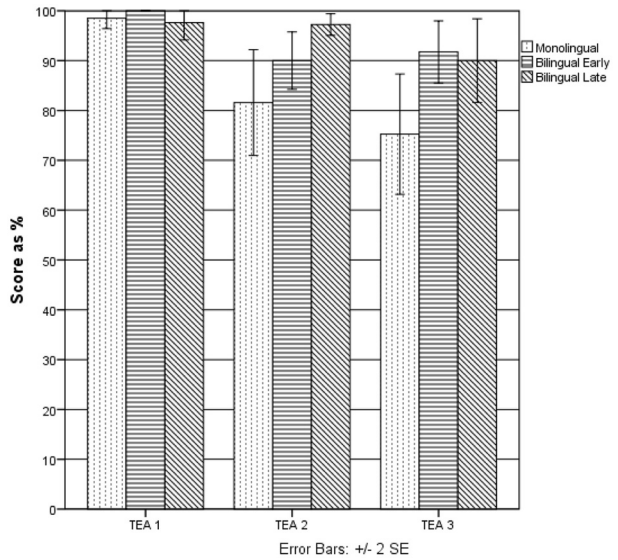


FIGURE 2 | Differences between the monolingual, the early, and the late childhood bilingual groups on TEA sub-tests (Experiment 1).

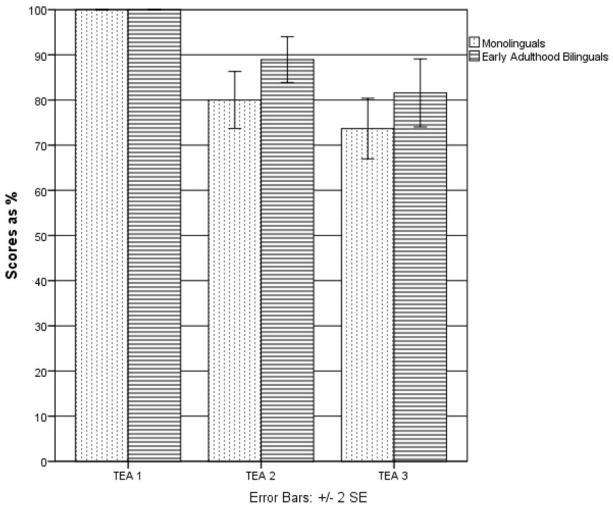


FIGURE 3 | Differences between the monolingual and early adulthood bilingual groups on TEA sub-tests (Experiment 2).

Table 3 | Experiment 2—Comparison of the number of correct answers in Monolinguals vs. Early adulthood bilinguals.

	Monolinguals ($N = 19$)	Early adult bilinguals ($N = 19$)
Elevator task	7.00 ± 0.00	7.00 ± 0.00
Elevator task with distraction	7.94 ± 1.32	8.89 ± 1.07*
Elevator task with reversal	7.37 ± 1.42	8.16 ± 1.60
Telephone search	2.69 ± 0.96	3.02 ± 1.14
Telephone search dual task	3.28 ± 0.94	3.72 ± 1.38

*$p < 0.05$ vs. ML (Mann–Whitney-U-test).

Search ($U = 154$, $p = 0.43$) and Telephone Search Dual Task ($U = 154.5$, $p = 0.44$).

DISCUSSION

In both experiments the performance on the subtests of the TEA revealed specific differences between the mono- and the bilingual group. The bilingual advantage on Elevator Tasks 2 and 3 confirms previous reports of bilingual advantage on cognitively demanding attentional control tasks (Bialystok et al., 2006; Treccani et al., 2009), extending them into the domain of auditory attention. The bilingual advantage was demonstrated using a relatively simple attentional task adapted from a standardized clinical assessment battery. In comparison with the sophisticated computerized design used in many previous studies, the TEA subtests have the advantage of easy applicability: they are fast, easy to perform and evaluate, do not require a lab setting and can be used in conjunction with any type of tape recorder or a laptop. Moreover, they are already used across the world in different clinical populations (Robertson et al., 1996; Chan, 2000; Chen et al., 2013). They could find, therefore, widespread use in future studies of cognitive functions in bilingualism, particularly in large cohort studies of cognitive aging and dementia (Bak and Alladi, 2014), in which current experimental paradigms would not be practicable.

Consistent with recent reports that qualify the scope of the monolingual-bilingual difference (Hilchey and Klein, 2011; Tao et al., 2011), the influence of bilingualism on attention observed in our study was selective, affecting specific cognitive functions. Bilingual groups were not uniformly better on all attentional tests included in this study. In Experiment 2, there was no difference between the groups on Telephone Search and Telephone Search Dual Task. Both are difficult and demanding tasks, in which none of the groups reached ceiling level. However, the type of attention required to perform a visual search required in Telephone Search and Telephone Search Dual Task is different in quality from selective attention of Elevator Task 2 and attention switching of Elevator Task 3. Even in Telephone Search Dual Task which includes a dual task (simultaneous visual search and counting tones), both tasks involve different modalities (visual and auditory) and are, therefore, fundamentally different from the experience of bilingualism, in which the selection and switching normally happen within the same modality (except in bimodal bilingualism; Emmorey et al., 2008a,b). Furthermore, the fact that the bilingual advantage is confined to Elevator Task 2 and 3 and does not seem to affect Telephone Search and Telephone Search Dual Task suggests that this effect is not easily explained by a sample bias, such as a higher general intelligence or an overall better level of cognitive performance in the bilingual group.

Importantly, the effects of the bilingual experience were not confined to ECB. It was observed in all three groups characterized by different age of acquisition of the second language (early and late childhood and early adulthood). Traditionally, the majority of bilingualism studies has focused on speakers who acquired both languages in the first years of life, during the period of maximal sensitivity to language stimuli (or "Critical Period"; see Birdsong, 1999; Newport et al., 2001). However, many people start learning a second language in late childhood or adulthood and reach a

very high and even native-like level of proficiency (Sorace, 2004; Sorace and Filiaci, 2006; MacLeod and Stoel-Gammon, 2010). The question whether this large group can also benefit from cognitive effects of bilingualism is of considerable practical relevance, particularly in light of the recent findings about the dementia-delaying effects of bilingualism (Alladi et al., 2013; Bak and Alladi, 2014).

However, although we found a positive effect of bilingualism in all three groups we examined (early and late childhood, early adulthood), its mechanisms might be slightly different. In a recent study, comparing early and late onset bilinguals, only those who started using both languages before the age of 10 were found to have a cognitive advantage (Luk et al., 2011). In contrast, Tao et al. (2011) found that both, early and late bilingual groups benefitted from bilingualism, but in different ways: the early group mainly on switching, the late on inhibition. Our results would be in line with this hypothesis. The cognitive requirements of the Elevator Tasks 2 and 3 are slightly different: Elevator Task 2 requires selective attention and successful inhibition of irrelevant stimuli. It could be compared, therefore, to visual inhibition tasks such as those used by Treccani et al. (2009). Elevator Task 3, in contrast, involves attentional switching between two (unpredictable) directions of counting. Hence, it is more similar to visual paradigms used by Prior and MacWhinney (2010) and Costa et al. (2009). It seems plausible that the early childhood experience of two languages especially enhances switching processes, whereas the later acquisition of a second language after the consolidation of the first one might require stronger inhibition of the native dominant language and would therefore have a greater impact on inhibitory control.

Our study has limitations. We have not conducted a general assessment of cognitive abilities beyond the TEA subtests used in our protocol. Although the dissociation between the Elevator Tasks, with a bilingual advantage and the Telephone Search Tasks without it speaks in favor of a specific effect of bilingualism on cognition we cannot exclude the possibility of "reverse causality." It could be that it is not bilingualism that causes a cognitive advantage in certain individuals but that a superior baseline cognitive ability makes them more likely to acquire more than one language. Such confound is extremely difficult to address, since it would require either longitudinal studies or at least knowledge of baseline cognitive abilities in early childhood. Since this is the first time that the TEA has been used not to characterize brain diseases but individual variations in performance in normal population depending on the knowledge of languages, we do not know which practical consequences the observed differences might produce. Finally, we have not examined individuals who acquired a second language after the age of 19 years—a large and very important group.

However, we hope that by raising the question whether a bilingualism advantage can be observed well-beyond the traditional age boundaries of critical periods, our study will encourage further research, using a wider range of tasks and comparing groups of subjects who acquired the second language at different stages of their lives. In this way, we might be able to determine exactly which aspects of cognitive processing are affected by the bilingual experience and whether age of onset of bilingualism might have differential impacts on cognitive functions. The fact that these questions can be addressed using a brief and simple standardized cognitive tests such as TEA makes this field of study all the more promising.

ACKNOWLEDGMENTS

We would like to thank Simon Everington, Sarah Garvin, and Ellie Rose for the data collection and Dr. Blanca Ramirez-Ruiz for her assistance in editing the manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: http://www.frontiersin.org/journal/10.3389/fpsyg.2014.00485/abstract

REFERENCES

Alladi, S., Bak, T. H., Duggirala, V., Surampudi, B., Shailaja, M., Shukla, A. K., et al. (2013). Bilingualism delays age at onset of dementia, independent of education and immigration status. *Neurology* 81, 1938–1944. doi: 10.1212/01.wnl.0000436620.33155.a4

Bak, T. H., and Alladi, S. (2014). Can being bilingual affect the onset of dementia? *Future Neurol.* 9, 101–103. doi: 10.2217/fnl.14.8

Bak, T. H., and Mioshi, E. (2007). A cognitive bedside assessment beyond the MMSE: the Addenbrooke's cognitive examination. *Pract. Neurol.* 7, 245–249.

Bialystok, E. (1999). Cognitive complexity and attentional control in the bilingual mind. *Child Dev.* 70, 636–644. doi: 10.1111/1467-8624.00046

Bialystok, E. (2007). Cognitive effects of bilingualism: how linguistic experience leads to cognitive change. *Int. J. Biling. Educ. Biling.* 10, 210–223. doi: 10.2167/beb441.0

Bialystok, E., Craik, F., and Luk, G. (2008). Cognitive control and lexical access in younger and older bilinguals. *J. Exp. Psychol. Learn. Mem. Cogn.* 34, 859. doi: 10.1037/0278-7393.34.4.859

Bialystok, E., Craik, F. I. M., and Freedman, M. (2007). Bilingualism as a protection against the onset of symptoms of dementia. *Neuropsychologia* 45, 459–464. doi: 10.1016/j.neuropsychologia.2006.10.009

Bialystok, E., Craik, F. I. M., Klein, R., and Viswanathan, M. (2004). Bilingualism, aging, and cognitive control: evidence from the Simon task. *Psychol. Aging* 19, 290. doi: 10.1037/0882-7974.19.2.290

Bialystok, E., Craik, F. I. M., and Luk, G. (2012). Bilingualism: consequences for mind and brain. *Trends Cogn. Sci.* 16, 240–250. doi: 10.1016/j.tics.2012.03.001

Bialystok, E., Craik, F. I. M., and Ryan, J. (2006). Executive control in a modified antisaccade task: effects of aging and bilingualism. *J. Exp. Psychol. Learn. Mem. Cogn.* 32, 1341. doi: 10.1037/0278-7393.32.6.1341

Bialystok, E., and DePape, A.-M. (2009). Musical expertise, bilingualism, and executive functioning. *J. Exp. Psychol. Hum. Percept. Perform.* 35, 565. doi: 10.1037/a0012735

Bialystok, E., and Martin, M. M. (2004). Attention and inhibition in bilingual children: evidence from the dimensional change card sort task. *Dev. Sci.* 7, 325–339. doi: 10.1111/j.1467-7687.2004.00351.x

Birdsong, D. (ed.). (1999). *Second Language Acquisition and the Critical Period Hypothesis*. Mahwah, NJ: Lawrence Erlbaum Associates.

Chan, R. C. K. (2000). Attentional deficits in patients with closed head injury: a further study to the discriminative validity of the test of everyday attention. *Brain Inj.* 14, 227–236. doi: 10.1080/026990500120709

Chan, R. C. K., Lai, M. K., and Robertson, I. H. (2006). Latent structure of the Test of Everyday Attention in a non-clinical Chinese sample. *Arch. Clin. Neuropsychol.* 21, 477–485. doi: 10.1016/j.acn.2006.06.007

Chen, H.-C., Koh, C.-L., Hsieh, C.-L., and Hsueh, I.-P. (2013). Test of Everyday Attention in patients with chronic stroke: test-retest reliability and practice effects. *Brain Inj.* 27, 1148–1154. doi: 10.3109/02699052.2013.775483

Costa, A., Hernández, M., Costa-Faidella, J., and Sebastián-Gallés, N. (2009). On the bilingual advantage in conflict processing: now you see it, now you don't. *Cognition* 113, 135–149. doi: 10.1016/j.cognition.2009.08.001

De Houwer, A. (2009). *Bilingual First Language Acquisition*. Bristol: Multilingual Matters.

Emmorey, K., Borinstein, H. B., Thompson, R., and Gollan, T. H. (2008a). Bimodal bilingualism. *Bilingualism (Camb. Engl.)* 11, 43. doi: 10.1017/S1366728907003203

Emmorey, K., Luk, G., Pyers, J. E., and Bialystok, E. (2008b). The source of enhanced cognitive control in bilinguals evidence from bimodal bilinguals. *Psychol. Sci*. 19, 1201–1206. doi: 10.1111/j.1467-9280.2008.02224.x

Frye, D., Zelazo, P. D., and Palfai, T. (1995). Theory of mind and rule-based reasoning. *Cogn. Dev.* 10, 483–527. doi: 10.1016/0885-2014(95)90024-1

Green, D. W. (1998). Mental control of the bilingual lexico-semantic system. *Biling. Lang. Cogn.* 1, 67–81. doi: 10.1017/S1366728998000133

Hamalainen, H., and Hugdahl, K. (2011). Bilingual advantage in attentional control: evidence from the forced-attention dichotic listening paradigm. *Biling. Lang. Cogn.* 14, 371–378. doi: 10.1017/S1366728910000118

Hernández, M., Martin, C. D., Barceló, F., and Costa, A. (2013). Where is the bilingual advantage in task-switching? *J. Mem. Lang.* 69, 257–276. doi: 10.1016/j.jml.2013.06.004

Hilchey, M. D., and Klein, R. M. (2011). Are there bilingual advantages on nonlinguistic interference tasks? Implications for the plasticity of executive control processes. *Psychon. Bull. Rev.* 18, 625–658. doi: 10.3758/s13423-011-0116-7

Klein, D., Mok, K., Chen, J.-K., and Watkins, K. E. (2014). Age of language learning shapes brain structure: a cortical thickness study of bilingual and monolingual individuals. *Brain Lang.* 131, 20–24. doi: 10.1016/j.bandl.2013.05.014

Krizman, J., Marian, V., Shook, A., Skoe, E., and Kraus, N. (2012). Subcortical encoding of sound is enhanced in bilinguals and relates to executive function advantages. *Proc. Natl. Acad. Sci. U.S.A.* 109, 7877–7881. doi: 10.1073/pnas.1201575109

Kroll, J. F., and Bialystok, E. (2013). Understanding the consequences of bilingualism for language processing and cognition. *J. Cogn. Psychol.* 25, 497–514. doi: 10.1080/20445911.2013.799170

Kroll, J. F., and De Groot, A. M. B. (eds.). (1997). "Lexical and conceptual memory in the bilingual: Mapping form to meaning in two languages," in *Tutorials in bilingualism: Psycholinguistic perspectives* (Mahwah, NJ: Lawrence Erlbaum Associates Publishers).

Luk, G., de Sa, E., and Bialystok, E. (2011). Is there a relation between onset age of bilingualism and enhancement of cognitive control. *Biling. Lang. Cogn.* 14, 588–595. doi: 10.1017/S1366728911000010

MacLeod, A. A. N., and Stoel-Gammon, C. (2010). What is the impact of age of second language acquisition on the production of consonants and vowels among childhood bilinguals? *Int. J. Biling.* 14, 400–421. doi: 10.1177/1367006910370918

Newport, E. L., Bavelier, D., and Neville, H. J. (2001). "Critical thinking about critical periods: perspectives on a critical period for language acquisition," In *Language, Brain, and Cognitive Development: Essays in Honor of Jacques Mehler*, ed E. Dupoux (Cambridge, MA: MIT Press), 481–502.

Paap, K. R. (2014). The role of componential analysis, categorical hypothesising, replicability and confirmation bias in testing for bilingual advantages in executive functioning. *J. Cogn. Psychol.* 26, 242–255. doi: 10.1080/20445911.2014.891597

Paap, K. R., and Greenberg, Z. I. (2013). There is no coherent evidence for a bilingual advantage in executive processing. *Cogn. Psychol.* 66, 232–258. doi: 10.1016/j.cogpsych.2012.12.002

Prior, A., and MacWhinney, B. (2010). A bilingual advantage in task switching. *Biling. Lang. Cogn.* 13, 253–262. doi: 10.1017/S1366728909990526

Robertson, I. H., Ward, T., Ridgeway, V., and Nimmo-Smith, I. (1994). *The Test of Everyday Attention: TEA*. Bury St. Edmunds: Thames Valley Test Company.

Robertson, I. H., Ward, T., Ridgeway, V., and Nimmo-Smith, I. (1996). The structure of normal human attention: the Test of Everyday Attention. *J. Int. Neuropsychol. Soc.* 2, 525–534. doi: 10.1017/S1355617700001697

Simon, J. R., and Small Jr, A. M. (1969). Processing auditory information: interference from an irrelevant cue. *J. Appl. Psychol.* 53, 433. doi: 10.1037/h0028034

Sorace, A. (2004). Native language attrition and developmental instability at the syntax-discourse interface: data, interpretations and methods. *Bilingual. Lang. Cogn.* 7, 143–145. doi: 10.1017/S1366728904001543

Sorace, A., and Filiaci, F. (2006). Anaphora resolution in near-native speakers of Italian. *Sec. Lang. Res.* 22, 339–368. doi: 10.1191/0267658306sr271oa

Tao, L., Marzecová, A., Taft, M., Asanowicz, D., and Wodniecka, Z. (2011). The efficiency of attentional networks in early and late bilinguals: the role of age of acquisition. *Front. Psychol.* 2:123. doi: 10.3389/fpsyg.2011.00123

Treccani, B., Argyri, E., Sorace, A., and Della Sala, S. (2009). Spatial negative priming in bilingualism. *Psychon. Bull. Rev.* 16, 320–327. doi: 10.3758/PBR.16.2.320

Zelazo, P. D., and Frye, D. (1997). "Cognitive complexity and control: a theory of the development of deliberate reasoning and intentional action," in *Language Structure, Discourse, and the Access to Consciousness*, ed M. Stamenov (Philadelphia, PA: John Benjamins), 113–153.

Zelazo, P. D., Frye, D., and Rapus, T. (1996). An age-related dissociation between knowing rules and using them. *Cogn. Dev.* 11, 37–63. doi: 10.1016/S0885-2014(96)90027-1

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 08 February 2014; paper pending published: 18 March 2014; accepted: 03 May 2014; published online: 26 May 2014.

*Citation: Bak TH, Vega-Mendoza M and Sorace A (2014) Never too late? An advantage on tests of auditory attention extends to late bilinguals. Front. Psychol. **5**:485. doi: 10.3389/fpsyg.2014.00485*

This article was submitted to Language Sciences, a section of the journal Frontiers in Psychology.

frontiers in PSYCHOLOGY

GENERAL COMMENTARY
published: 03 December 2014
doi: 10.3389/fpsyg.2014.01367

On extending experimental findings to clinical application: Never too late? An advantage on tests of auditory attention extends to late bilinguals

Andrea A. N. MacLeod*

École d'orthophonie et d'audiologie, Université de Montréal, Montreal, QC, Canada
**Correspondence: andrea.macleod@umontreal.ca*

Edited by:
Mary Grantham O'Brien, University of Calgary, Canada

Reviewed by:
Suzanne Curtin, University of Calgary, Canada

Keywords: bilingual, clinical assessments, vocabulary acquisition, attention, second language learning

A commentary on

Never too late? An advantage on tests of auditory attention extends to late bilinguals
by Bak, T. H., Vega-Mendoza, M., and Sorace, A. (2014). Front. Psychol. 5:485. doi: 10.3389/fpsyg.2014.00485

In *Never too late? An advantage on tests of auditory attention extends to late bilinguals*, Bak, Vega-Mendoza and Sorace explored whether the bilingual advantage could be observed using a clinical assessment tool of attention, instead of an experimental task. As the authors note, a number of studies have shown a bilingual advantage that extends beyond the linguistic realm to cognitive tasks. In particular, bilingual children and adults have been shown to outperform monolingual peers on executive function tasks such as the control of attention (Bialystok and Martin, 2004; Bialystok et al., 2004). In addition to better performance on these experimental tasks, older bilingual adults have been reported to show a 4–5 years delay in the onset of dementia when compared to older monolingual adults (Bialystok et al., 2007). Although a bilingual advantage has been observed in experimental tasks, it is less clear if they would show this advantage on clinical tasks of attention control. Bak and his colleagues demonstrate that bilingual adults maintain this advantage on the auditory attention subtests of the Test of Everyday Attention. Two key issues should be considered in future research: first, we need to consider the clinical implications of these results; and second, we need to carefully describe bilingual participants to allow for the application of research findings to clinical practice. In exploring these issues, I will draw parallels with research in the assessment of vocabulary among bilingual children.

The application of clinical assessment tools to bilingual populations is a critical step in the fields of speech-language pathology and clinical psychology. In language assessments, particularly those used to assess children, the clinical tools tend to underestimate the children's language capacities (Umbel et al., 1992; Pearson, 1998; Bialystok et al., 2010) for two main reasons. First, bilingual children are often assessed in only one of their languages (Caesar and Kohler, 2007), and thus strengths in the other language are not documented. Second, the assessment tools have been developed and normalized on monolingual children, and thus the bilingual's score may be typical for a bilingual child, but not for a child acquiring a single language (Bedore et al., 2005). The case of vocabulary assessments provides a simple illustration of the downfalls of using tasks developed for monolingual populations. Bilingual children do not have identical lexical knowledge in both of their languages: they have a shared vocabulary (e.g., knowledge of the word for "tree" in two languages), and language specific vocabulary (e.g., knowledge of the word "multiplication" in the language used at school, and of "house coat" in the language used at home). Bilingual children often score lower than their monolingual peers in each of their languages (Pearson et al., 1993; Core et al., 2013), which can result in a referral to a speech-language pathologist for treatment. The referral may not be appropriate, even if the child is assessed in both languages, since the assessment tool does not account for the bilingual child's shared and language specific vocabulary (Bedore et al., 2005). A better assessment of vocabulary would consider the child's lexical knowledge using either a measure of total vocabulary (all words known), or conceptual vocabulary (concepts known regardless of language). Researchers have demonstrated that typically developing bilingual children score the same or higher than their monolingual peers when measured using their total vocabulary (Core et al., 2013), and conceptual vocabulary (Bedore et al., 2005). In the absence of a clinical tool that can accurately measure the bilinguals' vocabulary, it is important to develop normative data based on bilingual children.

In the present study, Bak and his colleagues have shown that the clinical tool, the Test of Everyday Attention, is sensitive to differences between bilingual and monolingual adults. In contrast to the vocabulary example above, the bilingual adults scored higher than their monolingual peers on the auditory subtests. From a clinical point of view, a higher score may not seem problematic, since it would not lead to a referral for further assessment or intervention. Instead, perhaps the criteria for referral for a bilingual patient should be adjusted upward in light of the higher performance of typical bilingual adults. For example, a bilingual patient who scored lower than his bilingual peers

following a stroke may still be within the range of "normal" for a monolingual adult: should this lower score relative to his bilingual peers lead to more in depth evaluation? An important next step in this line of research would be to address the clinical significance of the difference observed. In particular, do bilingual adults who suffer from neurological traumas (e.g., stroke or head injury) or neurodegenerative conditions maintain the bilingual advantage?

In taking this next step, it will be important to carefully describe the bilingual population under study. As Bak and his colleagues found, bilingual adults may perform differently due to differences in age of second language acquisition: in comparison to monolinguals, adults who acquired two languages during early childhood performed better on the attention switching task, and those who acquired their L2 during late childhood and adolescence performed better on the selective attention task. Other research has shown that bilingual may also differ due to the contexts of second language learning, the contexts of on-going language use, and their abilities across different modalities. For example, in a study of bilingual children's vocabulary development in French and German, the amount of exposure played a strong role in the children's vocabulary development, despite simultaneous acquisition of both languages and daily exposure to both languages (MacLeod et al., 2013). In a series of studies that focused on bilinguals who spoke Welsh and English, Gathercole and her colleagues have documented the complex interplay between age of second language exposure, language learning context (home, school, or both), and on-going language use (Gathercole and Thomas, 2009; Gathercole et al., 2010). For example, in their study of executive function tasks among bilingual children, they found a bilingual advantage for bilingual children living in homes that used only Welsh (Gathercole et al., 2010). In addition to the context of language use, the bilinguals with more balanced use of both languages showed a stronger advantage (Gathercole et al., 2010). In experimental studies, a careful description of bilingual participants allows for replication and comparison across studies. This careful description is particularly important when applying findings to a clinical setting in order to provide the most accurate and appropriate services to patients.

I concur with Bak, Vega-Mendoza and Sorace: it is important to evaluate whether clinical tools are sensitive to bilingual abilities. Future research needs to carefully describe the bilingual participants with regards to age of second language acquisition, but also the context of language learning and on-going language use. Of equal importance is pursuing this line of research to understand whether the differences observed are clinically important. In the case of the assessment of bilingual children's vocabulary, the clinical impact was clear: bilingual children were at risk of over-diagnosis of a language disorder. For the control of attention, the clinical significance of the results remains to be documented but may result in the development of new criteria on attention subtests for bilingual adults.

REFERENCES

Bedore, L. M., Peña, E. D., Garcia, M., and Cortez, C. (2005). Conceptual versus monolingual scoring: when does it make a difference? *Lang. Speech Hear. Serv. Sch.* 36, 188–200. doi: 10.1044/0161-1461(2005/020)

Bialystok, E., and Martin, M. M. (2004). Attention and inhibition in bilingual children: evidence from the dimensional change card sort task. *Dev. Sci.* 7, 325–339. doi: 10.1111/j.1467-7687.2004.00351.x

Bialystok, E., Craik, F. I., and Freedman, M. (2007). Bilingualism as a protection against the onset of symptoms of dementia. *Neuropsychologia* 45, 459–464. doi: 10.1016/j.neuropsychologia.2006.10.009

Bialystok, E., Craik, F. I., Klein, R., and Viswanathan, M. (2004). Bilingualism, aging, and cognitive control: evidence from the Simon task. *Psychol. Aging* 19, 290. doi: 10.1037/0882-7974.19.2.290

Bialystok, E., Luk, G., Peets, K. F., and Yang, S. (2010). Receptive vocabulary differences in monolingual and bilingual children. *Bilingualism Lang. Cogn.* 13, 525–531. doi: 10.1017/S1366728909990423

Caesar, L. G., and Kohler, P. D. (2007). The state of school-based bilingual assessment: actual practice versus recommended guidelines. *Lang. Speech Hear. Serv. Sch.* 38, 190–200. doi: 10.1044/0161-1461(2007/020)

Core, C., Hoff, E., Rumiche, R., and Señor, M. (2013). Total and conceptual vocabulary in Spanish–English bilinguals from 22 to 30 months: implications for assessment. *J. Speech Lang. Hear. Res.* 56, 1637–1649. doi: 10.1044/1092-4388(2013/11-0044)

Gathercole, V. C. M., and Thomas, E. M. (2009). Bilingual first-language development: dominant language takeover, threatened minority language take-up. *Bilingualism Lang. Cogn.* 12, 213–237. doi: 10.1017/S1366728909004015

Gathercole, V. C. M., Thomas, E. M., Jones, L., Guasch, N. V., Young, N., and Hughes, E. K. (2010). Cognitive effects of bilingualism: digging deeper for the contributions of language dominance, linguistic knowledge, socio-economic status and cognitive abilities. *Int. J. Biling. Educ. Biling.* 13, 617–664. doi: 10.1080/13670050.2010.488289

MacLeod, A. A. N., Fabiano-Smith, L., Boegner-Pagé, S., and Fontolliet, S. (2013). Simultaneous bilingual language acquisition: the role of parental input on receptive vocabulary development. *Child Lang. Teach. Ther.* 29, 131–142. doi: 10.1177/0265659012466862

Pearson, B. Z. (1998). Assessing lexical development in bilingual babies and toddlers. *Int. J. Bilingualism* 2, 347–372.

Pearson, B. Z., Fernandez, S. C., and Oller, D. K. (1993). Lexical development in bilingual infants and toddlers: comparison to monolingual norms. *Lang. Learn.* 43, 93–120. doi: 10.1111/j.1467-1770.1993.tb00174.x

Umbel, V. M., Pearson, B. Z., Fernández, M. C., and Oller, D. K. (1992). Measuring bilingual children's receptive vocabularies. *Child Dev.* 63, 1012–1020. doi: 10.2307/1131250

Conflict of Interest Statement: The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 22 October 2014; accepted: 10 November 2014; published online: 03 December 2014.

*Citation: MacLeod AAN (2014) On extending experimental findings to clinical application: Never too late? An advantage on tests of auditory attention extends to late bilinguals. Front. Psychol. **5**:1367. doi: 10.3389/fpsyg.2014.01367*

This article was submitted to Language Sciences, a section of the journal Frontiers in Psychology.

frontiers in PSYCHOLOGY

ORIGINAL RESEARCH ARTICLE
published: 05 June 2014
doi: 10.3389/fpsyg.2014.00546

Double threshold in bi- and multilingual contexts: preconditions for higher academic attainment in English as an additional language

Simone Lechner* and Peter Siemund

Department of English and American Studies, University of Hamburg, Hamburg, Germany

Edited by:
Mary Grantham O'Brien, University of Calgary, Canada

Reviewed by:
Dorothea Hoffmann, University of Chicago, USA
Jeff MacSwan, University of Maryland, USA

****Correspondence:***
Simone Lechner, Department of English and American Studies, University of Hamburg, Von-Melle-Park 6, 20146 Hamburg, Germany
e-mail: simone.lechner@uni-hamburg.de

Bi- and multilingualism has been shown to have positive effects on the attainment of third and additional languages. These effects, however, depend on the type of bi- and multilingualism and the status of the languages involved (Cenoz, 2003; Jessner, 2006). In this exploratory trend study, we revisit Cummins' Threshold Hypothesis (1979), claiming that bilingual children must reach certain levels of attainment in order to (a) avoid academic deficits and (b) allow bilingualism to have a positive effect on their cognitive development and academic attainment. To this end, we examine the attainment of English as an academic language of 16-years-old school children from Hamburg ($n = 52$). Our findings support the existence of thresholds for literacy attainment. We argue that language external factors may override positive effects of bilingualism. In addition, these factors may compensate negative effects attributable to low literacy attainment in German and the heritage languages. We also show that low attainment levels in migrant children's heritage languages preempt high literacy attainment in additional languages.

Keywords: attainment of academic literacy, bilingualism, English as a foreign language, English as an additional language, migrant languages, third language acquisition, threshold hypothesis

INTRODUCTION

In Germany and elsewhere, it remains highly debated if bilingualism has a positive impact on cognitive development or academic attainment (Gogolin and Neumann, 2009), especially in subtractive bilingual situations (Cenoz, 2003, pp 74–80). Several studies have shown that bilinguals have cognitive advantages compared to their monolingual peers (Bialystok, 2009, pp 97–98), particularly in tasks that require cognitive flexibility and selective attention (Bialystok et al., 2009, p. 230). At the same time, however, bilingual children have been shown to be disadvantaged as far as lexical retrieval is concerned (Bialystok, 2009, p. 55).

Regarding the attainment of additional languages, positive effects have been identified for bilingual learners in comparison to their monolingual peers (Cummins, 1992, p. 65; Jessner, 2006, p. 27). Such positive effects seem to manifest themselves only once certain attainment levels have been reached. Swain et al. (1990 p. 73) claim that bilingual literacy development is especially important in this respect. Furthermore, language external variables seem to play an important role (De Angelis, 2007, p. 12).

According to the German DESI-study (DESI-Konsortium, 2006), subtractive bilingual heritage speakers show slight advantages in the attainment of third or additional languages, interpreted by Burghardt and Esser (2008), Esser (2009) as an effect of learning German as a home language, rather than an effect of bilingualism itself. Overall, research on third language literacy attainment has led to mixed results concerning effects attributable to subtractive bilingualism (Cenoz, 2003, p. 83).

Cummins' Threshold Hypothesis (1979, p. 227) provides an explanation of different academic outcomes in subtractive bilingual situations. Cummins here postulates that bilingual children have to reach a certain level of attainment in both their L1 and their L2 for positive effects of bilingualism to play out.

Cummins' Threshold Hypothesis has been the subject of much criticism and debate, particularly with regard to the notion of "limited bilingualism" (MacSwan, 2000, p. 5). It has been argued that limited bilingualism carries pejorative connotations in the same way as the term "semilingualism" does. Consequently, researchers who use the term "limited bilingualism" view certain types of bilingualism from a deficit perspective (MacSwan and Rolstad, 2006, p. 2309).

We believe that it is necessary to distinguish between linguistic competence and performance (langue versus parole) in the interpretation of the Threshold Hypothesis. Cummins seems to use the term "language proficiency" to refer to both competence and performance, including school literacy. MacSwan (2000, pp 33–34) argues that if the Threshold Hypothesis refers to language competence, it is spurious because there is no evidence to suggest that subtractive bilinguals did not know the underlying principles of their language. If, on the other hand, the Threshold Hypothesis refers to school literacy, it is irrelevant and tautological (MacSwan, 2000, p. 34), because in this case literacy and related school knowledge would have to be viewed as aspects of language itself rather than academic achievement. Following MacSwan (2000), we here view limited bilingualism or semilingualism as completely unrelated to linguistic competence. If at all, these notions say something about the failure to perform according to certain cultural norms.

We do not regard the Threshold Hypothesis as a competence-related construct, but rather as a performance-based concept relating to educational attainment. Performance data are used to

measure attainment, which only reflect the underlying linguistic competence. In this descriptive trend study, we investigate the effects of high and low attainment levels in informants' heritage language and their language of environment, i.e., German, on their attainment of English as a foreign language. We aim to do so by investigating the attainment of academic literacy in English by Turkish-German, Vietnamese-German, and Russian-German simultaneous and successive bilinguals in subtractive bilingual contexts who acquire English as their third or additional language.

The present study aims to investigate whether 16-years-olds with high literacy assessment scores in English also achieve high literacy assessment scores in German and their heritage languages, and whether a high assessment score in the heritage language in addition to the L2 German has a perceivable positive influence on literacy in the target language English.

It is important to emphasize that we are here measuring aspects of language performance, especially literacy achievement, and not proficiency understood as competence. To avoid confusion, we here opt to avoid the term "proficiency" altogether and use the terms "attainment" and "literacy achievement" instead. Furthermore, we here define the attainment of English as an academic achievement, i.e., educational attainment. We argue that the effects we can observe depend on a double threshold, meaning that thresholds for positive influence of literacy skills in informants' background languages are lower if socioeconomic factors are favorable.

METHODS AND DATA

The data presented here are the result of a panel study conducted in the context of the research cluster *Linguistic Diversity Management in Urban Areas* (LiMA-LiPS, 2009–2013), more specifically a pilot for a panel study initiated in the cluster that is still ongoing. Panel studies are defined as longitudinal studies that measure the same variables on the same units, in our case informants, over time. They therefore consist of multiple waves of testing. Two waves of testing were completed in the context of the LiPS pilot study. The panel study investigates the development of heritage languages and the language of environment (i.e., German) for children (aged 6, 11, 15 in the first wave of testing). They come from different migrant communities (Russian-German, Turkish-German, and Vietnamese-German) and a German control group, living in the urban space of Hamburg. In total, the LiPS pilot study tested 150 informants in each language group distributed equally across the three age groups.

We extracted $n = 132$ informants from the two older age cohorts (aged 12 and 16 at the time of data collection) in the second wave of this pilot study (henceforth *main panel*). In this study, we will only be focusing on the 16-years-old informants. The informants represent each of the language groups. The initial target number of participants we aimed to extract from the main panel was $n = 160$ ($n = 40$ for each language group, with $n = 20$ 12-years-old and $n = 20$ 16-years-old), but we encountered difficulties extracting data from the Turkish-German group in particular. In cases where the target number could not be achieved, additional interviews were conducted. Furthermore, we conducted interviews with monolingual student control groups equally distributed across the same ages with English as their L2 in Russia, Turkey, and Vietnam.

We differentiate between bilingual and monolingual informants, although it is possible to construe our German control group as bilinguals and our bilingual informants as multilinguals, as both groups have acquired English in addition to their native languages. We here opt to use the terms "bilingual" and "monolingual" because these appear in the main panel. Furthermore, we use the term "heritage language" instead of "home language" or "community language," because it is the term utilized in the main panel.

Background variables and informants' attainment levels for different text types, both in German and their heritage language, were tested in the context of the main panel study. When additional interviews were conducted, we relied on questionnaires with smaller sets of background variables. In addition to this, we conducted an additional socioeconomic background interview and a parental questionnaire with all of our informants.

The English language tasks consisted of an oral description based on a picture sequence, a written narrative based on a picture sequence, and an academic language task, likewise based on a sequence of pictures. The latter was only conducted with the 16-years-old and aimed for instructive texts. All of the instruments were piloted in advance with children of the same ages and with the same language backgrounds as well as with adults. We piloted specifically for manageability of the task to avoid any cultural or sex-based bias. Interviews were conducted by bilingual interviewers in the children's homes. Most of the bilingual children we interviewed spoke primarily their heritage language at home, while the German monolinguals spoke only German at home. The informants were chosen based on a mixed method of random sampling relying on data obtained from Hamburg's registration office and snowballing. The aim was to collect representative data rather than data from homogeneous groups, as we have informants with a wide range of socioeconomic and educational backgrounds in our sample.

The instructive task was an English translation of the first part of *Fast Catch Bumerang*,[1] a task which had been developed in the context of FÖRMIG (Reich et al., 2009). In the context of the main panel study, it had been conducted in German and informants' heritage languages with the oldest age group. The task had previously been used in large-scale projects in different languages, and was completed in English for the first time in the context of the LiPS pilot study (and therefore underwent additional piloting). It is an instrument aimed at measuring academic language that is not based on curricular goals. The instrument contains a set of six pictures showing the construction of a boomerang. The task is to write an instructive text describing the construction of the boomerang, understandable without the pictures. We allowed 20 min to complete this task. Two native speakers of English scored the task independently, thus increasing interrater reliability.

Six-digit numbers were assigned to each of the informants as IDs. The first digit encodes for city (1 = Hamburg; 2 =

[1] *Fast Catch Bumerang* is the German trademark of the instrument.

Lüneburg), the second digit encodes for language group (1 = L1 Russian, 2 = L1 Turkish, 3 = L1 Vietnamese and 4 = L1 German), and the third digit encodes for the age of the informants (2 = 12-years-old, 3 = 16-years-old). The last three digits are randomized sequences that allow us to identify each informant and to assign background variables from different testing sequences to each of them.

In this trend study, we focus exclusively on 16-years-old informants who were also part of the main panel and handed in completed versions of the Boomerang task in English,[2] because these informants completed this task in all three languages, i.e., English, German, and their respective heritage language. This leaves us with $n = 52$ informants, distributed as follows: $N = 20$ Russian-German bilinguals, $n = 11$ Vietnamese-German bilinguals, $n = 5$ Turkish-German bilinguals, and $n = 16$ German monolinguals.

In a first step, we will look at all of the informants and take into account not only the language assessment scores for German, their heritage languages, and English, but also socioeconomic background variables that have been shown to have effects on language development and, subsequently, on language production. We try to assess whether bilinguals with similar socioeconomic backgrounds show differences in comparison to their monolingual peers regarding their production of instructive texts in English. In a second step, we will look at the $n = 10$ informants with the highest and lowest proficiency scores in English, and examine whether there are any correlations between language assessment scores in German and/or the heritage languages.

To this end, we will compare their scores in English to their scores in German and their heritage languages, as supplied by the main panel. It needs to be pointed out that different scoring schemes were used in the main panel and our study. These differences in measurement are due to the fact that students encounter English almost exclusively as a school subject, while they encounter both German and their heritage languages in informal environments. While the target varieties for German and children's heritage languages are diverse, there is a clear target variety for English, i.e., standardized British or American English, as it is taught in the German school context. Moreover, informants often have experienced no formal language education in their heritage languages. Consequently, while an overall correctness score is part of the English scoring paradigm, it is not part of the scoring paradigms for either German or the heritage languages.

PRELIMINARY RESULTS

TYPOLOGIES OF THE LANGUAGES INVOLVED

The typologies of the background languages of our informants are highly diverse. Russian is an inflectional-fusional language that has free word order (but a preference for SVO). It has no articles and fairly complex conjugation and declension paradigms (Wade, 2011). Vietnamese is a tonal, isolating language with an SVO word order (Ngô, 2001). Although it has a complex classifier system, there are no word classes that correspond directly to articles. Turkish is an agglutinating language with basic SOV word order (Göksel and Kerslake, 2011). It has multiple ways of expressing indefiniteness of the noun phrase, including an indefinite article. There is no definite article, though definiteness may be marked via declension.

German, the language of environment for all of the informants in our sample, has V2 word order in main clauses and SOV patterns in subordinate clauses. It has indefinite and definite articles and is classified as a moderately inflecting language. English, finally, is a weakly inflecting language. It has a basic SVO word order and definite as well as indefinite articles.

Based on the typologies of the languages involved, positive as well as negative transfer to the target language English is hypothetically possible from all of the source languages, i.e., informants' heritage languages and the language of environment, German. We here define transfer in the sense of Odlin's (1989) "cross-linguistic influence" and view it as a bilateral process with possible facilitation and interference outcomes. Due to the bi- and multilateral nature of transfer phenomena, it is therefore also possible for English to have an influence on German and the heritage languages, although this will play no role in the study presented here.

SCORES IN ENGLISH WITH REGARD TO SCHOOL TYPE

Scores for each of the tasks in English were measured as a combined score of lexical richness (types/tokens, lemmas/tokens), structural complexity (number of subordinating and coordinating conjunctions, clauses, relative clauses, sentences and passives in relation to token output), overall correctness score (target-like occurrences/tokens), and the length of the text. The score for the length of the text was measured against the highest token output, i.e., the text with the highest number of produced words, in the sub-sample. This method led to scores that range from 8 to 70, with the majority ranging from 40 to 70. In principle, it would have been possible to achieve higher scores, but none of the informants in our subsample achieved a score higher than 70. In a next step, scores were transferred to a categorical scoring system that ranges from zero to seven (zero being the lowest and seven being the highest), which in turn corresponds to a category in the Common European Framework of References for Language (henceforth CEFR; Little, 2006). These categories are based on the Can-Do-Statements issued by the European Union. The highest possible score in the categorical scoring system corresponds to the C2 category in the CEFR. None of the informants in our subsample reached a C2 level, six being the highest score achieved. The categorical scores were established by three independent raters based on the scores achieved in the written task. Individuals with comparatively lower scores out of 70 were able to achieve comparatively higher CEFR scores if their writing corresponded to a higher CEFR level according to the Can-Do-Statements. Because our scores included lexical richness and structural complexity, however, informants with lower total scores did not achieve higher scores than informants with higher scores in the categorical scoring system.

[2]Some of the informants refused to participate in the Boomerang task, especially in the German-Vietnamese group. The reasons for this were diverse. Some informants thought that the task was too difficult, others simply did not want to do the task again, as they had already completed it in German and their heritage language.

Table 1 | Categorization of attainment scores.

ID	Total score	Total score English	CEFR
143032	68.60	6.0	C1

The three different categories are illustrated for informant 143032 (German monolingual) in **Table 1**.

The scores of all $n = 52$ informants investigated for the purposes of this study are listed from highest to lowest in Supplementary Table 1 (see Supplementary Material). They were generated for the Boomerang task. We generated independent scores for the other tasks. These may differ from results in the Boomerang task, as they measure other aspects of language production. In Supplementary Table 1, informants are listed according to their ID and language group. In addition to the scores, the following information is given: language background, informants' sex, age of onset for German, the HISCED[3] index (highest educational background in informants' families), the HISEI[4] index (highest socioeconomic background of the informants' households), and school type. The 6-digit ID serves as a reference point for the background data and the scores.

All of the bilingual informants in our subsample save one (133044) used their heritage language as their primary language of communication with their parents and spoke primarily their heritage language at home. Some of the Russian-German bilinguals (those who had started acquiring German after the age of six) underwent schooling and literacy development in Russian.

Germany has a tracked school system. The *Gymnasium* is the highest form of secondary schooling. The biggest gaps in attainment levels can normally be observed between students who attend the *Gymnasium* and those attending other school forms. Differences in attainment between other school types are not as high. The *Stadtteilschule*—like the *Gesamtschule*—is a hybrid combining middle and secondary school tracks. The *Realschule* offers middle school education only. There are special school forms, such as the *Förder-* and *Sonderschule*, which tend to children with learning disabilities and are attended by students with significantly lower attainment levels. Differences in attainment within classes of the same school type are typically not as high in countries with tracked school systems as they are in countries with comprehensive school systems (Dronkers et al., 2011, p. 31).

The school type informants attend can be viewed as a marker of their educational attainment, but it is important to keep in mind that school type is a symptom of multiple underlying variables. For informants who attend higher secondary education, these variables can normally be explained in terms of favorable socioeconomic conditions and high educational backgrounds in their families. There are exceptions, though, as evidenced in Supplementary Table 1.

The majority of informants achieving high scores in the English Boomerang task attends the *Gymnasium* and comes from families with high educational backgrounds. The two informants with the lowest overall attainment scores for the Boomerang task are 143565 and 143327 (see Supplementary Table 1), both German monolinguals, who attend schools for children with learning disabilities. They completed the task primarily in German with interspersed English function words. The informants at the lower end of the scoring spectrum attend diverse school forms. Most of the informants who do not attend the *Gymnasium* achieve comparatively lower scores. In cases in which informants attend the *Gymnasium* and still have lower scores for English, we typically find comparatively lower HISEI and HISCED scores. The educational background of informants' families seems to play a more pronounced role than household income. Age of onset seems to be irrelevant, as we find simultaneous and successive bilinguals both at the higher and lower end of the scoring spectrum. Similarly, sex does not seem to be an influencing factor.

Although influences from the heritage languages are observable, especially with informants who acquired German after the age of three, the majority of non-target-like effects occur regardless of differences in language background. They may be explainable in terms of (partly fossilized) language acquisition stages.

Non-target-like occurrences in informants' texts include code mixing, as in Example 1. It occurs exclusively from German, especially at the lower end of the scoring spectrum. Moreover, we find non-target-like subject-verb-agreement and tense- and aspect marking, again primarily at the lower end of the scoring spectrum. This is illustrated in Example 2. Non-target-like word order, particularly in the placement of adverbs and prepositional phrases, is portrayed in Example 3. The latter phenomenon occurred regardless of the scores that informants' achieved. As most informants were not accustomed to the specialized English vocabulary the task required, all of them used coping strategies such as direct lexical transfer (Example 4) and paraphrasing (Example 5). We use angled brackets to indicate the non-target like specimens under discussion.

(1) 123241 Turkish-German bilingual
I have a Boomerang <Schablone 'template'>, we <schneiden es 'cut it'>

(2) 133150 Vietnamese-German bilingual
[…] that you <has> the same form […] and your boomerang <are> finish

(3) 113161 Russian-German bilingual
You have to fix the wood with the table and cut it <carefully> out

(4) 143577 German monolingual
<boring machine> (instead of *drill*; German: *Bohrmaschine*)

(5) 143009 German monolingual
<a thing to put some holes into wood>

[3]The ISCED (International Standard Classification of Education) ranges from Level 1 to 6 and measures the educational background of informants' families. HISCED refers to the highest ISCED in informants' families (cf. Ehmke and Thilo, 2005).

[4]The ISEI (International Socio-Economic Index of Occupational Status) ranges from 16 to 90 and is based the occupation and related income of informants' parents. HISEI refers to the highest ISEI in the family (cf. Ehmke and Thilo, 2005).

Finally, note that the task did not trigger third person singular agreement, with which the majority of informants had difficulties in the other tasks we conducted.

SCORES IN ENGLISH WITH REGARD TO SCORES IN GERMAN AND THE HERITAGE LANGUAGES

Tables 2, **3** below show the 10 informants with the highest and lowest scores in English, listed from highest to lowest, along with relevant background variables and the language assessment scores in German and their heritage languages. The scores in the main panel were calculated with a mean value of 100 and a standard deviation of 20. As two waves of testing were conducted in the context of LiPS, two sets of scores are available. Here, we focus on the scores from the second wave.

Again, there does not seem to be any effect attributable to either sex or age of onset regarding the scores in German and the heritage language. With the exception of informant 113090, informants with high scores in English also achieve high scores in German.

Of the 10 informants with the highest scores, five are bilinguals. Four of these belong to the Russian-German group. The remaining bilingual informant stems from the Vietnamese-German group, achieving the highest score of all bilinguals. This informant (133044) speaks primarily German at home. Her scores in German are higher than in Vietnamese. Her assessment scores for German, however, are lower than those of the monolingual German informants (except informant 143411). Further background variables reveal that informant 133044 is a special case, as she attended an international school in Vietnam where English was the first language that she formally acquired. This is one of the primary reasons for her high literacy score in English.

Three of the Russian-German bilinguals achieved high scores in their heritage language Russian. Informant 113090, a Russian-German bilingual attending the *Gymnasium*, shows low assessment scores in German and her heritage language, even though she achieved comparatively high literacy levels in the English Boomerang task. HISCED and HISEI levels are both high in her case.

At the lower end of the scoring spectrum for English (see **Table 3**), we also find lower literacy scores for German. Except for informant 113177, who shows lower scores in both background languages though better results for German, all of the informants show higher results in their heritage languages. Eight of the 10 informants are of multinational descent. The two informants with the lowest literacy scores represent the two German monolingual girls receiving specialized schooling for children with learning disabilities. Their results for English can be interpreted as a consequence of their learning disabilities. Four of the 10 informants with lower attainment levels in English are Turkish-German bilinguals, with $n = 5$ informants in our sub-sample being of Turkish descent.

We may suspect a correlation between literacy attainment in German and English. A Pearson correlation for our bilingual informants reveals that the raw scores for the English Boomerang task correlate at the 0.01 level with the scores in the German Boomerang task. There is no significant correlation between the scores for the heritage languages and English. These results are summarized in **Table 4**.

BILINGUAL INFORMANTS' HERITAGE LITERACY ASSESSMENT SCORES IN RELATION TO THEIR ACADEMIC ACHIEVEMENT IN ENGLISH LITERACY

If we look only at our bilingual informants and rearrange our results according to the 10 informants with the highest literacy scores in their heritage languages, we find mixed results for their scores in English. If, however, we look at the 10 informants with the lowest assessment scores in their heritage language, this results in the picture shown in **Table 5**.

Informants with comparatively lower language assessment scores in the heritage language versions of the Boomerang task reach comparatively low literacy scores in the English Boomerang task. The exception to this is informant 133044, who, as has already been established, acquired English as her first formal language and achieves a relatively high score in the German version of the Boomerang task. Informant 113209 is an interesting case, because she reaches an above average literacy score in English,

Table 2 | Informants with highest attainment scores, including academic literacy scores for German/heritage languages.

ID	Group	Sex	OSG	HISCED	HISEI	School	LASG	LASHL	TSE
143032	Ger.	f	ml	Level 6	88	Gym	148.57	ml	6.0
143387	Ger.	m	ml	Level 6	65	Gym	134.59	ml	6.0
133044	Viet.-Ger.	f	6	Level 6	43	Gym	110.79	88.8	6.0
143009	Ger.	m	ml	Level 6	51	Gym	128.16	ml	6.0
143411	Ger.	f	ml	Level 6	77	Gym	114.41	ml	5.5
143396	Ger.	m	ml	Level 6	71	Gym	169.26	ml	5.5
113183	Rus.-Ger.	f	n/a	n/a	n/a	Real	112.30	106.24	5.5
113090	Rus.-Ger.	f	6	Level 6	67	Gym	88.00	96.99	5.0
113186	Rus.-Ger.	f	3	Level 6	57	Gym	113.35	109.97	5.0
113193	Rus.-Ger.	m	0	Level 6	71	Gym	143.49	165.19	5.0

OSG, Onset German; HISCED, Highest educational background in informants' families; HISEI, Highest socioeconomic background of the informants' households; LASG, Language Assessment Score German; LASCHL, Language Assessment Score Heritage Language; TSE, Total Score English; ml, monolingual; Gym, Gymnasium; Real, Realschule.

Table 3 | Informants with lowest attainment scores, including academic literacy scores for German/heritage languages.

ID	Group	Sex	OSG	HISCED	HISEI	School	LASG	LASHL	TSE
133098	Viet.-Ger.	f	3	Level 6	67	Gym	104.38	117.60	2,5
113177	Rus.-Ger.	f	3	Level 6	32	Gym	77.06	58.39	1.0
133130	Viet.-Ger.	m	>6	Level 6	49	Stadt	75.45	126.24	1.0
123240	Turk.-Ger.	f	0	Level 3	39	Stadt	98.58	102.59	1.0
123236	Turk.-Ger.	f	0	Level 2	43	Gym	n/a	n/a	1.0
113156	Rus.-Ger.	f	0	Level 2	30	Real	93.47	87.68	1.0
123163	Turk.-Ger.	f	0	n/a	n/a	Gesamt	99.79	123.19	1.0
123241	Turk.-Ger.	m	0	Level 3	49	Stadt	61.00	73.62	0.5
143565	Ger.	f	ml	Level 3	32	S/F	72.20	ml	0.0
143327	Ger.	f	ml	Level 3	33	S/F	101.52	ml	0.0

OSG, Onset German; HISCED, Highest educational background in informants' families; HISEI, Highest socioeconomic background of the informants' households; LASG, Language Assessment Score German; LASCHL, Language Assessment Score Heritage Language; TSE, Total Score English; ml, monolingual; Gym, Gymnasium; Stadt, Stadtteilschule; Real, Realschule; Gesamt, Gesamtschule; S/F, Sonderschule/Förderschule.

Table 4 | Pearson correlation scores.

	Score English	Score German	Score heritage languages
Score English	1	0.580**	0.277
		0.000	0.113
Score German	0.580**	1	0.638**
	0.000		0.000
Score heritage languages	0.277	0.638**	1
	0.113	0.000	

***Correlation is significant at the 0.01 level (2-tailed); Listwise N = 34.*

but comparatively lower levels of literacy in German and her heritage language. In this case, however, the family has a comparatively high educational background. Moreover, in the first wave of testing, she obtained a relatively high literacy score in Russian.

SUMMARY OF RESULTS

To sum up, it does seem to be the case that higher academic literacy scores in both German and the heritage language coincide with higher academic literacy scores in English. Whether or not literacy resources are accessible, however, seems to be dependent on language external factors. Moreover, comparatively higher academic literacy assessment scores in German seem to coincide more frequently with high academic literacy scores in English. Higher literacy scores in the informant's heritage language coinciding with comparatively lower attainment scores in German result in a lower academic literacy score in English. In general the lowest assessment scores in bilingual informants' heritage languages coincide with low academic literacy outcomes for English.

DISCUSSION

In this exploratory, qualitative analysis of our data set, we found no evidence for advantages of bilinguals regarding the production of written instructive texts in English, in comparison to their monolingual peers. Our results, however, show that bilingual informants with high assessment levels for academic literacy in both German and their heritage language are more likely to achieve better results in the production of academic English. In our view, this finding supports Cummins' Threshold Hypothesis as long as we view English literacy as a form of academic attainment. Moreover, informants with low literacy attainment levels in their heritage languages achieved comparatively lower scores for the task at hand.

Our results also show that there are individual thresholds, as some informants seem to be able to access their literacy resources on lower levels than others. The accessibility of these lower level resources seems to be dependent on socioeconomic background variables, as informants with low literacy scores in their background languages—though attaining high literacy scores in the English task—have a high socioeconomic and educational background.

Although we did not find evidence for advantages of bilingual informants regarding their literacy levels in English, it must be noted that there may be factors overriding our results. For example, 16-years-old students in Germany are likely to have encountered instructive text types in school and in their environment in German, but are much less likely to have encountered them in their heritage language, especially since the majority of our informants received no formal training in their home languages. Other overriding factors include the quality of English language education and students' motivation to learn English.

Even though our study is primarily concerned with literacy attainment, it would appear justified to take a brief look at the influencing factors identified in L3 acquisition studies. In this context, for example, typological proximity has been identified as an important factor (De Angelis, 2007, pp 22–31). In his *Typological Primacy Model* (2011), Rothman postulates that typological proximity is the strongest factor influencing syntactic transfer in L3 acquisition processes. Due to the close proximity of German and English, it appears possible that our informants rely more heavily on German than on their heritage languages in the production of English, even if their heritage language knowledge

Table 5 | Bilingual informants with lowest academic literacy scores in their heritage languages (Second wave).

ID	Group	Sex	OSG	HISCED	HISEI	School	LASG	LASHL	TSE
113209	Russ.-Ger.	f	3	Level 3	53	n/a	91.38	93.58	4.0
133044	Viet.-Ger.	f	6	Level 6	43	Gym	110.79	88.80	6.0
113156	Russ.-Ger.	f	0	Level 2	30	Real	93.47	87.68	1.0
133088	Viet.-Ger.	m	3	n/a	30	Gym	95.20	83.04	2.5
133008	Viet.-Ger.	m	3	n/a	31	Real	77.25	80.16	2.5
133099	Viet.-Ger.	m	3	n/a	45	Gym	81.30	80.16	2.5
133150	Viet.-Ger.	m	3	n/a	34	Stadt	81.10	80.16	2.5
123241	Turk.-Ger.	m	0	Level 3	49	Stadt	61.00	73,62	0.5
133007	Viet.-Ger.	f	3	n/a	30	Gym	96.09	60.00	2.5
113177	Russ.-Ger.	f	3	Level 6	32	Gym	77.06	58.39	1.0

OSG, Onset German; HISCED, Highest educational background in informants' families; HISEI, Highest socioeconomic background of the informants' households; LASG, Language Assessment Score German; LASCHL, Language Assessment Score Heritage Language; TSE, Total Score English; Gym, Gymnasium; Stadt, Stadtteilschule; Real, Realschule; Gesamt, Gesamtschule.

is comparatively high. This may even apply to informants whose heritage language is dominant, as is the case for some of the Russian-German informants. This claim seems to be supported by the fact that informants code-mix almost exclusively from German and that the majority of direct lexical transfer patterns that we can observe come from German. Another possible explanation for these observations is that transfer occurs from German because it is the L2, thus supporting the L2 status factor model initially put forth by Hammarberg (2001) and recently developed further by Bardel and Falk (2007) and Falk and Bardel (2011)[5]. According to the L2 status factor model, the L2 blocks out influence from L1, thus acting like a veil. Subsequently, we can make a strong case for a scenario in which high literacy scores in German are more likely to coincide with high literacy scores in English, not only due to the nature of the investigated task, but also due to the typologies of the languages involved.

It is important to note that we do not find any negative effects of high literacy scores in bilingual informants' heritage languages regarding their production of English academic texts. To the contrary, informants with high literacy assessment scores in both German *and* their heritage language are more likely to show higher literacy scores in English, though high assessment scores in German seems to be a precondition in this particular case. Moreover, informants with low literacy levels in their heritage languages have lower literacy scores in English. Informants' literacy levels in their heritage languages, therefore, contribute directly to their attainment of English literacy.

As already alluded to, it is difficult to compare informants' literacy skills in their heritage language to their literacy skills in German. Still, we would like to emphasize that due to the nature of bilingualism, comparing bilingual children's results in German or their heritage languages to monolingual children's results in German is also quite problematic. This follows from the fact that bilinguals cannot be viewed as a combination of two monolinguals, as established by Grosjean (1989).

Pursuing this line of thought further, we would also like to note that the comparison of bilingual and monolingual learners in the acquisition of English as an additional language poses similar difficulties. That is to say, advantages for bilinguals are more likely in domains where the same attainment levels have been reached for both their native languages. As children and adolescents who grow up in a monolingual environment are likely to have a more diverse knowledge of different registers than their bilingual peers, this may account for the high literacy scores that some of our monolingual informants achieve in English and disadvantage multilingual children in language assessment tasks for additional languages.

Another important factor to keep in mind with regard to our data is that there were 16 monolingual and 36 bilingual informants in total, and that the bilingual group was heterogeneous in terms of language background. Out of the bilingual informants, 11 were Vietnamese-German bilinguals and only 5 were Turkish-German bilinguals, while the others belonged to the Russian-German group. It is therefore difficult to draw conclusions concerning specific migration or language backgrounds.

CONCLUDING REMARKS

The exploratory study presented here is primarily intended as a trend study for further research. While we do find tendencies supporting Cummins' Threshold Hypothesis, the highly heterogeneous nature of the investigated data has to be kept in mind. Moreover, literacy and socioeconomic conditions do not cumulatively impact on the attainment of English as an additional language, at least not necessarily. Bilingual individuals achieving high literacy in German and their heritage languages also show high literacy achievement in English. While socioeconomic and educational background intensify these effects, informants with favorable socioeconomic preconditions are more likely to achieve high literacy levels. This means that they are able to access linguistic, or more specifically literacy, resources at a lower threshold.

[5]We would like to point out that both Rothman as well as Bardel and Falk define a true L2 as a non-native language (Bardel and Falk, 2007, p. 460), and that our findings would be more adequately viewed as L2 rather than L3 acquisition in the given context. We would also like to emphasize that the distinction between L2 and L3 acquisition is extremely difficult to establish for our groups of informants.

At the same time, bilinguals of lower socioeconomic backgrounds can realize high literacy scores in English, if they achieve higher assessment scores in German *and* their heritage languages. In other words, they are able to access literacy resources at a higher threshold, but once they do, they perform at a high level. In our task, high literacy achievement in German coincided more often with high literacy achievement in English than high literacy achievement in informants' heritage languages. We argue that this is due to both the typologies of the languages involved and the task at hand, which tested for academic language and the production of instructive text types. More importantly, low literacy achievement in informants' heritage languages resulted in lower literacy achievement in English. A low level of literacy achievement in these languages can therefore be viewed as detrimental to literacy attainment in the acquisition processes of additional languages. Our results are therefore in line with findings by Swain et al. (1990) who suggest that L1 literacy is a key factor for positive effects in the attainment of additional languages in migrant contexts.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: http://journal.frontiersin.org/Journal/10.3389/fpsyg.2014.00546/abstract

REFERENCES

Bardel, C., and Falk, Y. (2007). The role of the second language in third language acquisition: the case of Germanic syntax. Second *Lang. Res.* 23, 459–484. doi: 10.1177/0267658307080557

Bialystok, E. (2009). "Effects of bilingualism on cognitive and linguistic performance," in *Streitfall Zweisprachigkeit - The Bilingualism Controversy*, eds I. Gogolin and U. Neumann (Wiesbaden: VS-Verlag), 53–67. doi: 10.1007/978-3-531-91596-8_4

Bialystok, E., Craik, F., Green D., and Gollan, T. (2009). Bilingual minds. *Psychol. Sci. Public Interest* 10, 89–129. doi: 10.1177/1529100610387084

Burghardt, M., and Esser, H. (2008). Pro & contra: muttersprachlicher unterricht für immigranten? *Klett-Themendienst Heft* 42, 23.

Cenoz, J. (2003). The additive effect of bilingualism on third language acquisition: a review. *Int. J. Bilingual.* 7, 71–87. doi: 10.1177/13670069030070010501

Cummins, J. (1979). Linguistic interdependence and the educational development of bilingual children. *Rev. Educ. Res.* 49, 222–251. doi: 10.3102/00346543049002222

Cummins, J. (1989). "Bilingualism, language proficiency and metalinguistic development," in *Childhood Bilingualism and metalinguistic skills: Aspects of Linguistic, Cognitive and Social Development*, eds P. Homel, M. Palij, and D. Aaronson (Hillsdale: Lawrence Erlbaum), 57–75.

Cummins, J. (1992). Bilingualism and second language. *Annu. Rev. Appl. Linguist.* 13, 51–70. doi: 10.1017/S0267190500002397

Cummins, J. (2000). *Language, Power, and Pedagogy: Bilingual Children in the Crossfire*. Clevedon: Multilingual Matters.

De Angelis, G. (2007). *Third or Additional Language Acquisition*. Clevedon: Multilingual Matters.

DESI-Konsortium (eds.). (2006). *Unterricht und Kompetenzerwerb in Deutsch und Englisch. Zentrale Befunde der Studie Deutsch-Englisch Schülerleistungen International (DESI)*. Frankfurt am Main: Deutsches Institut für Internationale Pädagogische Forschung.

Dronkers, J., van der Velden R., and Dunne, A. (2011). *The Effects of Educational Systems, School Composition, Track-level, Parental Background and Immigrants' Origins on the Achievement of 15-years Old Native and Immigrant Students. A Reanalysis of PISA 2006 [=ROA Research Memorandum 6]*. Maastricht University: Research Centre for Education and the Labour Market (ROA). Available online at: http://EconPapers.repec.org/RePEc:unm:umaror:2011006 (Accessed April 8, 2014).

Ehmke, T., and Thilo, S. (2005). ISEI, ISCED, HOMEPOS, ESCS. *Z. Erziehungswissenschaft* 8, 521–539. doi: 10.1007/s11618-005-0157-7

Esser, H. (2009). "Der Streit um die Zweisprachigkeit: was bringt die Bilingulität?" in *Streitfall Zweisprachigkeit. The Bilingualism Controversy,* eds I. Gogolin and U. Neumann (Wiesbaden: VS-Verlag), 53–67. doi: 10.1007/978-3-531-91596-8_5

Falk, Y., and Bardel, C. (2011). Object pronouns in German L3 syntax. Evidence for the L2 status factor. *Second Lang. Res.* 27, 59–82. doi: 10.1177/0267658310386647

Gogolin, I., and Neumann, U., (eds.). (2009). *Streitfall Zweisprachigkeit. The Bilingualism Controversy.* Wiesbaden: VS-Verlag. doi: 10.1007/978-3-531-91596-8

Göksel, A., and Kerslake, C. (2011). *Turkish: An Essential Grammar*. New York, NY: Routledge.

Grosjean, F. (1989). Neurolinguists, beware! The bilingual is not two monolinguals in one person. *Brain Lang.* 36, 3–15. doi: 10.1016/0093-934X(89)90048-5

Hammarberg, B. (2001). "Roles of L1 and L2 in L3 production and acquisition," in *Cross-linguistic Influence in Third Language Acquisition: Psycholinguistic Perspectives*, eds J. Cenoz, B. Hufeisen, and U. Jessner (Clevedon: Multilingual Matters), 21–41.

Jessner, U. (2006). *Linguistic Awareness in Multilinguals: English as a Third Language.* Edinburgh: Edinburgh University Press. doi: 10.3366/edinburgh/9780748619139.001.0001

LiMA, Linguistic Diversity Management in Urban Areas-LiPS, LiMA Panel Study. (2009–2013). *Projektkoordination LiPS: Prof. Dr. Dr. H. C. Ingrid Gogolin; ©LiMA-LiPS 2013*. Hamburg: LiMA.

Little, D. (2006). The common european framework of reference for languages: content, purpose, origin, reception and impact. *Lang. Teach.* 39, 167–190. doi: 10.1017/S0261444806003557

MacSwan, J. (2000). The threshold hypothesis, semilingualism, and other contributions to a deficit view of linguistic minorities. *Hisp. J. Behav. Sci.* 22, 3–45. doi: 10.1177/0739986300221001

MacSwan, J., and Rolstad, K. (2006). How language tests mislead us about children's abilities: implications for special education placements. *Teach. Coll. Rec.* 108, 2304–2328. doi: 10.1111/j.1467-9620.2006.00783.x

Ngô, B. N. (2001). The vietnamese language learning framework. Part One: Linguistics. *J. Southeast Lang. Teach.* 10, 1–23. Available online at: http://www.seasite.niu.edu/jsealt/past%20issues/volume%2010/VN%20LLF%20Part%20I.pdf (Accessed April 8, 2014).

Odlin, T. (1989). *Language Transfer. Crosslinguistic Influence in Language Learning.* Cambridge: Cambridge University Press. doi: 10.1017/CBO9781139524537

Reich, H., Roth, H.-J., and Döll, M. (2009). "Fast catch bumerang. deutsche sprachversion," in *Auswertungsbögen und Auswertungshinweise. FÖRMIG Edition Band 5*, eds D. Lengyel, H. H. Reich, H. J. Roth, and M. Döll (Münster: Waxmann), 209–241.

Rothman, J. (2011). L3 syntactic transfer selectivity and typological determinacy. The typological primacy model. *Second Lang. Res.* 27, 107–127. doi: 10.1177/0267658310386439

Swain, M., Lapkin, S., Rowen, N., and Hart, D. (1990). The role of mother tongue literacy in third language learning. *Lang. Cult. Curric.* 3, 65–81. doi: 10.1080/07908319009525073

Wade, T. (2011). *A comprehensive Russian Grammar*. Oxford: Blackwell.

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 01 February 2014; accepted: 16 May 2014; published online: 05 June 2014.
*Citation: Lechner S and Siemund P (2014) Double threshold in bi- and multilingual contexts: preconditions for higher academic attainment in English as an additional language. Front. Psychol. **5**:546. doi: 10.3389/fpsyg.2014.00546*
This article was submitted to Language Sciences, a section of the journal Frontiers in Psychology.

frontiers in PSYCHOLOGY

OPINION ARTICLE
published: 31 October 2014
doi: 10.3389/fpsyg.2014.01197

The facilitation effect and language thresholds

Kellie Rolstad and Jeff MacSwan*

Teaching and Learning, Policy and Leadership, University of Maryland, College Park, MD, USA
**Correspondence: macswan@umd.edu*

Edited by:
Mary Grantham O'Brien, University of Calgary, Canada

Reviewed by:
Simone Lechner, University of Hamburg, Germany

Keywords: bilingualism, biliteracy, Threshold Hypothesis, facilitation theory, language minority education

Lechner and Siemund (2014) set out to determine whether bilinguals have an advantage for learning additional languages over monolinguals, purporting to evaluate the Threshold Hypothesis of Cummins (1979a) in this context. The study investigated the attainment of English literacy by Turkish-German, Vietnamese-German, and Russian-German simultaneous and sequential bilinguals for whom English is a third language, and found significant correlations (at 0.01 level) for the second language (German) with the third language (English) at 0.580, and for the heritage language with the second language at 0.638; while the heritage language correlated with the third language at 0.277, the result was non-significant ($N = 34$). This crosslinguistic transfer effect is well-documented in the scholarly literature for first language (L1) and second language (L2) learners (Genesee et al., 2006; Goldenberg, 2011), but very little prior work has been done to examine crosslinguistic transfer of literacy among trilinguals. The Threshold Hypothesis specifically points to ability levels in the first language as the mechanism which facilitates attainment in the second language (extended to a third language for Lechner and Siemund). The primary conceptual problem with "ability" in the first language is that it lacks any grounded theoretical description of "levels," and simply equates social status with linguistic ability much as classical prescriptivist ideology does (MacSwan and Rolstad, 2003, 2010; Wiley and Rolstad, 2014).

Cummins (1976) developed the Threshold Hypothesis to account for an apparent conflict in findings regarding the cognitive benefits of bilingualism. Earlier studies concluded that cognitive progress and school achievement were negatively affected by bilingualism, while more recent research appeared to show "positive cognitive consequences." Cummins noted that the studies that found a negative effect involved linguistic minorities, and those finding a positive effect involved a condition of "additive bilingualism" in which linguistic *majority* children are learning an additional language. Cummins theorized that the linguistic minorities were undergoing loss of their first language, and that "the level of linguistic competence attained by a bilingual child may mediate the effects of his bilingual learning experiences on cognitive growth." That is, reports of negative effects of bilingualism for "cognitive and scholastic progress" related to minority children's (hypothesized) lower level of linguistic proficiency in the first language, as affected by acquiring a second, while children in the "additive" bilingual programs had the benefit of continued support of their first language. As Cummins (1976) put it,

> Subtractive bilingualism, where L1 [first language] is being replaced by L2 [second language], implies that as a bilingual in a language minority group develops skills in L2, his competence in L1 will decrease. It seems likely that, under these circumstances, many bilingual children in subtractive bilingual learning situations may not develop native-like competence in either of their two languages (p. 20).

In later work, Cummins (1979a) extended his analysis to another similar problem. Swain (1978) had made the case that immersion programs, in which linguistic majorities are (partially or totally) immersed in an L2, differ in important respects from submersion programs, in which language minority children are immersed in a majority language (Cohen and Swain, 1976; Swain, 1978). Today, considerable research on program effectiveness has borne out this expectation, as it shows that children in bilingual programs generally outperform similar children in English immersion programs in the US, and that children with more access to home language support do even better than children with less access (see Rolstad et al., 2005, and works cited there).

To address these observed differences, Cummins (1979b, p. 223) proposed "a theoretical framework which assigns a central role to the *interaction* between sociocultural, linguistic and school program factors," in which "the level of competence bilingual children achieve in their two languages acts as an intervening variable in mediating the effects of their bilingual learning experiences" (Cummins, 1976, p. 229). Background characteristics, child input factors, and educational treatment variables acted together to influence "child process variables," in Cummins' theory, resulting in minority children's differential ability in L1 and L2. A potentially resulting condition of semilingualism is thus posited to explain academic achievement differences among children. Embedded in the Threshold Hypothesis,

> negative cognitive and academic effects are hypothesized to result from low levels of competence in both languages or what Scandinavian researchers (e.g., Hansegård, 1968; Skutnabb-Kangas and Toukomaa, 1976) have termed

> "semilingualism" or "double semilingualism" … Essentially, the lower threshold level of bilingual competence proposes that bilingual children's competence in a language may be sufficiently weak as to impair the quality of their interaction with the educational environment through that language (1979a, p. 230).

In Cummins' theory, semilingualism is a potential characteristic of minority language children, but not of majority language children, and is the cause of their weaker academic performance. For children in an additive situation, semilingualism does not degrade the quality of interactions in the classroom, generally leading to school success.

Lechner and Siemund take care to note, based on critical discussion in MacSwan (2000a) and MacSwan and Rolstad (2006, 2010), that literacy and language are different constructs, and seek to remove the blemish of semilingualism from the Threshold Hypothesis. In doing so, the authors observe, "We do not regard the Threshold Hypothesis as a competence-related construct, but rather as a performance-based concept relating to educational attainment." Elaborating,

> We believe that it is necessary to distinguish between linguistic competence and performance (langue versus parole) in the interpretation of the Threshold Hypothesis. Cummins seems to use the term "language proficiency" to refer to both competence and performance, including school literacy. MacSwan (2000a, pp. 33–34) argues that if the Threshold Hypothesis refers to language competence, it is spurious because there is no evidence to suggest that subtractive bilinguals did not know the underlying principles of their language.

However, the competence/performance distinction does not help in a general way to overcome the conceptual weaknesses of the Threshold Hypothesis. Competence refers to linguistic knowledge, and performance to the use of that knowledge in concrete, everyday situations (Chomsky, 1965). We utter things all the time which we immediately recognize to be ill-formed, reflecting on our linguistic competence, due to fatigue, distraction, memory loss, or other language-external factors. Because our underlying system of competence relies on recursive generative rules, it can theoretically produce sentences that are infinitely long; but as finite beings, we can't stick around long enough to say them. Claiming that "ability" levels differ according to linguistic performance rather than linguistic competence seems to achieve little or nothing, and still demands supporting evidence, just as it did when these differences were conceptualized in terms of linguistic competence. And as before, in Cummins' original proposals, relevant evidence is lacking, and other work indicates that the hypothesized "levels" are not to be found (MacSwan et al., 2002; MacSwan and Rolstad, 2006).

Granted, "linguistic performance" is used as a large, undifferentiated container of many very different kinds of psychological phenomena which competence-focused linguists generally wish to set aside, and context-sensitive language use, such as pragmatics and discourse, might reasonably be regarded as governed by the theory of linguistic performance, in part. Indeed, Cummins provides a four-component definition of "language proficiency," following Canale and Swain (1980) and Canale (1983): Grammatical competence, sociolinguistic competence, discourse competence, and strategic competence. Cummins' (1981) definition of "sociolinguistic competence" is similar to what Chomsky (1978, p. 224) called "pragmatic competence," defined as "knowledge of conditions and manners of appropriate use, in conformity with various purposes." For Cummins (1981), discourse competence consists of "knowledge of how to combine meanings and forms to achieve a unified text in different modes" (p. 7), and strategic competence is the "mastery of verbal and non-verbal strategies" which assist under conditions of breakdowns in other competence domains. In this broader context, Cummins (1981) settled on a framework in which "literacy is viewed as one aspect of communicative proficiency" (p. 14).

If we think of school-based literacy and the particular language used at school as a different language register, or a Discourse in Gee's (1996) sense, then we are well-positioned to characterize school language as domain- and place-focused—the language of school differs from the language of skateboarding just as the language of boatbuilding differs from the language of farming. But notice that this is not the concept of language proficiency embedded in the Threshold Hypothesis, where groups are said to differ by ability levels, not contexts, and so the appeal to linguistic performance, or even context of language use, does not help to avoid the prescriptivist character inherent in the model.

Rather than try to salvage the Threshold Hypothesis, we suggest that an alternative theoretical framework be pursued, and that the original Threshold Hypothesis be discarded. In our own work, we have advocated the facilitation theory (MacSwan and Rolstad, 2005)—the view that cognitive architecture permits and facilitates transfer of literacy cross-linguistically precisely because it is essentially language-external. This view is also consistent with the approach in Riches and Genesee (2006), who posit "a common underlying reservoir of literacy abilities" available to L2 learners who are good L1 readers.

As argued in MacSwan and Rolstad (2005), the neuropsychological evidence suggests that language is separate and discrete from other mental faculties, taking psychological modularity as our framework (as is typical in the cognitive neurosciences). In the case of bilingualism, both languages are represented in the human language faculty (Epstein et al., 1996; MacSwan, 2000b, 2014). But unlike language and other perceptual systems, western-style literacy is a recent invention, and is absent from many human cultures (MacSwan, 2000a; Gee, 2001; MacSwan and Rolstad, 2010).

In fact, literacy seems to rely on a wide range of cognitive faculties; besides knowledge of language, these include background knowledge, systems of reasoning, motor control, visual processing, shape recognition, and context. Reading and writing are independent of special-purpose mental faculties like language, and should be conceptualized as a technological invention. Thus, literacy recruits knowledge as needed from relevant cognitive systems. Evidence from cases of selective impairment in which a blow to the posterior regions of the brain renders a person suddenly unable to read but with

all normal language faculties intact adds additional support to this view (Gardner, 1974). School literacy may therefore be seen as one of several ways language is used to satisfy human purposes; it uses linguistic and other cognitive resources to represent language, but it is not itself an aspect of language ability in the linguistic sense.

We suggest, then, that "transfer" of literacy across languages occurs because in the bilingual brain, both languages have access to the same cognitive resources. As Genesee et al. (2006) observe in a comprehensive review, transfer of first language literacy to the second language context is found in studies of word reading (across age, linguistic typology, and L2 proficiency), reading comprehension (across age, typology, language status, direction of transfer, and tasks), and reading strategies. They found phonological processes underlying word recognition to be influenced by orthography, but a facilitation effect was still present. (We note that two of the three heritage language groups assessed in Lechner and Siemund's study—Vietnamese and Russian—use non-Latinate orthographies, contrasting with English and German, and the sample size of the Turkish-background group was relatively very small, at $N = 5$; these factors may underlie the positive but non-significant result for the correlation of heritage language literacy with English literacy in Lechner and Siemund's results.)

It is apparent, then, that one does not see a relationship between "first language ability," however that is to be conceived, and second language literacy, but between literacy in the first language and literacy in the second language; in other words, literacy is relatively independent of the particular language for which it was initially acquired. In this regard, the usual meaning of transfer, which implies that a process "moves" knowledge from one language to another, should be seen as strictly a metaphor: Rather than move, both languages have access to the same store of knowledge, available to learners regardless of how the knowledge was acquired in the first place, as Riches and Genesee (2006) also suggested. Access to knowledge acquired in a first language has a facilitation effect on learning in the second language context.

REFERENCES

Canale, M. (1983). "From communicative competence to communicative language pedagogy," in *Language and Communication*, eds J. Richard and R. Schmidt (New York, NY: Longman), 2–27.

Canale, M., and Swain, M. (1980). Theoretical bases of communicative approaches to second language teaching and testing. *Appl. Linguist.* 1, 1–47. doi: 10.1093/applin/1.1.1

Chomsky, N. (1965). *Aspects of the Theory of Syntax*. Cambridge, MA: MIT Press.

Chomsky, N. (1978). "Language and unconscious knowledge," in *Psychoanalysis and Language, Psychiatry and the Humanities*, Vol. 3, ed J. H. Smith (New Haven, CT: Yale University Press), 3–44.

Cohen, A., and Swain, M. (1976). "Bilingual education: the "immersion" model in North American context," in *English as a Second Language in Bilingual Education: Selected TESOL Papers*, eds J. Alatis and K. Twaddell (Washington, DC: Teachers of English to Speakers of Other Languages), 55–64.

Cummins, J. (1976). The influence of bilingualism on cognitive growth: a synthesis of research findings and explanatory hypotheses. *Work. Pap. Biling.* 9, 1–43.

Cummins, J. (1979a). Linguistic interdependence and the educational development of bilingual children. *Rev. Educ. Res.* 49, 221–251. doi: 10.3102/00346543049002222

Cummins, J. (1979b). Cognitive/academic language proficiency, linguistic interdependence, the optimum age question and some other matters. *Work. Pap. Biling.* 19, 121–129.

Cummins, J. (1981). "The role of primary language development in promoting educational success for language minority students," in *Schooling and Language Minority Students: a Theoretical Framework, 1st Edn.*, ed California State Department of Education, Office of Bilingual Education (Sacramento, CA: California State Department of Education), 3–49.

Epstein, S., Flynn, S., and Martohardjono, G. (1996). Second language acquisition: theoretical and experimental issues in contemporary research. *Behav. Brain Sci.* 19, 677–758. doi: 10.1017/S0140525X00043521

Gardner, H. (1974). *The Shattered Mind: the Person after Brain Damage*. New York, NY: Vintage Books.

Gee, J. P. (1996). *Social Linguistics and Literacies: Ideology in Discourses, 2nd Edn.* London: Taylor & Francis.

Gee, J. P. (2001). "Progressivism, critique, and socially situated minds," in *The Fate of Progressive Language Policies and Practices*, eds C. Dudley-Marling and C. Edelsky (Urbana, IL: National Council of Teachers of English), 31–58.

Genesee, F., Geva, E., Dressler, C., and Kamil, M. (2006). "Synthesis: cross-linguistic relationships," in *Developing Literacy in Second-Language Learners*, eds D. August and D. Shanahan (Mahwah, NJ: Erlbaum; Washington, DC: Center for Applied Linguistics), 153–174.

Goldenberg, C. (2011). "Reading instruction for English language learners," in *Handbook of Reading Research*, Vol. IV, eds M. Kamil, P. D. Pearson, E. Moje, and P. Afflerbach (Newark, NJ: International Reading Association), 684–710.

Hansegård, N. E. (1968). *Tvåspråkighet Eller Halvspråkighet?* Stockholm: Aldus series 253.

Lechner, S., and Siemund, P. (2014). Double threshold in bi- and multilingual contexts: preconditions for higher academic attainment in English as an additional language. *Front. Psychol.* 5:546. doi: 10.3389/fpsyg.2014.00546

MacSwan, J. (2000a). The Threshold Hypothesis, semilingualism, and other contributions to a deficit view of linguistic minorities. *Hisp. J. Behav. Sci.* 22, 3–45. doi: 10.1177/0739986300221001

MacSwan, J. (2000b). The architecture of the bilingual language faculty: evidence from codeswitching. *Biling. Lang. Cogn.* 3, 37–54. doi: 10.1017/S1366728900000122

MacSwan, J. (2014). "Programs and proposals in codeswitching research: unconstraining theories of bilingual language mixing," in *Grammatical Theory and Bilingual Codeswitching*, ed J. MacSwan (Cambridge: MIT Press), 1–33.

MacSwan, J., and Rolstad, K. (2003). "Linguistic diversity, schooling, and social class: rethinking our conception of language proficiency in language minority education," in *Sociolinguistics: The Essential Readings*, eds C. B. Paulston and R. Tucker (Oxford: Blackwell), 329–340.

MacSwan, J., and Rolstad, K. (2005). Modularity and the facilitation effect: psychological mechanisms of transfer in bilingual students. *Hisp. J. Behav. Sci.* 27, 224–243. doi: 10.1177/0739986305275173

MacSwan, J., and Rolstad, K. (2006). How language tests mislead us about children's abilities: implications for special education placements. *Teach. Coll. Rec.* 108, 2304–2328. doi: 10.1111/j.1467-9620.2006.00783.x

MacSwan, J., and Rolstad, K. (2010). "The role of language in theories of academic failure for linguistic minorities," in *International Perspectives on Bilingual Education: Policy, Practice, and Controversy*, ed J. Petrovic (Charlotte, NC: Information Age Publishing), 173–195.

MacSwan, J., Rolstad, K., and Glass, G. V. (2002). Do some school-age children have no language? Some problems of construct validity in the Pre-LAS Español. *Biling. Res. J.* 26, 213–238. doi: 10.1080/15235882.2002.10668718

Riches, C., and Genesee, F. (2006). "Literacy: crosslinguistic and crossmodal issues," in *Educating English Language Learners,* eds F. Genesee, K. Lindholm-Leary, W. Saunders, and D. Christian (New York, NY: Cambridge University Press), 64–108. doi: 10.1017/CBO9780511499913.004

Rolstad, K., Mahoney, K., and Glass, G. (2005). The big picture: a meta-analysis of program effectiveness research on English Language Learners. *Educ. Policy* 19, 572–594. doi: 10.1177/0895904805278067

Skutnabb-Kangas, T., and Toukomaa, P. (1976). *Teaching Migrant Children's Mother Tongue and Learning the Language of the Host Country in the Context of the Socio-Cultural Situation of the Migrant Family*. Helsinki: The Finnish National Commission for UNESCO.

Swain, M. (1978). French immersion: early, late or partial? *Can. Mod. Lang. Rev.* 34, 557–585.

Wiley, T., and Rolstad, K. (2014). The common core state standards and the great divide. *Int. Multiling. Res. J.* 8, 38–55. doi: 10.1080/19313152.2014.852428

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 05 September 2014; accepted: 03 October 2014; published online: 31 October 2014.

Citation: Rolstad K and MacSwan J (2014) The facilitation effect and language thresholds. Front. Psychol. ***5****:1197. doi: 10.3389/fpsyg.2014.01197*

This article was submitted to Language Sciences, a section of the journal Frontiers in Psychology.

frontiers in PSYCHOLOGY

METHODS ARTICLE
published: 30 June 2014
doi: 10.3389/fpsyg.2014.00557

Psychocentricity and participant profiles: implications for lexical processing among multilinguals

Gary Libben[1,2]*, Kaitlin Curtiss[3] and Silke Weber[4]

[1] Department of Applied Linguistics and Department of Psychology, Brock University, University of Calgary, St. Catharines, ON, Canada
[2] Language Research Centre, University of Calgary, Calgary, AB, Canada
[3] Department of Applied Linguistics, Brock University, St. Catharines, ON, Canada
[4] Department of Linguistics, University of Calgary, Calgary, AB, Canada

Edited by:
Mary Grantham O'Brien, University of Calgary, Canada

Reviewed by:
Matti Laine, Abo Akademi University, Finland
Cyril Perret, University of Poitiers, France

***Correspondence:**
Gary Libben, Department of Applied Linguistics and Department of Psychology, Brock University, University of Calgary, 500 Glenridge Ave., St. Catharines, ON L2S 3A1, Canada
e-mail: gary.libben@gmail.com

Lexical processing among bilinguals is often affected by complex patterns of individual experience. In this paper we discuss the psychocentric perspective on language representation and processing, which highlights the centrality of individual experience in psycholinguistic experimentation. We discuss applications to the investigation of lexical processing among multilinguals and explore the advantages of using high-density experiments with multilinguals. High density experiments are designed to co-index measures of lexical perception and production, as well as participant profiles. We discuss the challenges associated with the characterization of participant profiles and present a new data visualization technique, that we term Facial Profiles. This technique is based on Chernoff faces developed over 40 years ago. The Facial Profile technique seeks to overcome some of the challenges associated with the use of Chernoff faces, while maintaining the core insight that recoding multivariate data as facial features can engage the human face recognition system and thus enhance our ability to detect and interpret patterns within multivariate datasets. We demonstrate that Facial Profiles can code participant characteristics in lexical processing studies by recoding variables such as reading ability, speaking ability, and listening ability into iconically-related relative sizes of eye, mouth, and ear, respectively. The balance of ability in bilinguals can be captured by creating composite facial profiles or Janus Facial Profiles. We demonstrate the use of Facial Profiles and Janus Facial Profiles in the characterization of participant effects in the study of lexical perception and production.

Keywords: psychocentricity, psycholinguistics, lexical processing, multilingualism, Chernoff faces, facial profiles, P3 experiments

In this paper, we present a psychocentric view of language representation and processing, one that claims that, fundamentally, language representations have their reality in patterns of cognitive processing (Derwing, 1973). We claim that the psychocentric perspective is particularly relevant to the study of language processing in multilinguals in general and in modeling of the mental lexicon of multilinguals in particular. Tapping psychocentric effects requires the ability to triangulate among language perception ability, production ability, and individual participant properties. We have found that high density experimental paradigms such as those employed by Libben et al. (2012a,b) can capture these effects within an integrated experimental framework and that the evaluation of participant profile effects can be augmented through data visualization techniques such as the ones we present in this paper.

THE PSYCHOCENTRICITY OF LANGUAGE

Language ability contains an in-built paradox. On the one hand, it is something that is shared among members of a speech community. On the other hand, it is something that we possess as part of our individual cognitive states and capacities. The depth and complexity of this paradox becomes apparent when we consider the meanings of the apparently simple terms such as *share* and *individual*.

Members of a speech community *share* a language. The meaning of the word *share* in this context is of course different from its meaning in sentences such as "They share a chocolate bar" or "They share a taxi." In both of these cases, there is a well-defined external entity (i.e., the chocolate bar or the taxi) that is referred to. A language is different. Except for its codifications in grammatical descriptions or dictionaries, a language is not a well-defined external entity, but rather a generalized construct that results from the abilities and behaviors of individual community members.

This brings us to the term *individual*. Language resides in the minds of individuals. However, we also know that the possible variation in individual characteristics of language representation and processing in the mind are constrained. Decades of research on language disturbance as a result of damage to the brain and fMRI studies with unimpaired populations have offered substantial support to the view that our language behavior is both linked to and constrained by common features of brain anatomy and physiology (see Pulvermüller, 2005).

These commonalities provide the context and constraints within which individual differences and the effects of individual language experience can play a role in shaping the synchronic character of an individual's language ability. However, both the constraints and the abilities reside in individuals and, thus, it is the individual that constitutes the fundamental object of psycholinguistic inquiry. This is essentially the psychocentric perspective (Libben, 2010; Libben and Weber, 2014).

The psychocentric perspective on language processing affects the ways in with we think about what it means for members of a speech community to *share* a language. Taking lexical knowledge as an example, the psychocentric perspective claims that it is not the case that *English*, as a language, has these or those words in its vocabulary. Rather, it is members of the community that have these or those words, individually, in their vocabularies. Because new words are acquired throughout the lifespan and because their specific characteristics, both structural and semantic, are influenced by patterns of individual experience, the psycholinguistic characteristics of words will differ from one person to the next.

PSYCHOCENTRICITY AND THE SHIFT TOWARD GREAT COMPLEXITY IN EXPERIMENTAL DESIGN AND ANALYSIS

The psychocentric perspective on language representation and processing, by definition, increases the complexity of the psycholinguistic enterprise by opening the doors to individualized notions of language unit and linguistic structure. However, this is very much in line with developments in the field as a whole. In a great many domains of psycholinguistic research we have seen a shift from small, highly controlled, factorial experiments to ones that embrace both participant and stimulus complexity (Libben et al., 2012a,b). A good deal of this shift is made possible by new statistical techniques such as mixed effects modeling (Baayen, 2008; Baayen et al., 2008), and by the much more widespread use of computationally implemented models to both advance claims about language representation and process and also to test the predictions that correspond to those claims. Because computationally implemented models receive their support or lack thereof as a result of their performance rather than through their representational transparency in traditional box-and-arrow flowchart models, they can much more easily incorporate complexity.

The developments outlined above make it possible to incorporate the complexity associated with a psychocentric perspective into the practice of psycholinguistic experimentation. The embracing of complexity marks a significant shift in the design of psycholinguistic studies. For example, in the domain of lexical processing, which is our focus in this paper, simplifying strategies have traditionally been a pervasive feature of experimental designs. Accordingly, the differences that might exist among experimental participants were seldom core features of experiment reports (Libben and Jarema, 2002).

PSYCHOCENTRICITY AND MULTILINGUALISM

The majority of the world's population speaks more than one language (Grosjean, 2012). And, considerable evidence has shown that bilinguals show patterns of performance that differ from those of monolinguals in their respective languages (e.g., Gollan et al., 2005; Ivanova and Costa, 2008; Gollan and Goldrick, 2012). These findings underline the point brought forward by Grosjean (1989) that we cannot simply assume that a bilingual, even a balanced bilingual, has two sets of monolingual linguistic abilities in one brain. What follows from this is that, in the case of bilingualism, the state of the language system will be even more individualized because it must accommodate, within a single cognitive architecture, potentially disparate linguistic systems. Moreover, the balance of those systems will vary greatly depending on the particular experience of the multilingual. More often than not, a monolingual's ability in his or her languages will not be balanced. This underlines how, indeed, we cannot consider bilinguals to have two sets of language ability in one brain.

Another factor that is relevant to the characterization of the language ability of the multilingual is that, whereas monolinguals typically show comparable language production and comprehension abilities, this is not always the case for multilinguals. This fact has particular relevance to the value of high density psycholinguistic paradigms, such as the P3 paradigm that we discuss below, in psycholinguistic research with multilinguals. Finally, there is an additional reason why the language ability of multilinguals must be seen psychocentrically. That is that, except for cases in which the languages of a multilingual are acquired early in life, the language system of the multilingual will be in greater flux than that of a monolingual. This is perhaps most evident in the domain of lexical processing which we consider below.

IMPLICATIONS FOR THE MENTAL LEXICON AND LEXICAL PROCESSING

We see the mental lexicon as a theoretical construct that refers to the store of words in the mind, the organization, and the abilities and processes involved in employing words in language comprehension and production. Thus, if a multilingual is in possession of a single mental lexicon, whatever differences might exist between the two or more languages of a multilingual will need to be accommodated within a single cognitive system for lexical comprehension and production (Libben, 2000; Libben and Goral, in press). For the most part, these interlingual lexical differences will be most evident for multimorphemic words. And, these, rather than their simpler monomorphemic counterparts constitute the norm (Libben, 2007). Although we often consider words as atomic representations that are stored in memory and retrieved for the purposes of language comprehension and production, most words of English and other languages are not composed of a single unit of meaning, but rather contain two or more constituent morphemes.

The facts that most people are multilingual and most words are multimorphemic have important consequences for our understanding of the dynamic nature of the mental lexicon and lexical ability. Throughout our lives we learn new words. And, as a consequence of learning these new words, we develop new associations among words and, from those associations, complex networks of word families. An educated native speaker of English will, throughout adulthood, encounter many words that he or she has never seen or heard before. Most of these words

will be multimorphemic and thus morphological knowledge can be used to guess at the meaning on the basis of analogy with existing morphological patterns. When new words are acquired, morphological patterns are expanded and in some cases new morphological families are created. Thus, it is most appropriate to see the mental lexicon not as static store of individual representations (an image that is perhaps inherited from the metaphor of a language dictionary in the mind) but rather as a dynamic system of knowledge and knowledge processing that can be influenced by experience both in quantitative and qualitative ways. Quantitative changes may involve the expansion of vocabulary in childhood and adulthood as well as a possible contraction of vocabulary size as a result of disuse and aging (Goral et al., 2007).

Typically, a very dramatic jump in the size of an individual's vocabulary will occur when a second language is acquired. Indeed, perhaps the most dramatic difference between the mental lexicon of a monolingual and the mental lexicon of a bilingual is that, in the latter case, the individual simply knows many more words. According to Aitchison (1987), a typical speaker of English will know about 75,000 words. There is no evidence that learning an additional language (outside of cases of language attrition) is accompanied by a diminution of that number. Therefore, one might expect that a high functioning balanced bilingual would, *ceteris paribus*, have a vocabulary size of considerably more than 75,000 words. A high-functioning polyglot may have many more.

The qualitative effects upon the mental lexicon of the acquisition of a new language are substantial. Firstly, if we consider translation-equivalent lexical items to be special cases of synonymy, a speaker of multiple languages will possess an enriched network of synonymy. And, there may be multiple structural consequences. One language may have grammatical gender, the other might not. One language may have interfixes, the other might not. The languages of the multilingual may differ in their morphological headedness. And, they may differ in their patterns of prefixation and suffixation.

If we assume that the potential interlingual differences described above must be accommodated within a single cognitive system, it follows that the functional organization of the mental lexicon of multilinguals will have substantially greater complexity of structure and function than that of a monolingual. And, it is this complexity that gives rise to the need to track and analyze individual effects in the psycholinguistic study of lexical processing in multilinguals.

By definition, the language experience of multilinguals will be more heterogeneous than that of monolinguals. Thus, they will differ from each other more. On the one hand, this creates challenges to generalizability of results to broader populations, as it can be claimed that a multilingual is, by nature, *sui generis.* On the other hand, if our goal is to understand the ways in which the state of the mental lexicon and lexical ability are driven by experience, it is exactly the heterogeneity of experience that we should be seeking out and seeking to analyze and understand. Programs of psycholinguistic experimentation that embrace the kinds of complexity that this involves will need to employ methodologies and analyses that are both robust in the face of participant heterogeneity and at that same time sensitive enough to make use of the subtleties that they reveal.

These issues have been associated with longstanding debates in psychology. The distinction between a focus on the individual (the idiographic approach) and a focus on the group (the nomothetic approach) has been at the core of debate in both the experimental and clinical psychological literature since the introduction of the dichotomy in the late nineteenth century (see Robinson, 2011 for a review). Although the idiographic-nomothetic distinction has often been framed as an issue of appropriate sample size, the psychocentric approach that we describe does not lead to a favoring of small samples. Rather, the psychocentric approach intersects the idiographic-nomothetic dichotomy with respect to the matter of the locus of language as a theoretical construct. The psychocentric perspective claims that it is not external stimuli that have linguistic properties *per se*. It claims that linguistic properties reside as part of complex, dynamic systems within an individual. Thus, a conceptualization of language stimuli as "out there in the world" may be an example of what Alfred North Whitehead first coined as "the fallacy of misplaced concreteness" (Flynn, 1997).

THE USE OF HIGH DENSITY EXPERIMENTS TO BRING TOGETHER PARTICIPANT, PERCEPTION, AND PRODUCTION DATA

In the discussion above, we framed the challenge of psycholinguistics in terms of the psychocentric perspective. Within this perspective, the goal of psycholinguistic experimentation is to tap into the many facets of the dynamic system of language ability. Libben et al. (2012a) outlined the functional architecture of an experimental paradigm designed to achieve this goal in a manner that brings together measures of both language perception and production. The term they use, *P3*, for this paradigm refers to the key components: *participant, perception, and production*. As such, it falls within the category of what we term high density experiments, those that yield a rich set of dependent variables.

In its most general format, the P3 task can be considered to be a type of dictation task. Dictation is a highly integrative activity that has deep roots in both the practice of second language teaching and second language learning. It has long been considered to be a reliable indicator of overall language ability because it brings together almost all elements of language cognition. The dictation task is sensitive to the manner in which both comprehension and production can be integrated. The reason for this is that if the dictation stimulus is not perceived easily, it will be difficult to write because the writer is unsure of the nature of the stimulus and also because unfinished and ongoing perceptual processes must be carried out simultaneously with production processes. And, the greater the extent to which the writer has automatized production processes, the faster they will be able to be carried out, creating a lower level of demand upon cognitive resources. The dictation task was at the center of discussion in the language testing literature of the 1960s and 1970s (e.g., Carroll, 1961; Oller, 1971) and has been used successfully in psycholinguistic experiments, particularly those which have focused on sub-elements of the writing process (e.g., Frisson and Sandra, 2002).

The basic structure of a P3 experiment, as shown in **Figure 1**, involves three core components (1) the viewing of the stimulus

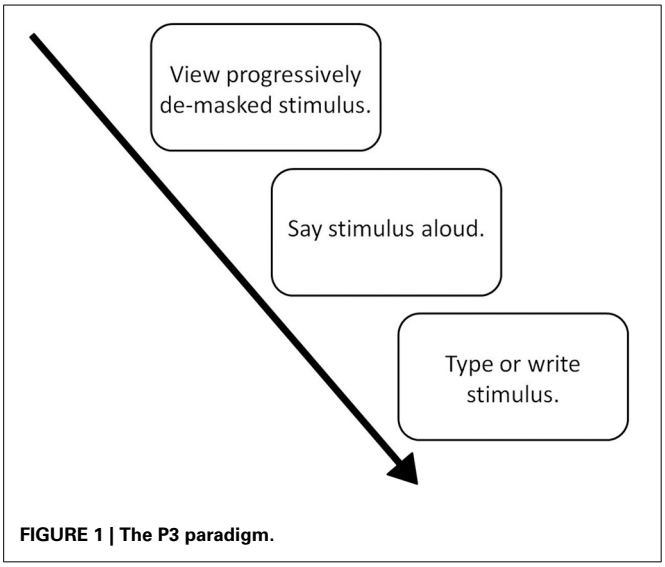


FIGURE 1 | The P3 paradigm.

(2) the oral production of the stimulus, (3) the writing of the stimulus. We discuss each of these, in turn, below.

VIEWING THE STIMULUS IN A P3 EXPERIMENT

The stimulus viewing component of the P3 paradigm was designed to probe lexical processing by building upon established techniques. We developed a variant of the progressive de-masking technique developed by Grainger and Segui (1990). This technique requires that participants recognize a linguistic stimulus as soon as possible. Stimulus presentation in the progressive de-masking technique differs from the more common format of word recognition paradigms in which a visual stimulus appears suddenly, and often for a very brief duration. In the progressive de-masking technique, on the other hand, a stimulus is presented over an extended period of time, emerging, as it were, from a fog. It is imperceptible at first, and then becomes slowly visible over a period of up to 3 s.

In the implementation that we have created for this task using PsyScope X for the Mac, the "out of the fog" effect is created by alternating stimulus presentation with a pattern mask of cross-hatches (#####) for 18 cycles of 300 ms (ms). In the first cycle, the stimulus is presented for only 16 ms and the pattern mask, immediately following is presented for 284 ms to create the total cycle duration of 300 ms. This proportion of stimulus duration to mask duration shifts by 16 ms in favor of stimulus duration in each successive cycle. From the perspective of the participant, cycles are continuous. So the participant simply perceives the stimulus becoming stronger and the pattern mask becoming weaker. This continues until the participant responds or until the 18 cycles have been completed. In the final cycle, it is the stimulus that is presented for 284 ms and the pattern mask that is presented for only 16 ms.

The entire presentation sequence takes almost 3 s. In practice, however, participants' response times to multimorphemic words are in the range of 1000–2500 ms. This fact is important because it demonstrates how the progressive de-masking technique is at once an online recognition task, but at the same time not one that requires extremely fast reaction-time-like responses. Thus, it has in-built applicability for use with second language learners as well as participants of different ages.

Libben et al. (2012a) also report the ways in which the progressive de-masking technique can incorporate masked priming as part of the stimulus presentation. The masked priming technique (Forster and Davis, 1984) has as its key motivation, the need in psycholinguistic experiments to block the participant's ability to make strategic guesses about the nature of a stimulus target on the basis of their conscious analysis of the prime. It is claimed that because masked priming durations are very brief (often less than 40 ms) there is insufficient time for such strategies to be developed. The progressive de-masking paradigm allows prime stimuli to be used in the early cycles of stimulus presentation. Our testing of the paradigm has revealed partial repetition prime differences when partial repetition primes have been incorporated into the initial two cycles (16 and 32 ms) of a progressively de-masked presentation.

The key strength of progressive demasking as a visual word recognition paradigm in comparison to lexical decision is that it does not require the presence of non-words in the experiment and does not require a metalinguistic judgment. Nevertheless, it is not without its drawbacks. Ferrand et al. (2011) compared the progressive demasking technique (using a button press response) to lexical decision and naming in a megastudy. The results of this research showed progressive demasking to be particularly sensitive to the visual characteristics of stimuli (e.g., length and the initial letter of the target string). In addition, however, the authors also reported that progressive demasking showed slightly greater sensitivity to semantic factors in comparison to lexical decision. It could indeed be the case that these observations are related to the effectiveness that Libben and Weber (2014) report for progressive demasking (across a number of versions) in the study of semantic transparency in English compounds. Here, sensitivity to semantic factors is exactly what is desired of the paradigm. Because compound words served as stimuli in this study, it may also be the case the sensitivity to length effects and initial segment effects were minimized. Compounds vary percentage-wise in length much less than monomorphemic words do, and, as Ferrand et al. note, initial segment effects are greatest for short words (Balota et al., 2004). Compound words are, by virtue of their structure, typically among the longer words of a language.

In our view, the progressive demasking task, despite the drawbacks noted by Ferrand et al. (2011) has particular applicability in a bilingual setting (see Lemhöfer et al., 2008) because it is not prone to influence by the composition of the non-words set of stimuli required in a lexical decision task. Moreover, as we have noted above, the distinction between words and non-words among bilinguals working in their non-native language, and in particular, second language learners, cannot be assumed to be identical to the word-nonword distinction for native speakers of a language.

ORAL STIMULUS PRODUCTION IN A P3 EXPERIMENT

In the original progressive de-masking technique presented by Grainger and Segui (1990), participants indicated their

recognition of a progressively de-masked word by pressing the response time key. Libben et al. (2012a) modified the technique so that participants indicate their recognition by saying the word aloud as quickly as possible. This provides the opportunity to assess response time through a voice key and also enables the recording and analysis of phonetic properties of the response. This modification of the classical progressive de-masking technique is necessary to enable the entire P3 paradigm to function as a type of dictation task. As we discuss below, the P3 paradigm has two fundamental variants. The first is a one-participant variant in which the same person sees the stimulus, says it, and then writes it. The second is a two-participant variant in which the first participant sees the word and says it aloud and the second participant writes it. By modifying the response type to an oral response, therefore, we create a situation in which the one-participant variant and the two- participant versions of the paradigm are exactly comparable terms of event structure. In addition, we gain the opportunity for speech analysis within the paradigm.

WRITING OF THE STIMULUS IN A P3 EXPERIMENT

The third component of the P3 paradigm focuses on the written production component of the overall dictation task. Here too Libben et al. (2012a) built upon existing techniques. A number of studies within the last decade have demonstrated the manner in which the analysis of writing and typing can be used to address key questions in psycholinguistics in general and in the study of lexical processing in particular. Kandel et al. (2006) and Alvarez et al. (2009) have shown that by analyzing handwritten responses it is possible to gain insight into the effects of syllable structure and syllable boundaries (see also Kandel et al., 2011). Kandel et al. (2008) also demonstrated handwriting effects in the morphological domain by contrasting truly suffixed and pseudo-suffix words of French. This research, together with the typed response research by Will et al. (2006) as well as by Sahel et al. (2008) demonstrates the manner in which online written production is influenced by the morphological structure of words as well as other variables relevant to the organization within the mental lexicon such as constituent and word frequency.

The fact that such factors emerge in the analysis of writing serves to remind us that features of words such as morphological structure have their fundamental reality in the minds of language users and are revealed through their activity. In a writing task, participants are not surprised by stimuli. Rather, they are revealing, through their writing, the nature of their internal representations. If a participant pauses at syllable and morpheme boundaries as has been found in the above studies, this demonstrates that such structures serve to organize the chunking of their motor activity in production.

Our implementation of the writing component within the P3 paradigm has both handwritten and typewritten variants. The typewritten version produces data that are more easily analyzed. However, those data are less rich than those available to the net through the analysis of handwriting, in which we currently have the ability to measure both within-letter and between-letter durations, as well as (depending on the hardware employed) measures such as pen jitter and pen pressure.

CAPTURING PARTICIPANT PROFILES THROUGH ONLINE QUESTIONNAIRES AND STIMULUS EVALUATION

The P3 technique, particularly in the single-participant version, produces a participant profile by enabling the analysis of word recognition latencies, oral production characteristics, and written production characteristics. In our implementation we have augmented these sources of evidence with two additional components.

The first is the use of a participant questionnaire that documents the participant's background on a number of variables as well as his or her experience with other languages. Because the P3 paradigm incorporates, by design, a writing component, it was natural to employ this technology in the acquisition of questionnaire data. This yields not only data regarding the actual answers to questionnaire items but also writing duration data for the questionnaire as a whole.

The P3 design also incorporates a post online experiment component in which participants are asked to rate the stimuli that they have seen along a number of dimensions. For multimorphemic words, these include overall word frequency, perceived age of acquisition, and semantic transparency ratings for morphological constituents. Together these constitute individualized measures for stimulus predictor variables that are typically used in the analysis of the effects of stimulus characteristics upon language performance.

SINGLE PARTICIPANT AND DUAL PARTICIPANT VARIANTS OF THE P3 TECHNIQUE

In our view, the P3 paradigm opens up an opportunity to compare language processing in traditional psycholinguistic laboratory settings to a somewhat more ecologically valid context in which individuals are interacting. To be sure, a two-person dictation task is nothing like a conversation. However, we suggest that the ability to contrast one-participant and two-participant versions opens up a number of opportunities for the study of second language and multilingual processing. The paradigm makes it possible to break down the components of the overall experiment so that the possible effects of individual variants can be examined. It is perhaps appropriate to consider the single participant version to be the base version. This is the one in which a single participant sees a progressively de-masked stimulus, says it aloud, and then writes it. The effect of having seen the stimulus oneself and of having said the stimulus aloud oneself can be isolated by substituting, for those components, a version in which the oral stimulus is presented by a computerized text-to-speech program. In this case, participants are engaged in a single task: writing to computerized dictation.

By substituting computerized dictation for human dictation in the two-participant version, and by varying the first language background of the first speaker, it is possible to employ the P3 paradigm to measure second-language speech comprehensibility, as operationalized by written production accuracy, written production latency, and written production duration.

ILLUSTRATIVE EXAMPLE: THE USE OF THE P3 TECHNIQUE IN THE STUDY OF THE SEMANTIC TRANSPARENCY OF ENGLISH COMPOUND NOUNS

Libben and Weber (2014) employed this adaptation of the P3 technique in a study of sematic transparency in English compounds. They employed a core stimulus set of 40 noun-noun English compounds that differed in terms of the semantic transparency of their compound constituents. Thus, a compound such as *sailboat* was classified as transparent–transparent (TT) because the meanings of both the compound constituents *sail* and *boat* are preserved in the meaning of the whole word. At the other extreme, a compound such as *humbug* was classified as opaque-opaque because neither the meanings of *hum* or *bug* are preserved in the meaning of *humbug*. Between these two extremes were opaque–transparent compounds such as *nickname* and transparent–opaque compounds (TO), such as *jailbird* (TO). These compounds had been studied in a lexical decision task by Libben et al. (2003) and they thus offered the opportunity to compare the P3 technique for the same set of stimuli. The core stimulus set is presented in **Table 1**.

Ninety-three native speakers of English participated in four versions of a P3 experiment. The versions contrasted individual vs. dyadic formats and whether or not a naming response or a button press response was made.

Before the main experiment, participants filled out a questionnaire on their language background and some demographic information. We have used the data derived from this questionnaire as input to the creation of the visual participant profiles that we present in section The Use of Facial Profiles in Monolingual and Multilingual Processing of the present report. Such questionnaire data are of course particularly valuable in cases in which the P3 experiment is conducted in participants' non-native language. Indeed, one of the advantages of the technique for the study of multilingual performance is that it has its roots in the second language testing.

All versions of the P3 paradigm showed the same data pattern for the four types of compounds. Thus, the results from the individual version, the interactive version, and the visual version for the analysis of progressive demasking latencies were merged.

Table 1 | The core compound stimulus set employed by Libben and Weber (2014).

TT	OT	TO	OO
Bedroom	Chopstick	Cardshark	Deadline
Coalmine	Crowbar	Doughnut	Dingbat
Daylight	Dashboard	Heatwave	Fleabag
Doorbell	Godchild	Jailbird	Hallmark
Farmyard	Jackknife	Oddball	Hogwash
Fencepost	Nickname	Shoehorn	Humbug
Paintbrush	Pothole	Slowpoke	Ragtime
Rosebud	Shortcake	Sourpuss	Rugrat
Sailboat	Strawberry	Spoilsport	Stalemate
Schoolboy	Sunfish	Staircase	Windfall

Compounds are classified as TT, transparent–transparent; OT, opaque–transparent; TO, transparent–opaque; and OO, opaque–opaque.

The resulting latency patterns are shown in the leftmost portion of **Figure 2**. As can be seen in **Figure 2**, the progressive demasking latencies were greatest for opaque-opaque compounds and least for TT compounds. This pattern accords with the lexical decision latency patterns obtained by Libben et al. (2003) and which are shown for comparative purposes in the right section of **Figure 2**. The difference in the scales of the response times for the two paradigms results from the nature of the progressive demasking paradigm in which, as described in section Viewing the Stimulus in a P3 Experiment above, stimuli are presented in incremental durations over a three second period.

In the second part of the P3 procedure, following the progressive demasking response, participants in the Libben and Weber (2014) study were asked to type the stimulus word. The results of the calculation of typing latencies yielded a pattern of results that supported the conclusion that typing latencies are affected by morpheme boundaries and that semantic transparency affects those latencies. These results accord with those of Sahel et al. (2008) who reported both these effects.

Figure 3 shows the pattern of typing latencies found by Libben and Weber (2014). For all compound types, the letter immediately following the morpheme boundary (the "plus one" condition) shows the greatest typing times. Those times were greatest for the TT compounds and least for the opaque-opaque compounds. Thus, the typing component of the paradigm supports the view that, in TT compounds, the full compound is "chunked" in terms of its constituent morphemes. This seems to be much less the case for the opaque-opaque compounds. It is worthy of note that the progressive demasking component and the typing component of the P3 technique target two distinct facets of compound transparency phenomena. The progressive

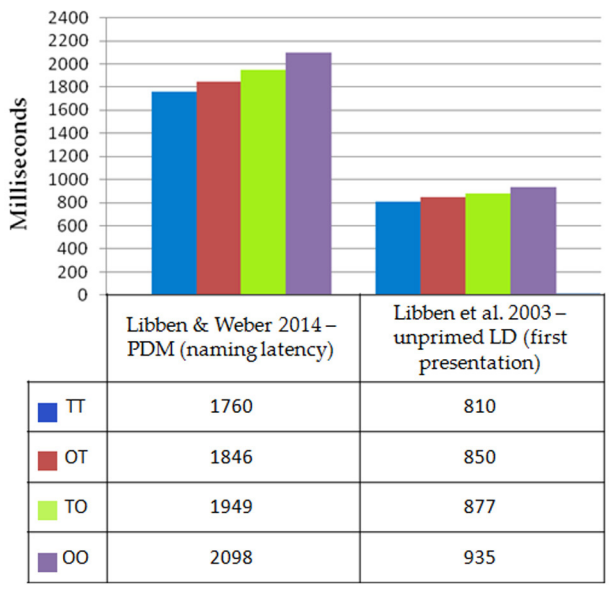


FIGURE 2 | Comparing the progressive demasking results of Libben and Weber (2014) and the lexical decision results of Libben et al. (2003) for four types of compounds: transparent–transparent, TT; opaque–transparent, OT; transparent–opaque, TO; and opaque–opaque, OO.

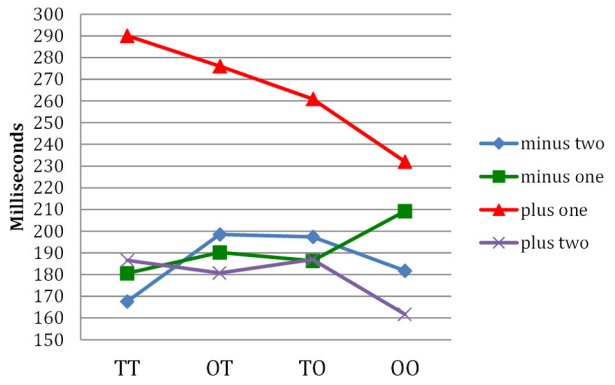


FIGURE 3 | Letter typing times in milliseconds for four types of compounds investigated by Libben and Weber (2014). The morpheme boundary is considered to be *position zero*. Position *minus two* is thus two letters before the boundary, position *minus one* is the letter before, and position *plus one* is the letter immediately following the morphemic boundary. Thus, for the compound sailboat, positions minus two to plus two would comprise the letters "i," "l," "b," and "o." The time taken to type the letter at position *plus one* (e.g., the "b" in *sailboat*) is interpreted as the time taken to pause at the morpheme boundary.

demasking component targeted overall ease of processing. The typing component targeted the manner in which the stimuli differ in terms of the extent to which they can be characterized as being internally structured.

SUMMARY: P3 EXPERIMENTS PROVIDE A MEANS BY WHICH PARTICIPANT PROFILES CAN BE CREATED

The P3 paradigm that we have presented above is essentially a recombination of existing psycholinguistic methodologies. The advantage of this type of recombination for the study of second language processing and multilingual processing is its high density as a technique. By high density, we mean the ability to generate a very rich set of data for each individual. As we discussed at the outset of this paper, experimentation with second-language users and multilinguals requires that researchers capture the heterogeneity that typically exists within the linguistic ability and linguistic performance of this group. The P3 technique enables the creation of participant profiles by enabling the triangulation of perception, oral production, and written production. This is particularly important for second-language users and multilinguals because there are often imbalances across those domains that are much larger than those that would be expected for native speakers and monolinguals.

The creation of a participant profile is also supported by the two adjunct procedures that we discussed above, namely the questionnaire and the off-line stimulus evaluation. These are of course not unique to the P3 paradigm. In any experiment with second-language users or multilinguals, an extensive language use and language background questionnaire will be of considerable value. Typically, however, employing the characteristics of participant profiles in the analysis of online data is less easy. One reason for this is that there is typically more questionnaire data collected that can be used in the analysis of online performance. Another reason is that when we do use such data as predictor variables in experiments, they are often used not as full profiles but rather as individual predictors. To a large extent, this problem can be overcome by bringing a multitude of variables together through a principal components analysis and then using the values of those principal components as predictor variables. In the section below, we present a supplement to such statistical techniques that involves a simple visual recoding of participant variables to create profiles.

THE USE OF FACIAL PROFILES IN MONOLINGUAL AND MULTILINGUAL PROCESSING

Throughout this paper, we have foregrounded the role played by the individual as the fundamental unit of psycholinguistic investigation. A perspective such as this creates somewhat of a paradox when we try to incorporate participant characteristics as predictor variables in psycholinguistic experiments. The reason for this is typically that we do this one variable at a time. Yet, we know that these variables must be considered as integrated components of an individual. If we take the term *individual* relatively literally, as that which cannot be divided, it seems reasonable to seek a means by which we can be aided in understanding the manner in which participant characteristics are indeed within a participant. In this section, we present a data visualization technique that we consider to be supportive of the psychocentric perspective on language processing and which can be valuable as a data analysis heuristic.

Our technique is based on the computer-generated faces developed by Chernoff (1973). In this approach, Chernoff reasoned that because humans, as a species, have a special aptitude for recognizing and analyzing small differences in facial structure and expression, it might be possible to use faces to code the values of many more variables than could normally be represented in a graph and have the values and relations among these variable more easily perceived by the researcher or the reader of data reports.

In our view, it is noteworthy that this technique, developed over 40 years ago, has been perhaps more talked about than actually used, despite the creativity of the approach and its potential application in a variety of domains (see De Los Reyes et al., 2013). It thus seemed to us that the basic insight that Chernoff brought to the domain of data visualization is worthy of both further consideration and further development. And, it may well be possible that a variation on the original Chernoff (1973) contribution could serve as an extremely valuable adjunct to high density paradigms such as the P3 paradigm discussed above.

In their original form, Chernoff faces used a multitude of facial characteristics to recode variables. These features included the following: size of face, length of nose, vertical position of mouth, curvature of mouth, width of mouth, separation of eyes, slant of eyes, eccentricity of eyes, size of eyes, position of pupils, vertical position of eyebrows, slant of eyebrows, and size of eyebrows.

Samples of faces in the Chernoff style are shown in **Figure 4**. At first blush, they seem to provide the perfect opportunity to instantiate a psychocentric approach to the analysis of psycholinguistic data. By embedding participant characteristics such as those obtained in the P3 questionnaire described above, it should

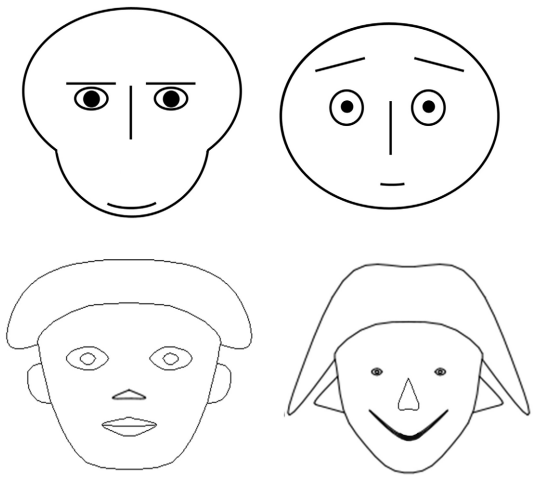


FIGURE 4 | Examples of Chernoff style faces.

be possible to graphically demonstrate the manner in which elements of a participant profile are indeed components of an integrated cognitive system.

There are however, achieve challenges to the use of classical Chernoff faces. The first is that their complexity often does not always allow them to the discrimination for which they were designed (Morris et al., 2000).

The second challenge is relatively straightforward: the manner in which Chernoff faces were originally created makes it difficult to transparently recode values into faces so that the researcher has the feeling that this is simply a reversible data transformation.

The third challenge is considerably more substantial. As is likely evident from a quick perusal of the original Chernoff facial features listed above, and as is shown also by Morris et al. (2000), facial features differ substantially in their salience. The human face recognition system prioritizes certain features over others, giving them a greater weight. This is a specific instance of the larger issue in the utilization of Chernoff's original insight. That insight was essentially that by mobilizing the human face recognition system, a very powerful, biologically driven, system would be able to detect small quantitative differences and interpret them as qualitative differences. This is at once the chief strength of the technique and its chief weakness. The biological face recognition system can be simply too powerful. Mobilizing it is, in many ways, like inviting a gorilla into your living room.

Our goal was to address all of these challenges while maintaining the advantages of using faces to code participant profiles. We reasoned that the first step was to ensure that there was a relatively transparent data recoding mechanism and that facial features would be relatively balanced for salience. To achieve this goal, we turned the faces sideways to produce two-dimensional profiles. Doing this solved one problem immediately. When seen in profile, it is no longer the case that a face has two eyes and two ears but only one nose and one mouth. This, at least to some extent, addressed the problem of facial feature imbalance. It also had the effect of "toning down" the powerfulness of facial features by reducing their affective impact on the viewer (in a manner that is comparable to the way in which profile faces in Ancient Egyptian hieroglyphic inscriptions have diminished affective impact).

The second innovation that we employed was to implement a transparent data recoding algorithm by simply recoding data values as the size of equilateral triangles and then by using those equilateral triangles as features of a facial profile. The use of triangles has two advantages: First, it is not uncommon to see eyes, nose, and ears stylized as triangular representations. Second, the use of triangles opened up the option of coding other variables as variations of those triangles. The first option employs degrees of shading. The second option is to change the shape of a triangle, while keeping the area constant. Thus, equilateral triangles can be changed to isosceles triangles with the same area. In **Figure 5**, examples of two Facial Profiles is provided. These examples show the maximum feature size as well as the minimum feature size in our current implementation.

Below, we demonstrate how Facial Profiles can be derived from simple datasets. We begin with an example taken from the performance of five sample bilinguals participants drawn from the P3 experiment reported in Libben and Weber (2014). In **Table 2**, their performance is shown with respect to four characteristics, their self-assessed reading, writing, speaking, and listening abilities.

To demonstrate the evolution of participant profiles from the data in **Table 2**. We begin with a bar graph (**Figure 6**) that is simply a graphic rendering of the data in **Table 2**.

In **Figures 7**, **8**, the power of participant profiles to bind and unite individual feature values is demonstrated. **Figure 7** was created by recoding the bar graph in **Figure 6** so that the heights of the bars are represented as areas of equilateral triangles. Those triangles are arranged into the configurations in which they will appear as the participant profiles.

The representations in **Figure 8** are identical to those in **Figure 7**, except that the triangles are monochromatic and encased in participant facial profiles. As such, the representations in **Figure 8** can be analyzed in terms of their individual feature characteristics. In addition, they can also be used as complex units that may interact with other variable configurations within an experiment. In **Figure 9**, we demonstrate how data from these five participants can be used in conjunction with performance data in a P3 experiment that, for example, plots progressive de-masking latencies against overall writing latencies. The data shown in **Figure 9** are exactly the data obtained for these five participants in the experiment reported by Libben and Weber (2014) and which is described in section Illustrative Example: The Use of the P3 Technique in the Study of the Semantic Transparency of English Compound Nouns above. As can be seen in **Figure 9**, the faces essentially replace what would be individual data points in a scatter plot, while at the same time demonstrating component characteristics of those individual data points.

The approach shown in **Figure 9** is effective when a small number of data points are involved. However, its usefulness decreases as the number of points to be plotted increases. The main reason for this is simply that an increase in the number of data points to be plotted will require that each facial

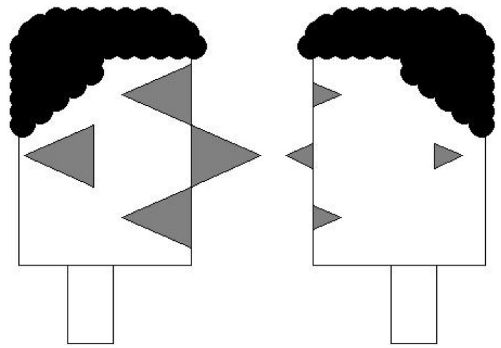


FIGURE 5 | Examples of Facial profiles showing maximum variable size and minimum variable size.

Table 2 | Self-assessed reading, writing, speaking and listening abilities for five participants on a 7-point scale.

Participant	Reading	Writing	Speaking	Listening
1	4	5	6	6
2	6	7	7	7
3	7	7	7	7
4	7	5	6	6
5	6	6	7	7

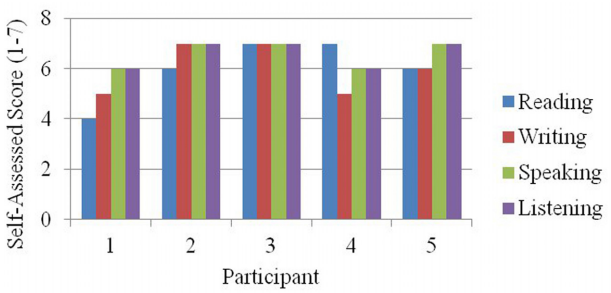


FIGURE 6 | Self-assessed reading, writing, listening, and speaking ability for the five participants described in Table 1. This bar graph recoding of the data from **Table 1** is the first step in the development of visual participant profiles.

profile be decreased in size so that they can all fit within the plot. As a result, the features, and hence their relative sizes, will be more difficult to see. A solution to this challenge is presented in **Figure 10**. Here, an entirely different approach is taken. Instead of using facial profiles to characterize individual participants, the plot has reverted to a standard scattergram, with each point representing an individual participant. Data for **Figure 10** are drawn from the progressive demasking latencies and typing latencies for 32 participants from the Libben and Weber (2014) who had performed both tasks and who had filled out the participant profile questionnaire at the outset of the experiment. The plot space has been divided into quadrants. For each quadrant, a single facial profile is constructed. These facial profiles are set as essentially watermarks upon which the plot is displayed. They key feature of such quadrant facial profiles is that they do not represent individuals. Rather, they represent the average features for each profile variable of all the participants (i.e., dots) in that quadrant. We see this approach as offering benefit in aiding in the understanding of how participant characteristics (both literally and metaphorically) map onto performance variables in a P3 experiment.

JANUS FACIAL PROFILES AND INTERACTIVE FACIAL PROFILES

The final two types of facial profiles that we discuss bring us back to issues of multilingualism and the interactive nature of the P3 paradigm respectively.

As we have claimed throughout this paper, multilinguals have particularly complex participant profiles, which must be taken into consideration in the understanding of performance data. So far, we have used facial profiles to code participant characteristics in a single language. It is, of course, possible to use the profiles to code participant characteristics in more than one language. In order to make more variables available, and in order to iconically represent bilingual characteristics, we have created what we term *Janus facial profiles*, named for the Roman god Janus. Janus is characterized as the god of beginnings and transitions and is traditionally depicted as having two faces, one looking to the past and the other to the future.

The Janus facial profile offers a convenient means of depicting bilingual features while maintaining the notion of individual integrity. Janus profiles can be used in any of the configurations described above, i.e., as representations of individuals and as representations of group characteristics.

The Janus faces also enable the final variant of facial profiles that we discuss. By using two faces in juxtaposition, it is possible to use facial profiles to represent participant dyads, such as those that comprise the pairs in the two-participant versions of the P3 experiments we describe above. In this way, participant facial profiles can be used as a convenient means of inspecting the extent to which participant pairs in interactive P3 experiments share selected characteristics. In **Figure 11**, we demonstrate the use of Janus Faces by adding bilingual information into the data presented in **Figure 9** above. The Janus faces in **Figure 10** replicate the left-facing profiles in **Figure 9** and add reading, writing, listening and speaking ability in the right-facing profiles.

INTER-PARTICIPANT VARIABILITY AND INTRA-PARTICIPANT VARIABILITY

In the sections above we have provided examples of how Participant Profiles can be used to encode scores or values associated with individuals and which are coded as the size of individual facial features. In **Figure 10**, we have also shown how group averages for specific variables can be encoded as facial features. In our design of participant profiles and their instantiation in R, we have also developed the means by which both inter-participant variability and intra-participant variability can be represented. We have used feature color/grayscale shading to core variation, so that fully color saturated features represent a standard deviation of zero. Shading becomes lighter as the standard deviation increases. Examples of this are shown in the left panel of **Figure 12**. The

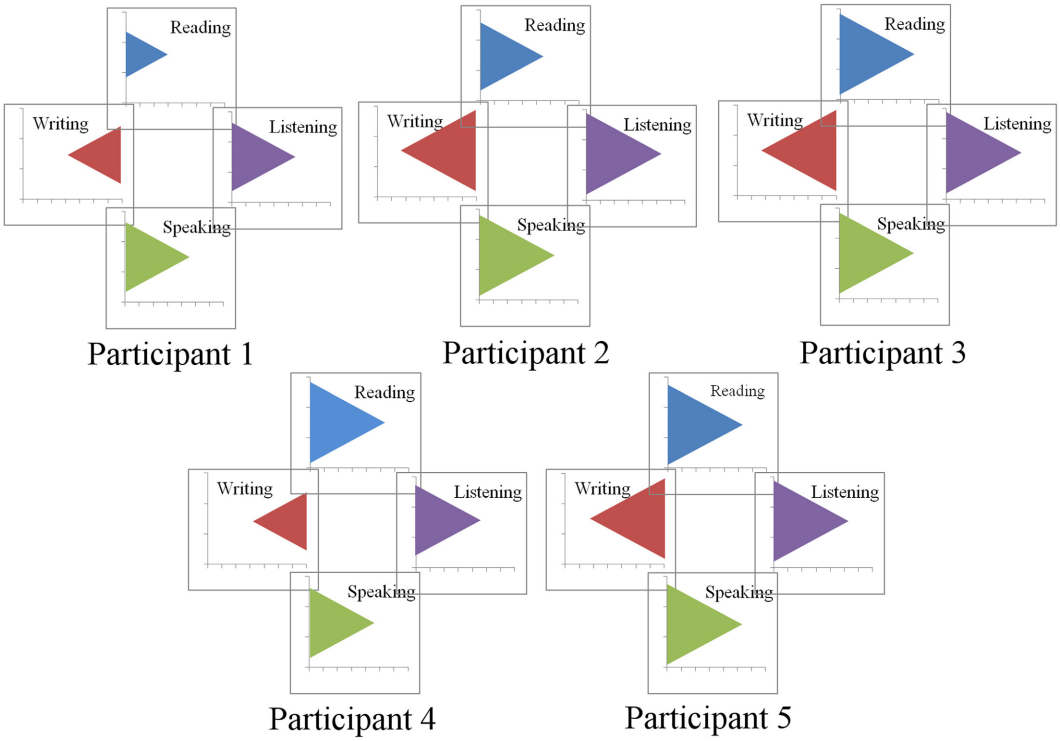


FIGURE 7 | Recoding of bar graph into relative triangle sizes. This is the second step in the development of visual participant profiles.

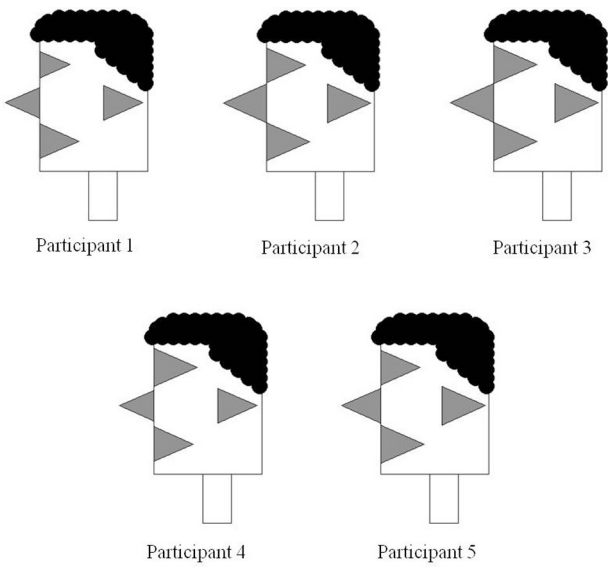


FIGURE 8 | Encasing the triangles from Figure 5 into facial profiles enables their perception as facial features. Recoding of bar graph into relative triangle sizes. This is the third and final step in the development of visual participant profiles.

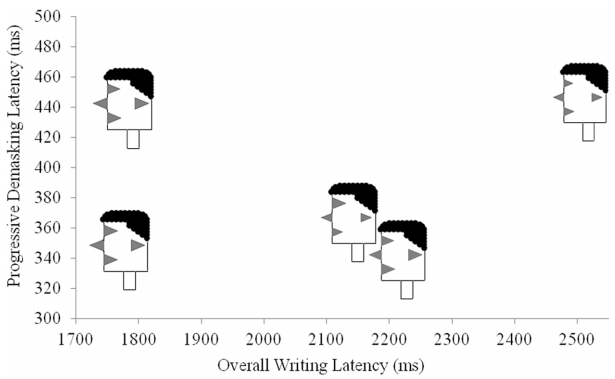


FIGURE 9 | Participant profiles used to replace participant data points on a scatterplot.

Participant Profile in this panel is identical to the type of group profile shown in **Figure 10** in that the size of the facial features represent group means for the variables. In this case, however, standard deviations are included so that we are able to also view the relative variability for each feature across the individuals in the group.

For Participant Profiles that encode individuals on a graph (e.g., **Figures 9**, **11**), it can also be valuable to be able to encode not only the sizes of individual features, but also the relative variability among features. We have implemented this type of intra-participant variation in the shading of hair color. Here too, smaller variability is associated darker shading and higher variability (i.e., lesser density) is associated with lighter shading. An example of this is shown in the right panel of **Figure 12**.

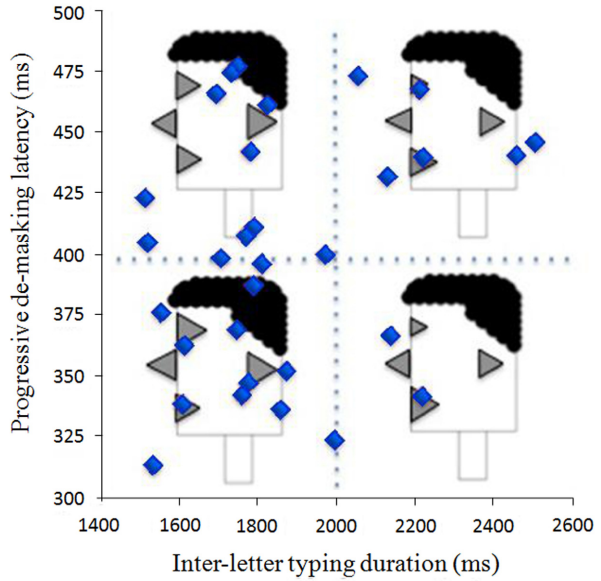


FIGURE 10 | Using facial profiles to code average values within a quadrant of graph space.

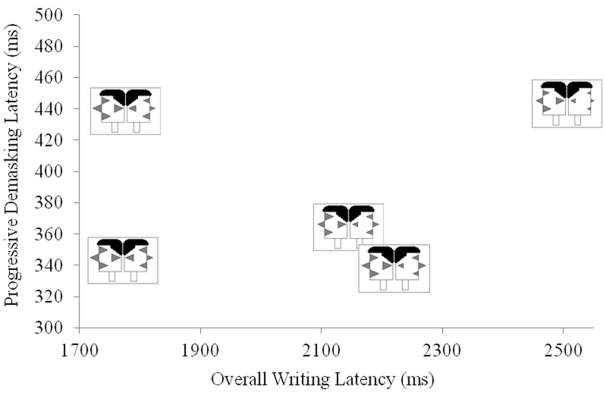


FIGURE 11 | Using Janus facial profiles to code individuals' first and second language abilities and their relations to on-line performance in a P3 experiment.

SUMMARY: FACIAL PROFILES ENABLE PARTICIPANT CHARACTERISTICS TO THE INTEGRATED INTO THE PRESENTATION AND INTERPRETATION OF P3 RESULTS

The examples of Participant Profiles that we have presented above demonstrate a new means by which participant characteristics can be linked to patterns of experimental performance in paradigms such as that P3 paradigm described above. As we have discussed above, our elaboration of the approach pioneered by Chernoff (1973) is designed to build upon human face recognition ability while constraining the manner in which it can affect the interpretation of multivariate data. By using faces in profile, we addressed some of the challenges of feature salience. The use of triangles was designed to homogenize the shape of each feature

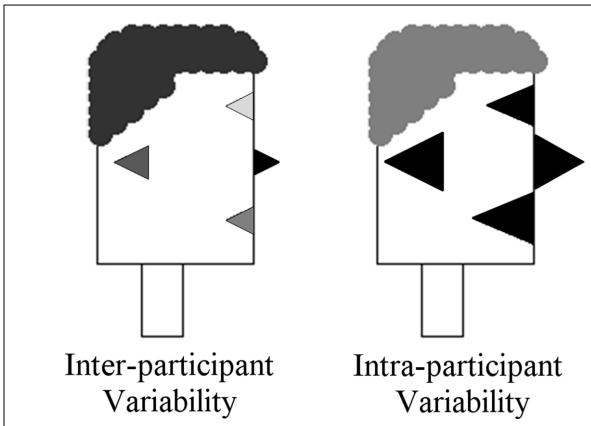


FIGURE 12 | Inter-participant variability (Left) coded by feature shading and intra-participant variability (Right) coded by hair shading.

and to ensure full translatability of the variable values into triangle size. The approach also enabled the translation of data density (leptokurtic vs. platykurtic distributions) into grayscale or color saturation. The ability to both encode multivariate means and standard deviations, the ability to link variables thematically to facial features, and the ability to mobilize the interpretive power of the human face recognition system distinguishes Facial Profiles from other multivariate data visualization techniques such as radar graphs. Finally, in the development of Participant Profiles, we have retained the ability to turn equilateral triangles into isosceles triangles with the same area, but a different shape. This creates the ability to code for more values for each face, resulting in a potential total of 26 values that can be coded within each Janus Profile.

CONCLUSION

We have presented a psychocentric perspective on language processing that embeds the linguistic nature of language structures within a psychological matrix. We have focused on the mental lexicon and lexical processing in multilinguals and have claimed that the nature of lexical representation and processing among multilinguals will be greatly shaped by experience across the lifespan.

We have claimed that high density experiments such as the P3 paradigm that we discuss are particularly advantageous in the study of lexical processing among bilinguals because they offer a rich set of dependent variables and have the capacity to simultaneously capture features of both language perception and production as well as participant profiles. To aid in the understanding of how those participant profiles interact with other aspects of experiment performance, we have proposed a data visualization technique that is based on the faces developed by Chernoff (1973).

The methodological and data visualization techniques that we propose can have application in many domains of language performance. In particular, though, we see them as having value in the study of lexical processing. Decades of psycholinguistic research have focused on the manner in which elements of

the mental lexicon are connected. Indeed, the entire program of masked priming research beginning with Forster and Davis (1984) has served to show the dimensions along which words in the mental lexicon are linked to one another. We have seen that they are linked along all dimensions-semantic, morphological, and phonological. And, research on bilingual lexical processing has shown that the bilingual (and by extension multilingual) lexicon is also richly networked. If we combine this observation with the fact, discussed above, that the lexicon is in a dynamic state throughout the lifespan, then new representations, i.e., newly acquired words, are not simply added to a list. Rather they are integrated into a network. As a result of that integration, the network changes character with each newly acquired component. Understanding this integration is the next key challenge for psycholinguistic research in lexical processing. We suggest that the techniques we have presented have potential to aid in addressing that challenge.

REFERENCES

Aitchison, J. (1987). *Words in the Mind: An Introduction to the Mental Lexicon*. Oxford: Basil Blackwell.

Alvarez, C. J., Cottrell, D., and Afonso, O. (2009). Writing dictated words and picture names: Syllabic boundaries affect execution in Spanish. *Appl. Psycholinguist.* 30, 205–223. doi: 10.1017/S0142716409090092

Baayen, R. H. (2008). *Analyzing Linguistic Data. A Practical Introduction to Statistics Using R.* Cambridge: Cambridge University Press. doi: 10.1017/CBO9780511801686

Baayen, R. H., Davidson, D., and Bates, D. (2008). Mixed-effects modeling with crossed random effects for subjects and items. *J. Mem. Lang.* 59, 390–412. doi: 10.1016/j.jml.2007.12.005

Balota, D. A., Cortese, M. J., Sergent-Marshall, S. D., Spieler, D. H., and Yap, M. J. (2004). Visual word recognition for single syllable words. *J. Exp. Psychol. Gen.* 133, 283–316. doi: 10.1037/0096-3445.133.2.283

Carroll, B. J. (1961). "Fundamental considerations in testing for English language proficiency of foreign students," in *Testing English Proficiency of Foreign Students* (Washington, DC: Center for Applied Linguistics), 30–40.

Chernoff, H. (1973). The use of faces to represent points in k-dimensional space graphically. *J. Am. Stat. Assoc.* 68, 361–368. doi: 10.1080/01621459.1973.10482434

De Los Reyes, A., Augenstein, T. M., Aldao, A., Thomas, S. A., Daruwala, S. Kline, S. K., et al. (2013). Implementing psychophysiology in clinical assessments of adolescent social anxiety: use of rater judgments based on graphical representations of psychophysiology. *J. Clin. Child Adoles. Psychol.* doi: 10.1080/15374416.2013.859080. [Epub ahead of print].

Derwing, B. (1973). *Transformational Grammar as a Theory of Language Acquisition*. Cambridge: Cambridge University Press.

Ferrand, L., Brysbaert, M., Keuleers, E., New, B., Bonun, P., Méot, A., et al. (2011). Comparing word processing times in naming, lexical decision, and progressive demasking: evidence from Chronolex. *Front. Psychol.* 2:306. doi: 10.3389/fpsyg.2011.00306

Flynn, M. (1997). The concept of intelligence in psychology as a fallacy of misplaced concreteness. *Interchange* 28, 231–244. doi: 10.1023/A:1007317410814

Forster, K. I., and Davis, C. (1984). Repetition priming and frequency attenuation in lexical access. *J. Exp. Psychol. Learn. Mem. Cognit.* 10, 680–698. doi: 10.1037/0278-7393.10.4.680

Frisson, S., and Sandra, D. (2002). Homophonic forms of regularly inflected verbs have their own orthographic representations: a developmental perspective on spelling errors. *Brain Lang.* 81, 545–554. doi: 10.1006/brln.2001.2546

Gollan, T. H., and Goldrick, M. (2012). Does bilingualism twist your tongue? *Cognition* 125, 491–497. doi: 10.1016/j.cognition.2012.08.002

Gollan, T. H., Montoya, R. I., Fennema-Notestine, C., and Morris, S. K. (2005). Bilingualism affects picture naming but not picture classification. *Mem. Cognit.* 33, 1220–1234. doi: 10.3758/BF03193224

Goral, M., Spiro, A., Albert, M. L., Obler, L. K., and Connor, L. (2007). Change in lexical-retrieval skills in adulthood. *Ment. Lex.* 2, 215–238. doi: 10.1075/ml.2.2.05gor

Grainger, J., and Segui, J. (1990). Neighborhood frequency effects in visual word recognition: a comparison of lexical decision and masked identification latencies. *Percept. Psychophys.* 47, 191–198. doi: 10.3758/BF03205983

Grosjean, F. (1989). Neurolinguists beware! The bilingual is not two monolinguals in one person. *Brain Lang.* 36, 3–15. doi: 10.1016/0093-934X(89)90048-5

Grosjean, F. (2012). *Bilingual: Life and Reality.* Cambridge, MA: Harvard University Press.

Ivanova, I., and Costa, A. (2008). Does bilingualism hamper lexical access in speech production? *Acta. Psychol.* 127, 277–288. doi: 10.1016/j.actpsy.2007.06.003

Kandel, S., Alvarez, C. J., and Vallée, N. (2006). Syllables as processing units in handwriting production. *J. Exp. Psychol.* 32, 18–31. doi: 10.1037/0096-1523.32.1.18

Kandel, S., Alvarez, C. J., and Vallée, N. (2008). "Morphemes also serve as processing units in handwriting production," in *Neuropsychology and Cognition of Language: Behavioural, Neuropsychological and Neuroimaging Studies on Spoken and Written Language*, ed M. Baciu (Thiruvananthapuram: Research Signpost), 87–100.

Kandel, S., Peereman, R., Grosjacques, G., and Fayol, M. (2011). For a psycholinguistic model of handwriting production: testing the syllable-bigram controversy. *J. Exp. Psychol.* 37, 1310. doi: 10.1037/a0023094

Lemhöfer, K., Dijkstra, T., Schriefers, H., Baayen, R. H., Grainger, J., and Zwitserlood, P. (2008). Native language influences on word recognition in a second language: a mega-study. *J. Exp. Psychol.* 34, 12–31. doi: 10.1037/0278-7393.34.1.12

Libben, G. (2000). "Representation and processing in the second language lexicon: the homogeneity hypothesis," in *Second Language Grammars*, ed J. A. Archibald (London: Blackwell Press), 228–248.

Libben, G. (2007). "Reading complex morphological structures," in *From Inkmarks to Ideas: Current Issues in Lexical Processing*, ed S. Andrews (Hove: Psychology Press), 192–215.

Libben, G. (2010). "Compounds, semantic transparency, and morphological transcendence," in *New Impulses in Word-formation* (Linguistische Berichte Sonderheft 17), ed S. Olsen (Hamburg: Buske), 212–232.

Libben, G., Gibson, M., Yoon, Y.-B., and Sandra D. (2003). Compound fracture: the role of semantic transparency and morphological headedness. *Brain Lang.* 84, 26–43. doi: 10.1016/S0093-934X(02)00520-5

Libben, G., and Goral, M. (in press). "How bilingualism shapes the mental lexicon," in *Cambridge Encyclopedia of Bilingual Processing*, ed J. Schwieter (Cambridge: Cambridge University Press).

Libben, G., and Jarema, G. (2002). Mental lexicon research in the new millennium. *Brain Lang.* 81, 1–10. doi: 10.1006/brln.2002.2654

Libben, G., and Weber, S. (2014). "Semantic transparency, compounding, and the nature of independent variables," in *Morphology and Meaning*, eds F. Rainer, W. U. Dressler, F. Gardani, and H. C Luschützky (Amsterdam: Benjamins), 205–221.

Libben, G., Weber, S., and Miwa, K. (2012a). P3: a technique for the study of perception, production, and participant properties. *Ment. Lex.* 7, 237–248. doi: 10.1075/ml.7.2.05lib

Libben, G., Westbury, C., and Jarema, G. (2012b). "Embracing complexity," in *Methodological and Analytic Frontiers in Lexical Research*, eds G. Libben, G. Jarema, and C. Westbury (Amsterdam: John Benjamins), 1–12. doi: 10.1075/bct.47.01int

Morris, C. J., Ebert, D. S., and Rheingans, P. L. (2000). "Experimental analysis of the effectiveness of features in Chernoff faces," in *Proceedings of SPIE* 3905, *28th AIPR Workshop: 3D Visualization for Data Exploration and Decision Making*, Vol. 12 (Washington, DC). doi: 10.1117/12.384865

Oller, J. W. (1971). Dictation as a device for testing foreign-language proficiency. *ELT J.* 25, 254–259. doi: 10.1093/elt/XXV.3.254

Pulvermüller, F. (2005). Brain mechanisms linking language and action. *Natl. Rev. Neurosci.* 6, 576–582. doi: 10.1038/nrn1706

Robinson, O. C. (2011). The idiographic/nomothetic dichotomy: tracing historical origins of contemporary confusions. *Hist. Philos. Psychol.* 13, 32–39.

Sahel, S., Nottbusch, G., Grimm, A., and Weingarten, R. (2008). Written production of German compounds: effects of lexical frequency and semantic transparency. *Written Lang. Lit.* 11, 211–227. doi: 10.1075/wll.11.2.06sah

Will, U., Nottbusch, G., and Weingarten, R. (2006). Linguistic units in word typing: effects of word presentation modes and typing delay. *Written Lang. Lit.* 9, 153–176. doi: 10.1075/wll.9.1.10wil

Conflict of Interest Statement: The Review Editor Dr. Mary Grantham O'Brien declares that, despite being affiliated to the same institution as author Silke Weber, the review process was handled objectively and no conflict of interest exists. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 17 February 2014; accepted: 20 May 2014; published online: 30 June 2014.

Citation: Libben G, Curtiss K and Weber S (2014) Psychocentricity and participant profiles: implications for lexical processing among multilinguals. Front. Psychol. ***5****:557. doi: 10.3389/fpsyg.2014.00557*

This article was submitted to Language Sciences, a section of the journal Frontiers in Psychology.

frontiers in
PSYCHOLOGY

OPINION ARTICLE
published: 29 October 2014
doi: 10.3389/fpsyg.2014.01235

Taking advantage of between- and within-participant variability?

***Cyril Perret*[1]* and Sonia Kandel*[2]**

[1] CeRCA, Centre National de la Recherche Scientifique, Unités Mixtes de Recherche 7295, Université de Poitiers, Poitiers, France
[2] Laboratoire de Psychologie et NeuroCognition, Centre National de la Recherche Scientifique, Unités Mixtes de Recherche 5105, Université Grenoble Alpes, Grenoble, France
*Correspondence: cyril.perret@univ-poitiers.fr

Edited by:
Mary Grantham O'Brien, University of Calgary, Canada

Reviewed by:
Matti Laine, Abo Akademi University, Finland

Keywords: central tendency effect, statistical distributions, between-participants variability, within-participant variabitity, mixed-effects models

⟨⟨ All other things being equal or held constant ⟩⟩ (i.e., *ceteris paribus*). This experimental principle is probably one of first concepts that teachers present in methodology courses in universities all around the word. Studying the influence of one (or more) experimental factors on a specific dependent variable requires an adequate control of all other sources that might affect it. This epistemological position is directly derived from positivism (e.g., Comte, 1869, 2010). According to this view, the most important scope in science is to develop theories that describe and model the environment and at the same time exclude all micro-variations. In other—philosophical—words, science attempts to understand what remains invariant despite constant transformation of the world. Language sciences follow this principle (psycholinguistics, linguistics, neurobiology of language processing, among others). Most studies try to differentiate the characteristics that human beings share—i.e., universals—from what is individual or specific.

Stochastic between- and within-participant factors are generally considered in experimental setups. However, this control is done more by habit than with a deep meditation on the way they can affect the outcome. Individuals are indeed specific. In a word reading task for instance, the Reaction Time variation across participants follows a Gaussian distribution. Moreover, a participant never performs identically when repeating the task. Individual performance is systematically subject to micro-variations across a set of similar items. In language science experiments, researchers diligently follow methodological recommendations. They generally recruit a group of 20–30 participants and select samples of homogeneous items for each experimental condition. In both, the researchers hope—or at least expect—to have representative samples. This is essential for the elaboration of models with different sources of variability. That is, it is possible to separate random influences from fixed-effects.

Experimental samples are then done to deal with the "fear" of between- and/or within-participant variability. Nevertheless, as in many nightmares, this fear is not totally rational. In their article, Libben et al. (2014) "*Psychocentricity and participant profiles: Implications for lexical processing among multilinguals*" presented a good example. The authors proposed a tool that takes into account the high diversity of multilingual participant profiles. The linguistic experience for each language is specific for every multilingual individual. So the problem when studying multilingualism is the stability of linguistic representations in each participant's mental lexicon. Each individual's language system is specific because he/she has different environmental inputs/outputs for each language. As multilingual person's languages often serve different social and communicative purposes, they form a unique whole that differs qualitatively from a monolingual's system. In other words, a bilingual's language system is not two monolingual systems in one brain (Grosjean, 1989). Another problem is the relation between language production and comprehension. Monolinguals show comparable abilities in the two modalities. This does not always hold for multilingual people. In sum, the difficulties Libben et al. (2014) highlighted focus on the consideration of between-participant variability and its modeling. Most studies rely on a quite monolithic conception of the participants' multilingualism. They do not take into account adequately the variability of the participants' characteristics and skills. Again, the latter do not behave like two or more monolinguals in every language they speak (e.g., Montrul and Sánchez-Walker, 2013). This means that in psycholinguistic studies on multilingualism experimental groups are by definition highly heterogeneous. Heterogeneity within the group is a real problem because it produces random "noise."

In more general terms, the authors raise the issue of the so-called central tendency. It consists of privileging a position parameter (e.g., mean, median, etc.) instead of its distribution. The idea is that this parameter is the best approximation of its distribution. It allows for an adequate control of the random error influence. The latter can be considered as a stochastic phenomenon. Therefore, a group's specific behavior would yield a sampling of the random error in agreement with its probability distribution. Moreover, the mean of the random error influence tends to zero when the number of observations that form the distribution increases. As a result, the position parameter that is calculated from the data distribution of an adequate sample should not be influenced by the random error. In language science, we use central tendency rather

systematically. The more frequent one is the analyses by participants (F_1) and items (F_2) (e.g., Forster and Dickinson, 1976; Raaijmakers, 2003) derived from Clark's (1973) proposal. The idea of checking F_2 is to verify whether a significant fixed-effect exists when the random effects variable of the statistical analysis corresponds to the experiment's items. So for each item we calculate the mean of the participants' responses. This implies that the random error resulting from the between-participant variability is captured perfectly from the participants' responses. In other words, participant samples have to allow for the estimation of between-participant random error.

Although Libben et al. (2014) did not directly discuss this issue, the central point is the ability to estimate correctly the random error from small samples that are typical in language sciences. The major advantage of the profile method called "psychocentricity" is indeed that it models better between-participant variability than the use of central tendency of multilingual characteristics. We can take another example derived from the idea of central tendency, namely lexical frequency. This is one of the most well-known independent variables that affect linguistic behavior. When researchers were looking for evidence in support of the idea that a word is stored in the mental lexicon, they tried to show facilitation in the processing of the items that occurred or were used more frequently. This is widely known as the lexical frequency effect. These experiments employed words for which mean frequency values were available from databases such as Lexique2 for French (New et al., 2004) or CELEX for English, Dutch and German (Baayen et al., 1993). However, it is possible to question the validity of this measure. Is the personal experience of the individuals participating in the study equivalent to what the frequency value of the table denotes? The difference between the theoretical value and the actual experience of the participant with the word can be a source of random noise. We can easily assume that these differences should be extremely variable among participants. A sample must be recruited to estimate correctly this within-participant random error but, as with multilinguals, 20–30 participants seems to be a too small sample for this purpose.

The central tendency principle (e.g., F_1/F_2) has been used almost systematically for a long time mainly because of statistical constraints. In language sciences, researchers used statistical models that did not allow to simultaneously take into account the variability across participants and items (e.g., Forster and Dickinson, 1976; Raaijmakers, 2003). The tools to go beyond the analysis of central tendency only appeared in the last 20 years. As Libben et al. (2014) pointed out, the development of non-linear and linear mixed-effects models allowed to examine a larger spectrum of situations (e.g., Pinheiro and Bates, 2000; Baayen et al., 2008; Quené and van der Berg, 2008; Bar et al., 2013)[1]. The basic idea underlying these models is to avoid fixing a priori constraints on the characteristics of the variance/covariance matrix. For instance, why work under a variance homogeneity assumption when heteroskedasticity can be modeled? The analysis is conducted on the whole data set (one value per participant/item pair) and not from a central tendency (e.g., Pinheiro and Bates, 2000; Baayen et al., 2008; Quené and van der Berg, 2008; Bar et al., 2013). The main advantage of the mixed-effects model is the freedom to deal with the sources of random variability (within- and between-participants). Rather than trying to collect (hopefully) adequate samples to estimate random error, the specific characteristics of the variance/covariance are directly modeled. Moreover, the specific profile of a multilingual participant or specific frequency of exposures can be modeled directly in the statistical analysis.

Moreover, mixed-effects models can take into account a final point that is directly related to the source of random variability. These models are called mixed because they are used to model interactions between fixed effect variables (e.g., the independent variable/s of the study) and random effect variables (e.g., participants and items). This is particularly relevant when we want to explore between-participant variation of a fixed effect. For example in picture naming experiments, it is well known that the participants begin to articulate the name of the image much faster (about 300 ms) than to write it (e.g., Bonin et al., 1998). Perret and Laganaro (2013)[2] provided evidence indicating that this result is in fact due to different initialization criteria between the two tasks. The point we would like to make is that they also observed a mixed-effect between the production mode (oral vs. written) and the participants' random effect variable. This means that the criterion for picture naming responses was modality dependent but also that it is specific to each participant. Without mixed-effect models, we could not have explored this hypothesis.

To conclude, we believe that Libben et al. (2014) provide an original tool that seems very promising. It seems more profitable to include within- and between-participant variability in the statistical model than controlling them with position parameters computed from (larger?) samples. Although the psychocentricity perspective (within- and between-participant) increases the complexity of the psycholinguistic enterprise, it opens the possibility to individualize concepts of language analyses. The examples we presented are far from being exhaustive. However, they support the idea that modeling within- and between-participant variability precisely is one way to explore the invariants of human cognitive functioning.

[1] Our goal is not do describe this kind of model. We refer to the special issue on modeling in language science that appeared in the Journal of Memory and Language (2008; number 59).

[2] See Alario and Moscoso del Prado Martin (2010) for an example of mixed-effect by items.

ACKNOWLEDGMENTS

Authors would like to thank an anonymous reviewer for interesting comments on a previous version of this paper.

REFERENCES

Alario, F.-X., and Moscoso del Prado Martin, F. (2010). On the origin of the "cumulative semantic inhibition" effect. *Mem. Cogn.* 38, 57–66. doi: 10.3758/MC.38.1.57

Baayen, R. H., Davidson, D. J., and Bates, D. M. (2008). Mixed-effects modeling with crossed random effects for subjects and items. *J. Mem. Lang.* 59, 390–412. doi: 10.1016/j.jml.2007.12.005

Baayen, R., Piepenbrock, R., and van Rijn, H. (1993). *The CELEx Lexical Database (CD-ROM)*. Philadelphia, PA: University of Pennsylvania, Linguistic Data Consortium.

Bar, D. J., Levy, R., Scheepers, C., and Tily, H. J. (2013). Random effects structure for confirmatory hypothesis testing: keep it maximal. *J. Mem. Lang.* 68, 255–278. doi: 10.1016/j.jml.2012.11.001

Bonin, P., Fayol, M., and Gombert, J.-E. (1998). An experimental study of lexical access in the writing and naming of isolated words. *Int. J. Psychol.* 33, 269–286. doi: 10.1080/002075998400312

Clark, H. H. (1973). The language-as-fixed-effect fallacy: a critique of language statistics in psychological research. *J. Verbal Learn. Verbal Behav.* 12, 335–359. doi: 10.1016/S0022-5371(73)80014-3

Comte, A. (1869, 2010). *Cours de Philosophie Positive [Course of Positive Philosophy]*. London: BookSurge Publishing.

Forster, K. I., and Dickinson, R. G. (1976). More on the language-as-fixed-effect fallacy: Monte carlo estimates of error rates for F1, F2, F', and minF'. *J. Verbal Learn. Verbal Behav.* 15, 135–142. doi: 10.1016/0022-5371(76)90014-1

Grosjean, F. (1989). Neurolinguists beware! The bilingual is not two monolinguals in one person. *Brain Lang.* 47, 191–198.

Libben, G., Curtiss, K., and Weber, S. (2014). Psychocentricity and participant profiles: implications for lexical processing among multilinguals. *Front. Psychol.* 5:557. doi: 10.3389/fpsyg.2014.00557

Montrul, S., and Sánchez-Walker, N. (2013). Differential object marking in child and adult Spanish heritage speakers. *Lang. Acquis.* 20, 109–132. doi: 10.1080/10489223.2013.766741

New, B., Pallier, C., Brysbaert, M., and Ferrand, L. (2004). Lexique 2: a new French lexical database. *Behav. Res. Methods Instrum. Comput.* 36, 516–524. doi: 10.3758/BF03195598

Perret, C., and Laganaro, M. (2013). Why are written naming latencies (not) longer than spoken naming? *Read. Writ.* 26, 225–239. doi: 10.1007/s11145-012-9365-8

Pinheiro, J. C., and Bates, D. M. (2000). *Mixed-Effects Models in S and S-PLUS*. New York, NY: Springer.

Quené, H., and van der Berg, H. (2008). Examples of mixed-effects modeling with crossed random effects and with binomial data. *J. Mem. Lang.* 59, 413–425. doi: 10.1016/j.jml.2008.02.002

Raaijmakers, J. G. W. (2003). A further look at the "language-as-fixed-effect fallacy." *Can. J. Exp. Psychol.* 57, 141–151. doi: 10.1037/h0087421

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 14 September 2014; accepted: 10 October 2014; published online: 29 October 2014.
*Citation: Perret C and Kandel S (2014) Taking advantage of between- and within-participant variability? Front. Psychol. **5**:1235. doi: 10.3389/fpsyg.2014.01235*
This article was submitted to Language Sciences, a section of the journal Frontiers in Psychology.

frontiers in
PSYCHOLOGY

ORIGINAL RESEARCH ARTICLE
published: 17 June 2014
doi: 10.3389/fpsyg.2014.00413

Evolving 50–50% bilingual pedagogy in Alberta: what does the research say?

Rahat Naqvi [1] ****, Elaine Schmidt*** [2] ***and Marlene Krickhan*** [3]

[1] *Werklund School of Education, University of Calgary, Calgary, AB, Canada*
[2] *Calgary Board of Education, Calgary, AB, Canada*
[3] *Senator Patrick Burns School, Calgary Board of Education, Calgary, AB, Canada*

Edited by:
Mary Grantham O'Brien, University of Calgary, Canada

Reviewed by:
Gatis Dilans, Ventspils University College, Latvia
Margot Kinberg, National University, USA
Ibon Manterola, Universidad del País Vasco/Euskal Herriko Unibertsitatea, Spain

****Correspondence:***
Rahat Naqvi, Werklund School of Education, University of Calgary, Education Tower 1004, 2500 University Drive North West, Calgary, AB T2N 1N4, Canada
e-mail: rnaqvi@ucalgary.ca

This paper outlines the provincial frameworks that define the Spanish bilingual program in Alberta, Canada, provides an historical overview of its pedagogic constraints and evolution, and proposes a framework for bilingual pedagogy. The framework is conceptualized from the research evidence of three local case studies, and is based on the centrality of cross-linguistic transfer, in relation to linguistic interdependence and bilingual learning.

Keywords: bilingual pedagogy, cross-linguistic transfer, bilingual learning, Spanish

INTRODUCTION

Canada's evolution as a global voice in language education was facilitated by the 1969 Official Languages Act, and the 1971 articulation of the framework of multiculturalism and bilingualism. Not only did this political underpinning immediately facilitate a coast-to-coast bilingual education movement, i.e., the internationally recognized and well-researched French Immersion program; but also, it has been seminal in the evolution of other significant provincial language and culture initiatives. In this article about a specific provincial scenario, we discuss emerging understandings regarding second language learning pedagogies, as they exist within the current globalized educational milieu.

In Western Canada, in the province of Alberta in particular, an initiative akin to the French Immersion educational concept is alternative bilingual language programs such as English-Chinese, English-German, and English-Spanish (Alberta Education, 2000). Similar to French Immersion, this bilingual model is additive in intent. Its purpose is to develop strong language competencies and literacy in two languages; an objective which is somewhat unique within the scope of North American bilingual programming. There is extensive research (for a complete review see Cummins, 1996, 2001; Genesee and Lindholm-Leary, 2007) describing the various types of bilingual programs prevalent in North America and other countries. The goals of the bilingual programs can differ to a great extent. For example transitional bilingual education, one of the most common forms of bilingual education for minority students in the United States during the past 40 years, aims only to promote students' proficiency in English (Cummins, 2009). That is to say, when students develop sufficient English language proficiency to follow instructions and write in English, the home language instruction is discontinued and they transition into mainstream classrooms.

In Alberta, the additive bilingual model also emphasizes a range of other educational goals in keeping with current demographic realities and values, such as the trend toward increased choice within public education systems, and the nurturing of global citizenship and intercultural competencies (Holmes, 2008). This approach aligns with the growing national and global trend toward multilingualism and multiculturalism, and is confirmed in Canada's most recent census, which documents an 11% increase in the population who speak languages other than the dominant language; and a total of 20.6% of Canadians who have a mother tongue other than English or French (The Globe and Mail, 2012). The social dynamics associated with linguistic diversity, the impact of emerging multi-modal technologies, and the central theme of educational policy within economic discourse (Padoan, 2012) result in a radically altered educational landscape that requires both exploration and interpretation.

This paper outlines the provincial frameworks that define the bilingual program, provides an historical overview of its pedagogic constraints and evolution, and proposes a framework for bilingual pedagogy based on theoretical underpinnings and local research evidence.

EDUCATIONAL FRAMEWORKS THAT PROVIDE THE CONTEXT FOR BILINGUAL PROGRAMS IN ALBERTA

The Spanish bilingual program in Alberta is governed by various key documents, and programming guidelines, outlined below:

ALTERNATIVE BILINGUAL PROGRAMS

Section 11 of the School Act gives school boards the authority to offer instruction in French or any other language, and Section 21 creates opportunities to learn other languages through alternative programs (Alberta Education, 2000). However, the Alberta Guide to Education states that all programs must offer a minimum of 50% of instructional time in an official language, i.e., English or French (Alberta Education, 2012). Consequently, there is significantly less instructional time allotted to the additional language within a bilingual program than within French Immersion which can dedicate up to 100% of instructional time in French. Bilingual programs operate at 50% English – 50% in the target language at the elementary level, changing to 65% English – 35% in the target language at the junior high level, and 75% English – 25% in the target language at the senior high level, which is determined at the discretion of the school jurisdiction offering the program.

ALBERTA BILINGUAL PROGRAMS OF STUDY

All grades 1 to 12 bilingual programs share a common framework, rationale and broad objectives as outlined in the respective language arts programs of study. As these language programs with entry points at kindergarten and grade 1, were designed for learners with no previous knowledge of the language, bilingual programs are accessible to all students irrespective of linguistic heritage (Alberta Education, 2005). Functional fluency in the L2 is targeted in each of the four competency areas (reading, writing, listening, and speaking), as well as the capacity for grade appropriate content learning in the L2.

INTERNATIONAL SPANISH ACADEMY (ISA)

Each alternative bilingual program has evolved somewhat differently and has been influenced by the international relationships that have been nurtured by both the province and each of the school jurisdictions involved. For example, the 26 Spanish bilingual program schools that are unique to the province of Alberta in Canada, have ISA status based on a memorandum of understanding (MOU) for Education Cooperation between the Ministry of Education and Science of the Kingdom of Spain and the Department of Education of the Province of Alberta. This MOU identifies general English-Spanish bilingual program expectations and strategies for advancing international relations and understanding between cultures, including access to visiting international teachers, resources, and professional development (Alberta Education, 2006).

PEDAGOGIC CONSTRAINTS AND EVOLUTION OF BILINGUAL PEDAGOGY

From the outset, the alternative bilingual language programs in Alberta have been strongly impacted by the traditional assumptions and pedagogy of French Immersion, including strict segregation of learning by language and subject, and by the *maximum exposure hypothesis* implication that only 50% of time in L2 is a deficiency to be managed relative to the learning of the L2 (Cummins, 2001). The notion of creating a dual-language space for explicitly comparing and contrasting languages has not been considered best pedagogical practice, with the view that translation or code switching threatens L2 language growth (Cummins, 2000).

This article highlights challenges faced in light of the current research and emphasizes the need for a pedagogical shift from the *monolingual solitude assumption* to a more flexible approach to language pedagogy (Cummins, 1979, 2005; Creese and Blackledge, 2010; García and Sylvan, 2011; Ó Duibhir and Cummins, 2012). Drawing upon emerging theory on integrated models of language learning, i.e., the strongly supported view of *language-as-a-resource* (Escamilla and Hopewell, 2009) and the *counterbalanced approach* to language learning in content areas (Lyster, 2011; Lyster et al., 2013), researchers discuss the need to inform practice around evolving bilingual pedagogy and literacy acquisition. They highlight the learning potential associated with the *linguistic interdependence principle* (Cummins, 1981, 2001), and recognize *metalinguistic awareness* as being critical in the learning process (Ó Duibhir and Cummins, 2012).

The Spanish bilingual program has encountered a series of unique pedagogical constraints, which are partially rooted in the *monolingual solitude assumption* (Cummins, 1979, 2008; Howatt, 1984). First, by segregating languages of instruction into compartmentalized subject areas, English and Spanish are not integrated into a shared learning space, which could otherwise enhance students' ability to express their thought processes and to deepen knowledge creation across and between languages (Celic and Seltzer, 2011). Second, when student curiosity is not peaked through relevant cross-curricular work, motivation decreases (Friesen and Jardine, 2009); which in turn conversely impacts language learning (Cummins, 2011; Lyster, 2011). Third, the segregation of languages and subject areas restrict teachers' abilities to plan inter-disciplinary inquiry projects, and to assess students' literacy skills considering the entire scope of their linguistic abilities (Cummins, 2005; Escamilla and Hopewell, 2010; Soltero-González et al., 2010).

These pedagogical constraints were further validated at the National Conference of the Association Canadienne des Professeurs d'Immersion in October 2013, in which renowned Canadian bilingual education researchers and advocates, Jim Cummins, Sharon Lapkin, and Fred Genesee engaged in dialog with administrators of Canadian French Immersion education about the need to update the monolingual instruction assumptions upon which French Immersion has operated for nearly 50 years. Empirical studies in recent years (see Dressler and Kamil, 2006 for a review) have consistently promoted the idea of cross-lingual interdependence. Results support Cummins' longstanding position that learners' common underlying proficiency be explicitly and strategically developed in order to maximize the cognitive, linguistic and socio-affective capacity of bilingual learners. Cummins posits that "if students are making cross-linguistic connections throughout the course of their learning in a bilingual or immersion program, why not nurture this learning strategy and help students to apply it more efficiently?"(Cummins, 2014).

This perspective is further strengthened by Garcia's idea of translanguaging based on extensive research with Spanish-English bilingual students and communities living in New York (García, 2009). According to Garcia, the blurred lines between the languages of bilinguals make it important to consider the pedagogical implications and potential cross-linguistic strategies that arise from this interconnectedness. Moreover, within the context of

interlanguage awareness, effective instructional strategies promoting two-way transfer across languages in mainstream multilingual classrooms produce clear evidence of how students develop a critical awareness of the social and cognitive functions of languages in their lives (García, 2009).

Although specific to the Spanish bilingual model in Alberta, the proposed framework which promotes general beliefs and values around teaching for transfer across languages is equally valid for other multilingual learning and teaching contexts.

RESEARCH EVIDENCE THAT INFORMS A CONCEPTUAL FRAMEWORK FOR 50–50% BILINGUAL PEDAGOGY

Between 2011 and 2013 a three part research study was carried out through ongoing collaboration between researchers at the University of Calgary and a Calgary public school district (school-based leaders and teacher practitioners in a primary Spanish bilingual context). In this district, the Spanish bilingual program has grown from approximately 125 students in kindergarten to grade 2 at its inception in 2001, to 3002 students, kindergarten to grade 12 in 2013 (Calgary Board of Education, 2013). To date a vast majority of the students entering the program have been native English speakers who have no previous knowledge of the Spanish language, albeit previously noted national census data shows changing trends in this regard. The continual program growth experienced within the district provoked the need for action research in various components of instructional planning and pedagogy.

The articulated research questions for each study are:

(1) How can the introduction of dual language books (DLB) be used as an instructional strategy in the Spanish bilingual classroom, for strengthening young emerging bilinguals' explicit awareness of both English and Spanish?
(2) How can authentic task design strengthen cross-linguistic transfer and bilingual identities?
(3) (a) What are the critical principles of an evolving bilingual pedagogy within a holistic learning context? (b) What is the nature of professional learning support needed to leverage such a shift in bilingual pedagogy?

Researchers examined the initial findings of each of the subsequent action research studies in which teachers and students explored the role of cross-linguistic transfer relative to engaging content learning, literacy development in both languages, and pedagogic approaches to second language acquisition. Emerging trends from each of the studies' key findings were then extrapolated and further described in a proposed framework for bilingual pedagogy.

PART 1: DUAL LANGUAGE BOOKS IN KINDERGARTEN AND GRADE 1

Dual language books are illustrated books, written in two languages: generally, one language is featured on a page, and the facing page features the other language. By reading these languages in tandem (Sneddon, 2009), it is possible to allow language learners to access a unique fund of knowledge and encourage transfer of conceptual knowledge and skills across languages (Cummins et al., 2005). This study explored the question: how can the introduction of DLBs be used as an instructional strategy in the Spanish bilingual classroom, for strengthening young emerging bilinguals' explicit awareness of both English and Spanish?

Participants and methodology

The research involved 102 students in kindergarten and grade 1, several grade 3 and grade 4 students selected as reading partners and four teachers and parents. Informed consent was obtained for the varying participants, based on district-level ethics protocols. The researchers organized several professional development sessions hosted by the school in which best practices were shared for developing holistic bilingual literacy instruction. As part of these sessions, DLBs were introduced as possible instructional tools and further information was provided to the parent community through letters and meetings. Several goals were identified: (a) to establish targeted instructional strategies for enhancing metalinguistic awareness in pre-readers, (b) to draw in parents as educational partners within the bilingual program, and (c) to encourage older students in the school to participate as readers in the DLB reading program.

Preparatory work to discuss the principles and functions of DLB reading included a 1-hour session for parent readers and mini-sessions for selected grade 3 and grade 4 advanced student readers. Three 20 minute DLB reading sessions, filmed by researchers and assistants, were held weekly and attended by the parent readers. In the first reading, the teacher built vocabulary in Spanish for the text and read a page in Spanish, followed by a parent reading the same passage in English. In the second reading, the parent participant read in Spanish (L2), and the teacher read in English with a focus on explicit metalinguistic awareness. This included vocabulary building, drawing on previous experience with themes, and direct comparisons between the two languages. This was aided by projecting the books using interactive white boards (Smart board technology). In the third reading, the grade 3 and grade 4 students read the text with their younger buddies (kindergarten or grade 1) in six small groups (each group was provided with a copy of the dual language text). The grade 3 and grade 4 students made observations, asked questions, modeled leadership, and interacted with the kindergarten readers about the DLB texts.

All sessions were recorded to capture conversation between all participants on the similarities and differences between languages. Teacher participants, together with other colleagues on the campus, analyzed the video recordings for evidence of metalinguistic awareness. These recordings were also used in professional learning community discussions.

Results

When students within the early years bilingual context are provided with strategic mini-readings of DLBs, students, teachers, parents, and student readers have permission to explore commonalities and differences between languages and initiate conversations about language as an object of thought and a resource for enriching interdependent language proficiencies. Further, when languages are displayed on the interactive whiteboard so that comparisons can be made as a class, students develop sophisticated metalinguistic awareness, which supports not only strong second language learning, but also enhances students' knowledge of their

first language. During a reading of a DLB the teacher reflected on the purposeful way that students engaged with both languages, for example one student commented on the different number of letters in the Spanish and English alphabet because the ñs (*eh-nyeh*) in Spanish adds another sound and symbol to the Spanish alphabet.

Results taken from video vignette analyses also demonstrated development of leadership skills in student readers as they modeled their bi-literacy and bilingual identity to younger participants. Older students facilitated heightened language awareness and comparison of similarities and differences in text between English and Spanish through a series of noticing exercises. From the professional learning perspective, as a result of the use of DLBs teachers engaged in discussion and exploration of pedagogical strategies to support the growth of metalinguistic awareness, bi-literacy and the emerging bilingual identity of young readers.

As well as increasing parent community involvement in the classroom as a result of volunteering as DLB readers, this process provides the opportunity to coach parents in ways of using bilingual texts to engage readers at home and to further promote metalinguistic awareness in young children. Students were exposed to different accents in Spanish. One teacher described how two mothers from different Hispanic backgrounds had to verify certain words before reading. "So when we were reading the Spanish both of them at different times had to take the turnip book in particular. The lady who was from Mexico had to take and she had to write down words that were written in Spanish because she never heard them before. Same with Señora C from Chile she identified words that she had never seen before."

PART 2: CROSS-LINGUISTIC VIDEO LITERACY PROJECT IN GRADE 3 AND 4

Through a single case study the researcher explored the question: How can authentic task design strengthen cross-linguistic transfer and bilingual identities? The aim was to determine what specific aspects of cross-linguistic transfer occurred when engaging in research on the ancient civilization of Peru in L1 (English), and transferring knowledge into the development of a modern Indian Jones story in L2 (Spanish). The video production included creating characters and a plot, writing a script in small groups, and acting in, filming and editing the video recordings in both L1 and L2.

Participants and methodology

Over a period of 6 months a multi-grade bilingual teacher, an English speaking professional videographer and 23 grade 3 and grade 4 students participated in this project. Data from the teacher interviews, student learning artifacts, student responses and self-reflections was collected and the results triangulated through the lens of three main aspects of cross-linguistic transfer: conceptual knowledge, linguistic elements, and metacognitive/metalinguistic effects (Ó Duibhir and Cummins, 2012).

Results

Analysis of the data revealed the effects of the teacher's intentionality in bridging conceptual knowledge between the program of studies (Spanish) and the personal, lived experiences of the students (English). Knowledge was created and shared using extensive collaborative dialog, a key precursor to the writing process, which students later worked on together in small groups. The teacher extrapolated key outcomes in the program of studies for both languages, emphasizing the common processes for social and cognitive development. She sought out how the students could build their vocabulary in Spanish, while also learning, building and investigating in English to broaden their knowledge base. This approach positively influenced simultaneous, bilingual literacy growth as well as the integration of learner identity across and between Spanish and English.

Through analyzing student speaking parts of the video project, an active interlanguage phase that includes awareness of content in both languages is evident. The teacher regularly conducted conferences on linguistic elements with small groups of students to build vocabulary, grammatical structures and syntax as the transfer of linguistic elements was weak (verb tenses, word gender, syntax, and possession). These results support earlier work by Verhoeven (1994), in which syntactic functioning transfer is poor. These conferences occurred strategically and in response to expressed student needs. Students also showed sophisticated levels of awareness about these linguistic elements. During student focus group interviews and in reflection journals, they commented on how their language had changed through more exposure to explicit instruction in sentence structure and syntax.

Salient to the process of inquiry was the ongoing feedback that the teacher requested of the students in their own, and each other's learning, including evaluating one another's Spanish scripts, and assessing aspects of oral language production through student-created rubrics. A final reflection piece was given to students at the conclusion of the project with questions posed in English, such as: *what new skills did you learn?* and, *how will these skills help you in your life, or in another project?* The teacher described the metacognitive and metalinguistic awareness processes as being integral to the building of self-awareness throughout content and language learning.

Results of the case study confirm that students' engagement through meaningful, relevant inquiry is the most significant indicator of their level of engagement with the second language. Engagement is best supported through multi-disciplinary tasks which intentionally enlist both L1 and L2 in the creation of cross-linguistic knowledge transfer and ultimately enhance bi-literacy and growth of bilingual identity in learners. Multi-disciplinary tasks also facilitate strategic engagement of metalinguistic awareness and explicit development of features of the L2.

PART 3: PROFESSIONAL LEARNING JOURNEY OF SPANISH BILINGUAL PROGRAM TEACHERS

The multi-faceted goals of this provincially mandated additive bilingual model combined with the lack of an articulated pedagogy for this model, produced a complex pedagogic challenge for bilingual program teachers and leaders. They attempted to shift their professional practice to explore bilingual pedagogy, and simultaneously to identify, nurture, and sustain the professional learning process needed to advance this exploration. Consequently this study addressed a two-part question: (a) what

are the critical principles of an evolving bilingual pedagogy within a holistic learning context? and, (b) what is the nature of professional learning support needed to leverage such a shift in bilingual pedagogy?

Participants and methodology

Over a period of three school years a campus team of 25 kindergarten to grade four Spanish-English bilingual program teachers participated in the study. Within the school's Professional Learning Community (PLC) structure, members of the team collaborated in designing authentic inquiry-based learning tasks across the two languages (L1 and L2), exploring the tasks with students, and then collecting, sharing and analyzing artifacts and feedback with colleagues in the PLC context. The bilingual pedagogic challenges and strategies and the collaborative professional learning needs were tracked through several cycles of professional inquiry during the 2010–2011 school year. Qualitative data was gathered using the tools of individual teacher questionnaires, a teacher focus group, and PLC reflections. As well, at the end of the year, four grade 3 and grade 4 students were interviewed to validate and further inform teacher perceptions about this experience. During the next two school years 2011–2012 and 2012–2013, two individual follow-up teacher video interviews were conducted, and additional professional learning community questions were generated during a staff retreat. This additional data contributes to building a longitudinal perspective about this professional learning experience.

Results

Through the eyes of practicing bilingual teachers and corroborated by student voice, this study tracks shifts in practice from traditional teacher-directed language learning to increased design-for-learning that capitalized on activation of cross-linguistic transfer. Teachers cited examples of increasing sophistication in critical thinking and increased levels of intellectual engagement as students made conceptual connections and applied skills across languages. One teacher describes both languages as the tools that support the content, which is the star of each conversation. She continued to say that sometimes students are not aware that they are asking a question in Spanish. At the same time, students articulated approaches and strategies for dealing with language related challenges, which demonstrates increasing awareness of their personal control of learning. For example one student commented on the ease of learning when connections existed between the classroom languages, and another student articulated how her strategy to independently borrow and read library books in L2 has positively impacted her Spanish pronunciation and her confidence to take risks in learning. From the perspectives of teachers and students, engagement in learning was being activated by the discovery of meaningful connections across content and across languages. Further, engagement facilitated by cross-linguistic transfer contributed positively to the growing bilingual identity of students, as was demonstrated by the increased amount of natural flow between languages.

Teachers quickly identified pedagogic questions and challenges relevant to a shift that focuses on cross-linguistic learning in a holistic environment. This includes questions about task design and strategies for cross-linguistic transfer, appropriate interactive classroom structures for L2 practice and feedback, and principles of instructed language learning as they pertain to the effective role of L1 and access to extended time to L2. Teachers were adamant that access to expert knowledge on current pedagogy and collaborative exploration of professional learning environments including, observation, peer coaching and resource development are critical to the effective evolution of a 50–50% bilingual pedagogy.

To summarize, this professional inquiry perspective data supports several key findings: (1) when students learn in holistic contexts, there is strong evidence of cross-linguistic transfer, as well as growing metalinguistic awareness and an evolving bilingual identity, (2) teachers identified their need for articulating appropriate second language acquisition strategies within this context and for facilitating student collaboration environments, (3) teachers identified their need for access to expertise on second language pedagogic approaches, and for regular collaborative inquiry and peer-coaching opportunities.

FRAMEWORK FOR BILINGUAL PEDAGOGY: THE ROLE OF CROSS-LINGUISTIC TRANSFER

As a result of ongoing research and collaboration between the school jurisdiction and the University of Calgary, the authors propose a conceptual framework representing an evolutionary shift in pedagogical practices in elementary bilingual schools. While the principles highlighted below are specific to one elementary Spanish bilingual school, they provide relevance to other bilingual settings in Alberta as well. In the framework shown in **Figure 1** the researchers situate cross-linguistic transfer, rooted in the *principle of linguistic interdependence*, at the center of bilingual learning. Cross-linguistic transfer at the center facilitates a flexible, reciprocal and dynamic interplay between content, language and the student learning experiences. When viewed as a theory of action, the framework proposes that when learning in the bilingual context focuses on two-way transfer across languages, then learners will develop stronger metalinguistic awareness and enhanced biliteracy skills; while experiencing greater student engagement and therefore nurturing bilingual identities.

Our data demonstrates that as teachers and students involved in the three action research studies explored the potential of cross-linguistic transfer in various learning contexts, they experienced extensive examples of linguistic interdependence and related learning effects. Below, in the words of teachers and students, we present examples that illustrate the specific elements of this conceptual framework in relation to these experiences.

BI-LITERACY DEVELOPMENT

In the professional learning study teachers repeatedly commented that students were trying strategies without being asked, and transferring the literacy skills from language to language. Comments included: "Students are independently transferring English story telling skills to relevant Spanish language contexts"; and "students spontaneously switched to debating in Spanish during a news debate started in English." Another teacher

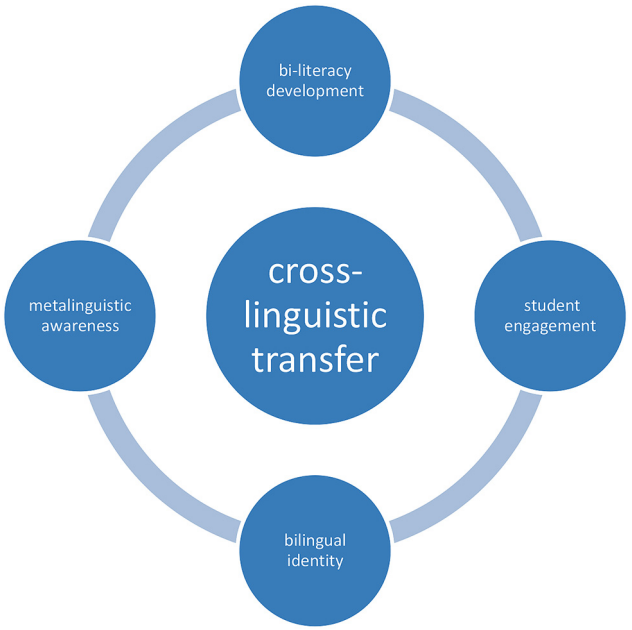


FIGURE 1 | Conceptual framework for 50–50% bilingual pedagogy, diagramming the centrality of cross-linguistic transfer in relation to linguistic interdependence and bilingual learning.

commented on her own uncertainty as to whether she had taught students the structuring of informative texts in Spanish or in English, she concluded by saying that ultimately it did not matter because meaningful learning was happening in both languages and the knowledge and skills taught or practiced in one language were soon applied in other relevant learning contexts. In the DLB study teachers provided similar examples where students were building a deeper knowledge of the two languages: "It was really fun and delightful to see one of my students," "Well Señorita M. those two sounds are the same when you hear them but they're written differently in the book."

BILINGUAL IDENTITY

Teachers and students provided many examples of personal engagement in either language when students participated in meaningful tasks and in a risk-supported environment. One student described his experience: "sometimes it just happens (in the other language), it comes to mind and I switch." A student participating in the video literacy project said: "We came up with all the ideas in our head in English, and it just came out in Spanish. There was no – like – How do you fit this word in here?" Another student shared: "at home in the middle of dinner, I speak some in Spanish!" Children as young as 4 years old were negotiating varying colloquial terms for "school bus" in varying Spanish-speaking countries, discussing the "wua-wua" in Cuba and the "camion" in Mexico.

METALINGUISTIC AWARENESS

As the study progressed students were able to articulate specific aspects of their own languaging which had changed since being in the bilingual program. For example when reflecting on the video literacy project a student said: "When I was in kindergarten I used to say," "Yo gusta." Now that I am in grade 4, there is no such thing. Now it's "A mi me gusta." Another student shared: "In kindergarten I couldn't say anything, now I can say paragraphs and sentences, I can finally write in Spanish." They reflect on how they spoke initially and on how their understanding of grammatical elements and usage had grown. As such, they recognized their own growth along the interlanguage continuum. Another student contrasted the two languages: "the easiest part of learning Spanish is the sounds, the way you pronounce is the way you read it, but in English there are funny sounds; you can guess what the word is in English."

STUDENT ENGAGEMENT

Authentic tasks are at the heart of student engagement and when cross-linguistic transfer is employed to deepen the learning experience, heightened student engagement and more self-directed learning follows. As one teacher commented: "They didn't ask for help, they use their English skills. . ."; and from a students' perspective: "Everything is connected in our class [topics in English and Spanish], it helps us if it's connected." One teacher described the level of ownership for learning that she was now experiencing with her students: "They told me what to write on their report cards and once they did that they owned it, they are engaged and it leads to the adjustment cycle." Within the context of the DLB readings grade 3 and 4 students read to the grade 1 students in Spanish and asked them to identify linguistic differences between English and Spanish. "Today, in our last reading one group with Jessica's kids were umm Señora, we are, we have challenged these grade ones today, we are challenging them to find five differences." Within the video literacy project, the teacher described her planning processes in this way: the students all began to think about how they could tie in the Incan [people] with a story that sparked their interest in unraveling ancient clues. We discussed what types of personalities and characters they wanted to include. And we held onto that piece that excited them in the theaters about Indiana Jones, and with that they began to create their own story. I began to think, most of the background information was conducted in English. "How could we take that interest and start to transform it, and to build their Spanish vocabulary around it?"

We specifically refer to the Ó Duibhir and Cummins (2012) report, in which extensive research highlights similar evidence to support the view that:

> "literacy-related skills and knowledge can be transferred across languages. When teachers encourage this transfer explicitly they make learning more efficient for the learners and reinforce effective learning strategies." (p. 12).

This position is reinforced and mandated in the Alberta bilingual programs of study, wherein the rationale explicitly addresses cross-language competence, stating that many of the first language skills of learners are transferable within the stated bilingual programming context and that in acquiring a new language, these skills can also be transferred to the first language (Alberta Education, 2005). This document further identifies effective bilingual

learning environments as those where there is a significant relationship between various subject area experiences and where connections to prior knowledge and experience are made (Alberta Education, 2005).

DISCUSSION: CONCLUSION AND RECOMMENDATIONS

Referring back to Ó Duibhir and Cummins (2012) and to the rationale in the Alberta bilingual programs of study, the researchers advocate for a pedagogy building on connections across languages (in this specific example Spanish and English). Our results provide powerful examples of flexible approaches to bilingual pedagogy that foster higher levels of literacy engagement in both languages, as well as other relevant learning effects as described in **Figure 1**. "When we free ourselves from exclusive reliance on monolingual instructional approaches, a wide variety of opportunities arise. . .that acknowledge the reality of, and strongly promote cross-linguistic transfer (Cummins, 2007).

Through our findings we invite practitioners to reflect on the proposed framework as a stepping stone to evolving a collaborative pedagogy with cross-linguistic transfer at the center of this work. Our results provide a strong argument for practitioners and researchers to address the following recommendations:

(1) Allow for flexibility in scheduling so that inter-disciplinary and inter-linguistic learning facilitate cross-linguistic transfer; ultimately supporting all elements in the framework.
(2) Participate in further action research regarding current bilingual pedagogy that is tailored to each specific learning context and the potential programming similarities and differences in each [e.g., elementary years (kindergarten to grade 6) 50% English-50% Spanish vs. junior high (grade 7 to grade 9) 65% English-35% Spanish], as well as further research regarding metacognitive and metalinguistic awareness in this cross-linguistic learning environment.
(3) Research approaches for explicitly addressing the second language learning component within this bilingual context.
(4) Negotiate professional learning networks to participate and collaborate in action research to further explore the dynamics of inter-linguistic task design, with specific attention to feedback and practice in L2, and to address controversial elements such as translanguaging and translation in the bilingual classroom, while specifically outlining the role and purpose for language usages in task design.
(5) Support recruitment and professional learning that assures an aligned vision of appropriate pedagogy for the bilingual context.

ACKNOWLEDGMENTS

We wish to gratefully acknowledge the participation of the research team members, partner educators, parents, volunteer readers, support staff and administration. As well we thank the student participants who took part in the DLB reading program, the video-literacy project, and the student interviews and questionnaires. Finally, we thank Professor Jim Cummins (Canada Research Chair) at the University of Toronto for his interest in and support of the work. This project was supported by the Calgary Board of Education.

REFERENCES

Alberta Education. (2000). "School act," in *Revised Statues of Alberta*. Available at: http://www.qp.alberta.ca/documents/Acts/s03.pdf

Alberta Education. (2005). *Spanish Language Arts Kindergarten to Grade 6 (Program of Study)*. Available at: http://www.education.alberta.ca/media/831240/span_ele.pdf

Alberta Education. (2006). *Memorandum of Understanding for Education Cooperation Between The Ministry of Education and Science of the Kingdom of Spain and the Department of Education of the Province of Alberta*. Available at: http://www.international.alberta.ca/documents/International/Spain-AB.pdf

Alberta Education. (2012). *Guide to Education, ECS to Grade 12, 2012–2013*. Available at: http://newsmanager.commpartners.com/linktrack.php?url=http%3A%2F%2Feducation.alberta.ca%2Fadmin%2Fresources%2Fguidetoed.aspx

Calgary Board of Education. (2013). School Enrolment Report 2013–2014. Available at: http://www.cbe.ab.ca/aboutus/documents/2013-2014-School-Enrolment-Report.pdf.16, Attachment II

Celic, C., and Seltzer, K. (2011). *Translanguaging: A CUNY-NYSIEB Guide for Educators*. New York: CUNY – NYSIEB, The Graduate Center, The City University of New York.

Creese, A., and Blackledge, A. (2010). Translanguaging in the bilingual classroom: a Pedagogy for learning and teaching? *Mod. Lang. J.* 94, 103–115. doi: 10.1111/j.1540-4781.2009.00986.x

Cummins, J. (1979). Linguistic interdependence and the educational development of bilingual children. *Rev. Educ. Res.* 49, 222–251. doi: 10.3102/00346543049002222

Cummins, J. (1981). "The role of primary language development in promoting educational success for language minority students," in *California State Department of Education (Ed.), Schooling and Language Minority Students: A Theoretical Framework* (Los Angeles: Evaluation, Dissemination and Assessment Center, California State University), 3–49.

Cummins, J. (1996). *Negotiating identities: education for empowerment in a diverse society*. Los Angeles, CA: California Association for Bilingual Education.

Cummins, J. (2000). *Language, Power and Pedagogy: Bilingual Children in the Crossfire*. Clevedon: Multilingual Matters.

Cummins, J. (2001). *Negotiating Identities: Education for Empowerment in a Diverse Society*. Los Angeles, CA: California Association for Bilingual Education.

Cummins, J. (2005). A proposal for action; strategies for recognizing heritage language competencies as alearning resource within the mainstream classroom. *Mod. Lang. J.* 89, 585–592.

Cummins, J. (2007). Rethinking monolingual instructional strategies in multilingual classrooms. *Can. J. Appl. Linguist.* 10, 221–240.

Cummins, J. (2008). "Teaching for transfer: challenging the two solitudes assumption in bilingualeducation," in *Encyclopedia of Language and Education*, Vol. 5, *Bilingual education,* 2nd Edn, eds J. Cummins and N. H. Hornberger (Boston: Springer), 65–75.

Cummins, J. (2009). Pedagogies of choice: challenging coercive relations of power in classrooms and communities. *Int. J. Biling. Educ. Biling.* 12, 261–271.

Cummins, J. (2011). *The Power of Pedagogy: Negotiating the Identities of Competencies in the Language Classroom*. Graz: ECML Conference.

Cummins, J. (2014). To what extent are canadian second language policies evidence-based? Reflections on the intersections of research and policy. *Front. Psychol.* 5:358. doi: 10.3389/fpsyg.2014.00358

Cummins, J., Bismilla, V., Chow, P., Cohen, S., Giampapa, F., Leoni, L., et al. (2005). Affirming identity in multilingual classrooms. *Educ. Leadersh.* 63, 38–43.

Dressler, C., and Kamil, M. L. (2006). "First- and second-language literacy," in *Developing Literacy in Second-Language Learners. Report of the National Literacy Panel on Language-Minority Children and Youth,* eds D. August and T. Shanahan (Mahwah, NJ: Lawrence Erlbaum Associates Publishers), 197–238.

Escamilla, K., and Hopewell, S. (2009). "Transitions to biliteracy: creating positive academic trajectories for emerging bilinguals in the United States," in *International Perspectives on Bilingual Education Policy, Practice and Controversy*, ed. J. E. Petrovic (Charlotte, NC: Information Age Publishing), 60–94.

Escamilla, K., and Hopewell, S. (2010). "Transitions to biliteracy: creating positive academic trajectories for emerging bilinguals in the United States," in *International Perspectives on Bilingual Education: Policy, Practice, Controversy*, ed. J. E. Petrovic (Charlotte, NC: Information Age Publishing), 69–93.

Friesen, S., and Jardine, D. (2009). "21st century learning and learners," in *Prepared for Western and Northern Canadian Curriculum Protocol by Galileo Educational Network*. Available at: http://education.alberta.ca/media/1087278/wncp%2021st%20cent%20learning 2, no. 0 : 2

García, O. (2009). *Bilingual Education in the 21st Century: A Global Perspective*. New York: Wiley-Blackwell.

García, O., and Sylvan, C. E. (2011). Pedagogies and practices in multilingual classrooms: singularities in pluralities. *Mod. Lang. J.* 95, 385–400. doi: 10.1111/j.1540-4781.2011.01208.x

Genesee, F., and Lindholm-Leary, K. (2007). "Dual language education in Canada and the USA," in *Encyclopedia of Language and Education*, Vol. 5, *Bilingual Education*, ed. J. Cummins and N. Hornberger (Norwell, MA: Springer), 253–266.

Holmes, M. (2008). An update on school choice in Canada. *J. School Choice* 2, 199–205. doi: 10.1080/15582150802138229

Howatt, A. (1984). *A history of English language teaching*. Oxford: Oxford University Press.

Lyster, R. (2011). "Content-based second language teaching," in *Handbook of Research in Second Language Teaching and Learning 2* (New York: Routledge), 611–630.

Lyster, R., Quiroga, J., and Ballinger, S. (2013). The effects of biliteracy instruction on morphological awareness. *J. Immersion Content Based Lang. Educ.* 1, 169–197. doi: 10.1075/jicb.1.2.02lys

Ó Duibhir, P., and Cummins, J. (2012). *Towards an integrated language curriculum in early childhood and primary education (3–12 years)*. Research Report No. 16. Dublin: National Council for Curriculum and Assessment. 1649–3362.

Padoan, P. (2012). "The evolving paradigm," in *OECD Observer* 288 18. Available at: http://www.oecdobserver.org/news/fullstory.php/aid/3657/The_evolving_paradigm.html

Sneddon, R. (2009). *Bilingual Books – Biliterate Children: Learning to Read through Dual Language Books*. London: Trentham Books.

Soltero-González, L., Escamilla, K., and Hopewell, S. (2010). "A bilingual perspective on writing assessment: implications for teachers of emerging bilingual writers," in *Best Practices in ELL Instruction,* eds L. Goufan and P. Edwards (New York: Guilford Press), 222–244.

The Globe and Mail. (2012). *New bilingualism taking hold in Canada.* Available at: http://www.theglobeandmail.com/news/national/new-bilingualism-taking-hold-in-canada/article4650408/ (accessed April 28, 2014).

Verhoeven, L. T. (1994). Transfer in bilingual development: the linguistic interdependence hypothesis revisited. *Lang. Learn.* 44, 381–415. doi: 10.1111/j.1467-1770.1994.tb01112.x

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 16 February 2014; accepted: 19 April 2014; published online: 17 June 2014.
Citation: Naqvi R, Schmidt E and Krickhan M (2014) Evolving 50–50% bilingual pedagogy in Alberta: what does the research say? Front. Psychol. ***5****:413. doi: 10.3389/fpsyg.2014.00413*
This article was submitted to Language Sciences, a section of the journal Frontiers in Psychology.

frontiers in PSYCHOLOGY

OPINION ARTICLE
published: 05 December 2014
doi: 10.3389/fpsyg.2014.01359

Bilingual education searching for promising didactic proposals

Ibon Manterola*

Department of Linguistics and Basque Studies, Universidad del País Vasco/Euskal Herriko Unibertsitatea, Vitoria-Gasteiz, Spain
**Correspondence: ibon.manterola@ehu.es*

Edited by:
Mary Grantham O'Brien, University of Calgary, Canada

Reviewed by:
Mary Grantham O'Brien, University of Calgary, Canada
Jim Cummins, University of Toronto, Canada

Keywords: bilingual education, instructional strategies, integrated didactics of languages, text genres, didactic sequences

In the Basque context, the English-French bilingual education systems from Canada and Quebec are considered an indispensable reference for the Basque-Spanish and Basque-French bilingual schools, which, for the approximately last 40 years, constitute a keystone for the revitalization process of the Basque language (Zalbide, 1998). One of the crucial contributions of English-French bilingual education was to confirm that it was possible to successfully provide schooling in a second language, given some sociolinguistic, didactic, and psycholinguistic conditions. Research on French immersion showed that not only would children successfully develop the L2 or language of instruction, but also the L1 or family language and moreover, positive academic results would be obtained (Genesee, 2006). From the Basque perspective, these findings marked a milestone to support immersion schooling in Basque for Spanish or French L1 children and obviously constituted a very powerful argument in order to defend a similar system for the Basque Country (Idiazabal, 2003). It should be noted that in this new context of bilingual education and more specifically immersion education, the specificity of the Basque case was and still is that one of the languages involved is a minority language. We consider that this is not a minor fact since the Basque case is considered a very interesting example of bilingual and immersion education from the perspective of minority language education (Idiazabal et al., 2008; Cenoz, 2009).

One of the core assumptions for immersion pedagogy was that children should be provided as much contact and input with the immersion language as possible and this implied that the family language should not be present in the classroom or that its use should be minimal, keeping the language of immersion and the family language separate. This is what is called the monolingual instructional approach (Cummins, 2008). However, recent research not only in immersion but also in other bilingual and multilingual approaches proposes going beyond these assumptions and adopting a more bilingual or even multilingual didactic perspective. Cummins claims that new opportunities appear for bilingual instructional strategies in order to promote cross-linguistic transfer in bilingual students. Cummins not only mentions translations, but he also refers to the use of students' L1 in very precise stages in the production of dual language identity texts.

A bilingual or even multilingual didactic perspective is also adopted by the so-called plural approaches to languages and cultures (Troncy, 2014), which supports teaching and learning activities that imply the use of more than one linguistic variety (i.e., more than one language but also more than one variety within a single language). One of the main proposals within this approach is that children need to work with more than one language together and the core type of activity is the comparison across languages in metalinguistic activities (Candelier et al., 2012).

In our opinion, the paper by Naqvi et al. (2014) can be included in this trend toward bilingual and multilingual didactics. By offering a compact synthesis of diverse types of data (video observations, questionnaires, students' responses etc.), it permits to go beyond the "monolingual solitude assumption" in Spanish (L2)-English (L1) bilingual education. Naqvi et al. show that dual language book reading sessions provide many opportunities to work on the similarities and differences between Spanish and English and by doing so, they clearly enhance the development of metalinguistic awareness. Another type of activity studied in the paper refers to video-literacy projects in which children use both L1 and L2 as a strategy to foster cross-linguistic transfer. Overall, a more integrated model of language teaching and learning is proposed in order to exploit cross-linguistic transfer. And this requires several didactic challenges, i.e., new models of task design and strategies to successfully combine L1 and L2 in classroom activities.

Another didactic approach that is very in line with the previous ideas is the integrated didactics of languages. It consists on the design of multilingual curricula and teaching materials, and according to Cavalli (2005), its origins can already be found in 1973, when the Council of Europe claimed that the efforts to establish the links between the teaching of the mother tongue and the teaching of other languages were far from being enough. So language teachers should be able to coordinate their pedagogical activities and base their teaching on common linguistic principles. Roulet (1980) specifies that the coordination between languages covers the curricula and teaching materials, linguistic terminology, and the

design and realization of classroom activities.

As it can be appreciated, the coordination and combination between languages is conceived not only in very precise classroom activities but also in a more macro level such as the design of teaching materials and curricula. For instance, in the Andorran multilingual education Catalan is the language of instruction in the first 2 years of nursery school, that is to say, from ages 2 to 4 (Dolz and Wharton, 2008). French is added to Catalan as the language of instruction between ages 4 and 6. Within the first cycle of primary school (ages 6–8) Catalan is used to teach reading, writing, and all the subjects. French is used in some subjects but only orally and for a very initial level of reading and writing. Both Catalan and French are the languages of instruction during the second cycle of primary school (ages 8–10) and English is introduced as a subject. At ages 10 and 12 Spanish is included as the third language of instruction (and also as a subject, together with English). Finally, within the secondary school the four languages are taught as subjects and at least one subject other than a linguistic course is taught in French and in Spanish. Most subjects are taught in Catalan but the aim for the future is to increase the number of subjects taught in other languages.

In our opinion, one of the most interesting contributions of the Andorran case to the field of multilingual didactics is that it is based on didactic sequences and text genres (Dolz and Schneuwly, 1998; Bronckart, 2007) [1]. A didactic sequence is constituted by sequentially organized classroom activities whose main aim is to work on the production and comprehension of a text genre (written fairy tale, public debate, written or oral recipe, letter to the editor, etc.). The work on genres is always included within projects where the communicative context is always very clearly specified. Didactic sequences begin with the presentation of the communicative project (for instance, to create a multicultural recipe book that will be distributed to the school community), and are constituted by the production of initial texts, subsequent sets of activities focusing on difficulties identified in the initial texts, and the production of a final text which permits to assess the progression of the students and the relevance and efficiency of the activities designed by the teacher.

A recent experimental study in the field of integrated didactics of languages carried out in the Basque Country shows that a multilingual didactic sequence carried out mainly in Basque but containing some activities in English and Spanish can be successful for the learning of the three languages (Badiola et al., 2014). This research also shows that transfer plays a central role. Participants were 16-year-old multilingual students whose first language is Spanish and who live in a very predominant Spanish-speaking sociolinguistic context. Basque is their second language and the main language of instruction at school. Finally, English constitutes the third language. The text genre chosen for the didactic sequence was the short biography, which had to be produced in three languages. Within the activities of the multilingual didactic sequence very precise discursive skills were targeted (such as the organization of the contents, the production of text organizers and the reference to characters). The organization of the contents and the reference to the characters were only worked in Basque but in the final productions students not only improved the texts in Basque but also the ones in Spanish and English. Text organizers were worked in each language and overall they showed a general improvement in the final texts in three languages. The authors emphasize that the transfer of discursive skills was from the L2 of students (Basque) to the L1 and L3. We would add that this constitutes a remarkable fact since in this case the L2 is not a language of international presence such as Spanish, English or French but rather a minority language of very limited social use in a revitalization process.

The main goals of bilingual and multilingual education include three fundamental aspects of linguistic education (Idiazabal et al., 2015): the promotion of multilingual competence to use languages in diverse communicative contexts, the development of metalinguistic skills and the development of positive attitudes toward linguistic diversity in general and toward minority languages in particular. As it is argued by Naqvi et al. (2014) it is necessary to go beyond the monolingual assumption in bilingual education and precisely their research shows that bilingual instructional strategies can be successful in promoting bilingual competence and metalinguistic awareness. Along the same line, research carried out in the field of integrated didactics of languages shows that the coordination and combination between languages is also possible at the curriculum level. And it also suggests that the teaching of text genres within bilingual didactic sequences constitutes a promising didactic proposal for bilingual education.

[1]Another interesting example can be found in the Italian Aosta Valley where Italian and French bilingual didactic sequences were designed (Joly et al., 2004).

ACKNOWLEDGMENT

This work has been carried out thanks to the financial support granted by the Basque Government (IT676-13) and the Spanish Government (FFI2012-37884-C03-01).

REFERENCES

Badiola, A., Etxeberria, L., Murciano, A., and Rota, G. (2014). *Biografia Laburra Testu-Generoaren Didaktika Eleanitza D.B.H. 4. Mailan*. Donostia: Eusko Ikaskuntza-Estudios Vascos.

Bronckart, J.-P. (2007). *Desarrollo del Lenguaje y Didáctica de Las Lenguas.* Villa Lynch, Argentina: Miño y Dávila.

Candelier, M., (coord.), Camilleri-Grima, A., Castellotti, V., de Pietro, J.-P., Lõrincz, I., Meißner, F.-J., et al. (2012). *A Framework of Reference for Pluralistic Approaches to Languages and Cultures Competences and resources*. Graz: European Centre for Modern Languages.

Cavalli, M. (2005). *Education Bilingue et Plurilinguisme. Le cas du Val d'Aoste.* Paris: Didier.

Cenoz, J. (2009). *Towards Multilingual Education. Basque Educational Research from an International Perspective*. Bristol: Multilingual Matters.

Cummins, J. (2008). "Teaching for transfer: challenging the two solitudes assumption in bilingual education," in *Encyclopedia of Language and Education. Bilingual Education. Vol. 5*, eds J. Cummins and N. H. Hornberger (New York, NY: Springer), 65–75. doi: 10.1007/978-0-387-30424-3_116

Dolz, J., and Schneuwly, B. (1998). *Pour un Enseignement de l'oral.* Issy-les-Moulineaux: ESF.

Dolz, J., and Wharton, S. (2008). "Une approche socio-didactique comparée de l'enseignement des langues: le rôle des langues premières de socialisation," in *De la Comparaison en Éducation. Hommage à Soledad Perez*, eds M. A. Broyon, A. Gorga, S. Hanhart, and T. Ogay (Paris: L'Harmattan), 282–305.

Genesee, F. (2006). Una revisió dels programmes d'immersió en francès al canadà. *Quaderns d'avaluació* 6, 56–77.

Idiazabal, I. (2003). "Euskal Irakasteredu elebidunak etorkizunari begira," in *Euskaltzaleen Biltzarraren Mendeurrena. Sabino Arana Elkargoaren Jardunaldiak 2001*, ed M. Atxaga (Bilbao, NY: Fundación Sabino Arana Elkargoa), 341–353.

Idiazabal, I., Amorrortu, E., Barreña, A., Ortega, A., and Uranga, B. (2008). "Mother tongue, language of immersion. What can the school do to revitalize minorized languages," in *Endangered Languages and Language Learning Proceedings of the Conference FEL XII*, ed T. de Graaf, N. Ostler, and R. Salverda (Ljouwert: Mercator European Research Centre on Multilingualism and Language Learning; Fryske Akademy), 139–146.

Idiazabal, I., Manterola, I., and Diaz de Gereñu, L. (2015). "Objetivos y recursos didácticos para la educación plurilingüe," in *La Educación Plurilingüe y el Interaccionismo Socio-Discursivo,* eds I. Garcia-Azkoaga and I. Idiazabal (Bilbao: Universidad del País Vasco/Euskal Herriko Unibertsitatea).

Joly, M., Pasquier, A., Praz, E., and Floris, P. (2004). *Collection Crayon*. Assessorat Régional de l'Education et de la Culture de la Vallée d'Aoste, Service d'Inspection Technique.

Naqvi, N., Schmidt, E., and Krickhan, M. (2014). Evolving 50–50% bilingual pedagogy in Alberta: what does the research say? *Front. Psychol.* 5:413. doi: 10.3389/fpsyg.2014.00413

Roulet, E. (1980). *Langues Maternelles, Langues Secondes, Vers une Pédagogie Intégrée*. Paris: Hatier.

Troncy, C. (dir.) (2014). *Didactique du Plurilinguisme. Approches Plurielles des Langues et des Cultures. Autour de Michel Candelier.* Rennes: Presses Universitaires de Rennes.

Zalbide, M. (1998). Normalización lingüística y escolaridad: un informe desde la sala de máquinas. *Revista Internacional de Estudios Vascos* 43, 2. 355–424.

Conflict of Interest Statement: The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 27 September 2014; accepted: 07 November 2014; published online: 05 December 2014.

*Citation: Manterola I (2014) Bilingual education searching for promising didactic proposals. Front. Psychol. **5**:1359. doi: 10.3389/fpsyg.2014.01359*

This article was submitted to Language Sciences, a section of the journal Frontiers in Psychology.

frontiers in
PSYCHOLOGY

ORIGINAL RESEARCH ARTICLE
published: 18 June 2014
doi: 10.3389/fpsyg.2014.00533

A multilingual and multimodal approach to literacy teaching and learning in urban education: a collaborative inquiry project in an inner city elementary school

Burcu Yaman Ntelioglou[1]*, Jennifer Fannin[2], Mike Montanera[2] and Jim Cummins[1]

[1] *Department of Curriculum, Teaching and Learning, Ontario Institute for Studies in Education, Toronto, ON, Canada*
[2] *Toronto District School Board, Toronto, ON, Canada*

Edited by:
Rahat Naqvi, University of Calgary, Canada

Reviewed by:
Heather Dianne Lotherington, York University, Canada
Shelley Kathleen Taylor, Western University, Canada

****Correspondence:***
Burcu Yaman Ntelioglou, Department of Curriculum, Teaching and Learning, Ontario Institute for Studies in Education, 706-2 Clairtrell Road, Toronto, ON M2N 7H5, Canada
e-mail: b.yaman@mail.utoronto.ca

This paper presents findings from a collaborative inquiry project that explored teaching approaches that highlight the significance of multilingualism, multimodality, and multiliteracies in classrooms with high numbers of English language learners (ELLs). The research took place in an inner city elementary school with a large population of recently arrived and Canadian-born linguistically and culturally diverse students from Gambian, Indian, Mexican, Sri Lankan, Tibetan and Vietnamese backgrounds, as well as a recent wave of Roma students from Hungary. A high number of these students were from families with low-SES. The collaboration between two Grade 3 teachers and university-based researchers sought to create instructional approaches that would support students' academic engagement and literacy learning. In this paper, we described one of the projects that took place in this class, exploring how a descriptive writing unit could be implemented in a way that connected with students' lives and enabled them to use their home languages, through the creation of multiple texts, using creative writing, digital technologies, and drama pedagogy. This kind of multilingual and multimodal classroom practice changed the classroom dynamics and allowed the students access to identity positions of expertise, increasing their literacy investment, literacy engagement and learning.

Keywords: urban education, multilingualism, multiliteracies, multimodality, collaborative inquiry, identity texts

INTRODUCTION: STUDENTS' HOME LANGUAGES, THE MISSING CONVERSATION EVEN IN PRO-SOCIAL JUSTICE URBAN EDUCATIONAL CONTEXTS

The 2011 Canadian census revealed that more than 200 languages were reported as immigrant home languages and 9 in 10 Canadians who speak a home language other than English or French live in cities, particularly Toronto, Montreal, Vancouver, and Calgary (Statistics Canada, 2013). This increase in linguistic diversity reflects the fact that over a period of 20 years, annual immigration to Canada has remained steady at about 250,000 per annum. Thus, linguistic diversity is becoming the norm in urban school systems across Canada. This increase in diversity highlights the obvious fact that "literacy" cannot be viewed as synonymous with English (or French) literacy. Outside of school, students and communities are engaged with multiple forms of literacies (Gee, 1996; Street, 2003), involving different languages.

Many educational researchers have addressed the need to respond to this demographic shift in the linguistic composition of Canadian classrooms (Cummins, 2000; Lotherington, 2011; Naqvi et al., 2012a). Within the prevailing educational practices of urban schools, it is clear that English language learners (ELLs) face serious challenges in achieving high literacy levels and literacy engagement (Collier, 1992, 1995a,b; August and Hakuta, 1998; Cummins, 2000), and also face the risk of losing their home languages (Wong-Fillmore, 1991; Portes and Hao, 1998; Baker, 2001; Oller and Eilers, 2002; Baca and Cervantes, 2004; Bialystok et al., 2004; Cummins, 2005). As early as 1988, Mary Ashworth called attention to the fact that, even with the multiculturalism that was being promoted in Canadian educational systems at the time, bilingual children were becoming less than they were, not more than they were – a contradiction to the purpose of education, which should exist to increase, rather than decrease, students' potential. Empirical research in applied linguistics and language education on the use of more than one language as a medium of instruction in schools has been carried out since the 1920s. There is considerable consensus in these studies that development of literacy in two or more languages provides linguistic, cognitive, and social advantages for bilingual/multilingual students (Hornberger, 1990, 2003; Cummins, 2001; García et al., 2007; Dagenais et al., 2008; Cummins and Early, 2011; Naqvi et al., 2012a,b). As García (2009, p. 157) has argued, schools need "to recognize the multiple language practices that heterogeneous populations increasingly bring and which integrated schooling, more than any other context, has the potential to liberate."

Unfortunately, Canadian schools have been slow to recognize the multiple language practices of their students and communities. Even in school systems that have endorsed social justice as a defining attribute of their educational philosophies (such as the Toronto District School Board TDSB), there has been little conversation about the implications of linguistic diversity for educational practice. The topic is largely absent from principals' courses and from initial teacher education courses. Prominent

books on school leadership and the management of educational change (e.g., Fullan, 2001) ignore the issue. In other words, until recently, home languages other than English or French have been viewed as largely irrelevant to children's schooling. At best, they are treated with benign neglect and ignored; at worst, some educators still consider them an obstacle to the acquisition of English or French and discourage their use in school and at home. An example of this latter orientation is the November 2011 decision of the Commission Scolaire de Montréal (CSDM), where 47% of students speak a home language other than French or English, to mandate that all students use only French throughout the school.

The absence of serious policy consideration of issues related to linguistic diversity at all levels of the educational system has resulted in the "normalization" of certain assumptions and practices in Canadian schools serving ELL:

- Provision of instructional support for ELL students is the job of the ESL teacher;
- "Literacy" refers only to English (or French) literacy;
- The cultural knowledge and home language proficiency that ELL students bring to school have little instructional relevance;
- Culturally and linguistically diverse parents, whose English may be quite limited, do not have the language skills to contribute to their children's literacy development.

In recent years, these normalized assumptions have been challenged by Canadian educators and researchers who have engaged in collaborative projects to articulate a very different set of pedagogical assumptions in regard to the multilingual realities of urban schools. These projects have attempted to build on and extend students' multilingual competencies within both "mainstream" and ESL classrooms. Cummins et al. (2006) articulated the following pedagogical claims on the basis of their collaborative work:

- ELL students' cultural knowledge and language abilities are important resources in enabling academic engagement across the curriculum;
- ELL students will engage academically to the extent that instruction affirms their identities and enables them to invest their identities in learning;
- Culturally and linguistically diverse parents represent a significant source of support for students' literacy development in both English and the home language when literacy instructional practices in the school encourage home-school collaboration.

In recent years, there has been concentrated attention by researchers across Canada on the urban classroom reality of multilingualism. These researchers come from different geographical and theoretical places, but their findings converge on the conclusion that, with little funding but a change of outlook, mainstream classroom teachers can implement multilingual, multiliteracies pedagogies with positive results for their students.

The following projects are among those that have attempted to change the ways in which Canadian schools respond to the multilingual realities of their students and communities (expanded from the list provided in Cummins and Persad, 2014):

- The *ÉLODiL* project (Éveil au Langage et Ouverture à la Diversité Linguistique – Awakening to Language and Opening up to Linguistic Diversity[1]) has developed a wide variety of classroom activities to promote students' awareness of language and appreciation of linguistic diversity. This project has been undertaken both in Montreal (Dr. Françoise Armand, Université de Montréal) and Vancouver (Dr. Diane Dagenais, Simon Fraser University; Dagenais et al., 2008; Armand and Dagenais, 2012).
- The *Dual Language Showcase*[2] was created by educators at Thornwood Public School in the Peel District School Board near Toronto to showcase the dual language writing accomplishments of elementary school students (Chow and Cummins, 2003; Schecter and Cummins, 2003).
- The *Multiliteracies* project involved a series of collaborations between educators and university researchers in the Vancouver and Toronto areas to explore the pedagogical possibilities that emerge when conceptions of literacy within schools are broadened to take account of multilingualism, multiliteracies, and multimodalities[3] (Early and Yeung, 2009; Cummins and Early, 2011).
- The *Multiliteracies Pedagogy* project initiated in 2003 by Dr. Heather Lotherington of York University in Toronto involved a range of collaborations between educators in Joyce Public School and researchers at York University to explore how the concept of plurilingualism could be translated into pedagogical design. The professional learning community at Joyce P. S. worked with students to rewrite traditional stories from a critical perspective using multimodal and multilingual forms of representation (Lotherington, 2011, 2013; Lotherington and Sinitskaya Ronda, 2012; Lotherington et al., 2013).
- *Linguistically Appropriate Practice (LAP)* is an approach to working with preschool and primary grade children from immigrant backgrounds, aimed at enabling children to realize their bilingual potential. Developed by Dr. Roma Chumak-Horbatsch (2012) at Ryerson University in Toronto, LAP consists of both an educational philosophy and a set of concrete instructional activities that help teachers transform their classrooms from monolingual into multilingual environments where students' languages are acknowledged and come to life.
- *The Dual Language Reading Project* was initiated by Dr. Rahat Naqvi of the University of Calgary and colleagues in the Calgary Board of Education. It documented the linguistic and metalinguistic benefits that students experienced as a result of teachers and community members reading dual language books to students both in linguistically diverse schools and in the Calgary Board of Education's Spanish-English bilingual program[4] (Naqvi et al., 2012a,b).
- The *Family Treasures and Grandma's Soup* dual language book project was initiated by Dr. Hetty Roessingh at the University of Calgary in collaboration with the Almadina Language Charter Academy, a public charter school focused on providing

[1] http://www.elodil.com/

[2] http://www.thornwoodps.ca/dual/index.htm

[3] www.multiliteracies.ca

[4] www.rahatnaqvi.ca

comprehensive language support to students learning English as an additional language. In the project, Kindergarten and Grade 1 students created dual language books as a means of enhancing their early literacy progress[5] (Roessingh, 2011).

- Dr. Shelly Taylor at Western University, London, Ontario, conducted a dual language book project designed to produce positive identity texts to counter damaging representations of Aboriginal communities. "The participant-authors were Aboriginal parents who wrote books intended for their preschool-aged children in their ancestral language and English" (Taylor, 2011, p. 289).
- The *ScribJab* website and iPad application[6] were created by Simon Fraser University researchers Dr. Diane Dagenais and Dr. Kelleen Toohey to enable students to read and create digital stories (text, illustrations and audio recordings) in multiple languages (English, French and other non-official languages). The website notes that "*ScribJab* creates a space for children to communicate about their stories, and come to an enhanced appreciation of their own multilingual resources."

These projects document the possibilities of what we have called *teaching through a multilingual lens* (Cummins and Persad, 2014). They represent "bottom-up" school-based language policy initiatives in which educators challenge the restrictive normalized assumptions with respect to linguistic diversity that still predominate in schools across Canada. The collaborative project which we describe below is rooted in similar pedagogical and social philosophies; simply stated, our starting point is that instruction in multilingual and multicultural schools will be effective to the extent that it challenges societal power structures that marginalize students' cultural and linguistic capital.

CONTEXT AND METHODOLOGY

METHODOLOGY AND DATA COLLECTION METHODS

The project was initiated by Jennifer Fannin and Mike Montanera, who co-taught Grades 2/3 students in this inner-city school. They questioned how, as teachers, they could build on their students' *funds of knowledge* (Gonzalez, 1995; González et al., 2005) and promote students' academic engagement, literacy investment, and literacy learning. They contacted Jim Cummins and Burcu Yaman Ntelioglou, university-based researchers, in October 2012 to explore possibilities for collaboration. This paper presents the findings from the resulting collaborative inquiry project. Methodologically, we decided that this project would be a *Collective Pedagogical Inquiry*. The goal of a collective pedagogical inquiry framework is for the teachers/school-based researchers and university-based educators/researchers to work collaboratively and examine the organizational and pedagogical choices that are being made in a specific context, explore possible alternatives, and mobilize the research evidence and their own pedagogical experiences both to articulate school-based language policies and collectively implement instructional and organizational changes that respond to the challenges and opportunities represented by the students and communities.

[5]http://www.duallanguageproject.com/

[6]www.scribjab.com

Collective Pedagogical Inquiry methodology, like Practitioner Research/Action Research (Crookes, 1993; Cochran-Smith and Lytle, 2009; Simon et al., 2012) is situated in teacher practice with the aim of researching the pedagogical questions identified by the teachers. In addition to the important aspect of the research questions coming directly from the teachers' pedagogies and the teaching and learning in their specific classrooms, another very important aspect is the collaborative and participatory approach in Collective Pedagogical Inquiry methodology. The teachers and the researchers work collaboratively from the planning of classroom work to data analysis. Challenging the teacher/researcher dichotomy, the teachers and the researchers become co-teachers and co-researchers in all aspects of the process. The data sources for this project included observation field-notes, videotaped classroom practice, and multimodal artifacts created in the classroom (e.g., digital texts, drama performances, student writings), as well as formal and informal interviews with the teachers and the students, and individual and focus group interviews with the parents.

CONTEXT AND PARTICIPANTS

Jennifer and Mike were teachers in a Grades K-8 school with about 550 students, 76% of whom spoke a language other than English at home. The two teachers described the school and community context as follows:

> Our school is an inner city school with each class composed of around 50% Hungarian Roma students. These students are here claiming refugee status and their situation has been very tenuous. The rest of our student population comprises a high number of ELLs from different backgrounds such as Tibetan, Indian, Sri Lankan, Vietnamese, Gambian and several others. (Email communication, October, 2012)

As the teachers describe in this first email communication, the research took place in an inner city elementary school with a large population of recently arrived and Canadian-born linguistically and culturally diverse students from countries such as Gambia, India, Mexico, Sri Lanka, Tibet, and Vietnam. A high number of these students were from low-SES backgrounds and some of the families lived in the subsidized "community housing" buildings in the school's neighborhood. The student body also included a recent wave of Roma students. Some of these students, at the time of the project, were experiencing significant language, literacy and social challenges. These challenges were compounded by the fact that these Roma students came from a social group that has been subjected to racism in their home countries and whose status, both social and legal, within Canada is marginalized and uncertain. In fact, over the course of the academic year, many of the Roma students and their families had been deported back to Hungary. Most of these students' lack of experience or negative experience with schooling, and their uncertainty of not knowing if their families' refugee claims would be accepted or not, all influenced both the classroom environment and students' investment and academic engagement. Within this same email, the teachers explained that their primary goals, therefore, were to spark the students' interest in reading and to change their attitudes toward literacy:

> We are interested in creating identity texts with our students in order to increase their interest in reading and improve their attitudes toward

reading. Our neediest students are also our most under-represented in terms of the books that are available to them. Our project would have these students create their own books and digital stories drawing on their cultural experience and sharing their stories with others. (Email communication, October, 2012).

The notion of identity texts (Cummins and Early, 2011) focuses on linking identity affirmation and literacy engagement. Students invest their identities in the creation of these "texts," which can be written, spoken, signed, visual, musical, dramatic, or combinations in multimodal form. Through identity texts, students' identities, cultures, languages, and past and present experiences are "reflected back in a positive light." When students share identity texts with multiple audiences (peers, teachers, parents, grandparents, sister classes, the media, etc.) they are likely to receive positive feedback and affirmation of self in interaction with these audiences. In this classroom, the use of digital technologies, as well as the use of multimodal drama pedagogy, acted as an amplifier to enhance the process of identity text production.

As mentioned in the above email, the teachers were particularly interested in the creation of multilingual identity texts with their students, not only because the home languages of most of their students were not reflected in the bilingual or multilingual books available to them, but also because they thought that their students' academic engagement and interest in literacy would increase if they could bring their knowledge of, and pride in, their cultures, identities and languages into their mainstream classrooms through the creation of multilingual texts.

The collaboration between these two Grade 3 teachers and the university-based researchers sought to create instructional approaches that would support students' academic engagement in general, and literacy engagement in particular. Many different projects took place during the academic year, based on the curriculum expectations articulated by the provincial Ministry of Education, the two teachers' specific questions, and projects that connected with students' lives and interests, opening up the pedagogical space to include students' home languages and cultural knowledge. Students were encouraged to write in their home languages, as well as in English (with the help of the school translator, their parents and their proficient peers). Our goal was to observe and document the literacy practices that emerged when the learning space was opened up to other languages in addition to English and when digital technology tools and drama pedagogy provided incentives and support for students to engage with multimodal forms of literacy. For the purposes of this paper, we will describe one of these projects, in which we explored how a descriptive writing unit could be implemented in a way that connected with students' lives and enabled them to use their home language(s) in order to increase their engagement in learning and interest in literacy.

The claims to knowledge afforded by collaborative pedagogical inquiry rest in the documentation of teaching/learning interactions and their outcomes, which are brought about by the instructional initiatives undertaken. These claims are obviously not generalizable beyond the specific classroom contexts in which the initiatives were implemented and observed. However, the documentation of what happened in these pedagogical interactions constitutes phenomena that require explanation and are capable of refuting theoretical hypotheses. For example, the claim that students' home languages cannot feasibly be mobilized for instructional purposes has been refuted by numerous examples deriving from this type of research (e.g., Chow and Cummins, 2003; Lotherington, 2011). The implications for policy can be summarized succinctly in the phrase *Actuality implies Possibility* – if a particular instructional initiative has been successfully implemented, then it *can* be implemented. Thus, our goal in the present study was to add to the documentation regarding the feasibility of undertaking instructional initiatives that position students' home languages as cognitive and instructional resources.

THEORETICAL FRAMEWORK

A number of theoretical lenses informed this work. Multiliteracies approach, initially proposed by the New London Group (1996) and elaborated subsequently by numerous researchers (e.g., Cope and Kalantzis, 2000, 2009; Hull and Schultz, 2001, 2002; Pahl and Rowsell, 2005; Anstey and Bull, 2006; Alexander, 2008; Gee, 2008; Jewitt, 2008; Mills, 2010; Lotherington, 2011; Yaman Ntelioglou, 2011; Heydon, 2012; Leander and Boldt, 2012; Hibbert, 2013) with its focus on multimodality, stresses the need for schools in the 21st century to focus on a broader range of literacies than simply traditional reading and writing skills, distinguishing itself from mainstream language and literacy theories by drawing attention to multiple modes of meaning making and communication (e.g., audio, visual, linguistic, spatial, performative) and how they can help students optimize their language and literacy learning. It also responds to the increasing cultural and linguistic diversity, paying attention to the importance of multilingualism and L1 use in the classroom.

Drawing on sociocultural and poststructural theories of identity and the notions of identity positioning (Toohey et al., 2007) and identity investment (Norton, 2000) is also important for our work, since, as Toohey et al. (2007) argue, "the formation and negotiation of identity positions represent an important dimension of classroom practices that contributes critically to students' evolving relationship with school communities and their investment in learning English" (627). Based on the poststructural notions of identities as hybrid, multiple and dynamic, and the notion of identity positioning, classroom practices that draw on students' funds of knowledge and linguistic and cultural capital help students to develop a positive sense of who they are and how they relate to their teachers, classmates and to the outside world. Literacy Engagement pedagogical framework and identity texts pedagogical practice, which we describe below, complement these notions of identity positioning, identity investment and literacy learning.

Literacy Engagement pedagogical framework (Cummins and Early, 2011) posits that literacy engagement is a major determinant of literacy achievement. This proposition is well-established empirically (e.g., Organisation for Economic Cooperation and Development [OECD], 2010) but has rarely been explicitly articulated in school improvement policies. The framework also highlights the importance of literacy engagement for (a) scaffolding meaning, (b) connecting to students' lives, (c) affirming student identities, and (d) extending students' awareness and

command of academic language across the curriculum. There is general consensus among researchers, educators, and policy-makers about the importance of scaffolding meaning, connecting to students' lives (e.g., by activating and building background knowledge) and extending language. This is illustrated by the fact that all three constructs are repeatedly invoked by the authors who were invited to contribute to the synthesis of research on ELLs published by the California Department of Education [CDE], (2010). However, the role of identity affirmation has not been generally acknowledged by policy-makers and many researchers. Thus, the Literacy Engagement framework differs from other school improvement tools insofar as it is focused on school improvement in schools serving multilingual students and highlights the role of both literacy engagement and identity affirmation as central components of effective instruction. The Literacy Engagement framework was used in the project as a starting point for discussion, among educators and researchers of the research evidence regarding effective pedagogical practice.

Linked to this pedagogical framework is the pedagogical practice of the creation of identity texts, described in a previous section. The basic claim underlying the concept of identity text is that students will engage actively with literacy only to the extent that such engagement is identity-affirming. In this regard, creative writing and other forms of cultural production (e.g., art, drama, computer animation) assume particular importance as an expression of identity, a projection of identity into new social spheres, and a re-creation of identity as a result of feedback from and dialog with multiple audiences. This re-creation of identity through the production of identity texts assumes particular importance in the case of students from social groups whose languages, cultures, religions, and institutions have been devalued, often for generations, in the wider society.

Finally, in developing our pedagogical initiatives, we took account of the need to acknowledge explicitly the multilingual and plurilingual realities of students' linguistic repertories. A distinction between multilingualism and plurilingualism has been made by the Council of Europe (CECR) and scholars in North America such as Danièle Moore (Moore, 2006; Moore and Castellotti, 2008; Moore and Gajo, 2009), Heather Lotherington (Lotherington, 2013), and Enrica Piccardo (Piccardo, 2013). Plurilingualism refers to the dynamically integrated and intersecting nature of bi/plurilingual individuals' linguistic repertoires, which include unevenly developed competencies in a variety of languages, dialects, and registers. Multilingualism, by contrast, in the Council of Europe's framework refers to the presence of several languages in a given geographical area or social context, regardless of those who speak them (Coste et al., 2009; Beacco et al., 2010; Cenoz and Gorter, 2013; Piccardo, 2013). Moore and Gajo (2009) explain that multilingualism is "the study of societal contact" and that plurilingualism is "the study of individuals' repertoires and agency in several languages" (p. 138). Citing the English version of the CECR, Moore and Gajo state that "plurilingual and pluricultural competence refers to the ability to use languages for the purposes of communication and to take part in intercultural interaction, where a person, viewed as a social agent has proficiency, of varying degrees, in several languages and experience of several cultures. This is not seen as the superposition or juxtaposition of distinct competences, but rather as the existence of a complex or even composite competence on which the user may draw" (CECR, English version, 2001, p. 168 as cited in Moore and Gajo, 2009). This nuanced understanding of plurilingual speakers as social actors developing a repertoire of multiple languages, and rarely equally or entirely fluent in all of their languages, was important to our study. In the context of our project, any attempt to connect instruction to students' lives must take account of the fact that students speak multiple languages and have varying degrees of competence in them.

RESULTS AND DISCUSSION: DESCRIPTIVE WRITING – MULTILINGUAL, MULTIGENERATIONAL DESCRIPTIONS OF FAVORITE PLACES IN SCHOOL

In this paper we describe only one of the multilingual projects in which students engaged. Our purpose is to illustrate the kinds of academic work that students with very limited English are capable of producing when teachers teach through a multilingual lens that acknowledges (1) the dynamically interconnected nature of their multiple languages and/or dialects and their relationships with each other (Piccardo, 2013); (2) that students' competencies in these multiple languages can be unevenly developed; and 3) that not only multilingual students but all students, including those who are monolingual, benefit from a multilingual pedagogy by increasing their "Language Awareness," that "has students attend systematically to language diversity and compare the patterns of their own languages as well as those of their classmates, communities, and the media" (Dagenais, 2005, n. page); and (4) that students develop metalinguistic awareness in these cross-linguistic learning environments (Duibhir and Cummins, 2012; Naqvi et al., 2014).

Descriptive writing was a curriculum expectation for Grade 3 students, and the two teacher/researchers found that this was a challenging task for the students in this class, who had a range of literacy levels from emerging to grade-level, for a number of reasons: most students had trouble moving beyond simple physical descriptions (e.g., big, green, wooden) to richer sensory and emotional analysis. Because many of ELL students were in the initial stages of reading or pre-reading and writing in English (and some with their other languages as well), their descriptions were further limited by gaps in vocabulary. Finally, some students were at such a beginning level of literacy awareness and practice, like some of the recently arrived Roma students, that engaging them in writing itself was the goal. In order to make their descriptive writing richer and more meaningful, we searched for a theme that would help them relate to and personalize their writing. We decided that the theme of "their favorite places within the school" could nurture a more descriptive, sensory, and emotional piece of writing. We also wanted them to experiment with multiple forms of text and multiple languages rather than being confined to traditional print-based text in English.

Each student first brainstormed about their favorite place and made a drawing of it. Then, each student took pictures of this favorite place using iPads. Next, they wrote a sensory and emotional description of what this special place meant for them. We recognized early on that students would become more engaged in the project if their parents and community were also involved.

Therefore, we invited the parents and extended family members to be part of the project. For homework, the students interviewed their parents or an older family member about their own experiences in Grade 3 (or elementary school), and about their own favorite place or activity in the school they attended. Students took notes during the interview and brought these notes back to school. We invited the students to write both their own stories and their parents' stories in other languages, if they wished, in addition to English.

As Toohey et al. (2007) suggest, "through participation in the social practices of the classroom, children develop a sense of the order of the academic world and their place within it, their status relative to teachers and peers, the nature of the tasks they face, and the relative legitimacy ascribed to their cultural and linguistic resources. For young second language learners, these broad lessons crucially influence investment in, access to, and acquisition of English" (626). The multilingual and multimodal practices in the classroom changed the power relations in the classroom and allowed the students access to identity positions of expertise, increasing their literacy investment, literacy engagement and learning. At the beginning of this project, the two teachers were worried because many of the newcomer ELL students, especially the Roma students, had developed "learned helplessness." When they were asked to read or write any text, their immediate response was "Miss, I don't know how to read/write." Both the multimodal practice and the multilingual practice changed this dynamic. For example, from the outset of the project, whenever we introduced the students to any technology, we decided to first teach the use of the technology (use of iPad, computer applications, etc.) to these ELL students so that they could become the experts, and later could teach their classmates, accessing their identity positions of expertise. The multimodal nature of the texts they created using digital media allowed them to express themselves in ways not limited to the linguistic mode, but multimodally using gestures, visuals, demonstrations etc. in addition to the linguistic mode. These multimodal affordances especially helped certain students who normally felt embarrassed about their lack of spoken language fluency.

The multilingual focus also allowed the student access to identity positions of expertise. **Figure 1** shows Jose [pseudonym]'s narrative, which is written both in English and Spanish. Jose was born in Canada, yet he was a fluent Spanish speaker since Spanish was regularly spoken at home. However, he had never been schooled in this language and so could not read or write in Spanish. On the other hand, his teacher, Jennifer, had studied Spanish as a foreign language and could read and write in that language, yet she never had the opportunity to become immersed in the language and develop a natural fluency. The picture of the two of them working on this project was intriguing: a standing student dictating his narrative to the seated teacher, who was trying to write it all down. There was a lively bilingual conversation between the two, since they were collaboratively deciding on certain vocabulary, expressions, and sentence structures that would best describe Jose's story. Jose's body language alone expressed the deep engagement he was experiencing in this literacy activity. He was in charge, directing the narration of his own story, and the teacher was the facilitator, working alongside her student to co-construct the text. This reversal of the traditional classroom dynamic (in which, generally, the teacher dictates to the student) resulted in the student having at least equal say in what the text was going to be about and how it was going to be told, which organically and inevitably shifted the power relations in the classroom. This kind of collaborative practice engaged the student by acknowledging his bilingual skills and maintaining his ownership of the narrative. This identity position of expertise, in turn, resulted in greater agency and a deeper level of investment as observed by the teachers and researchers.

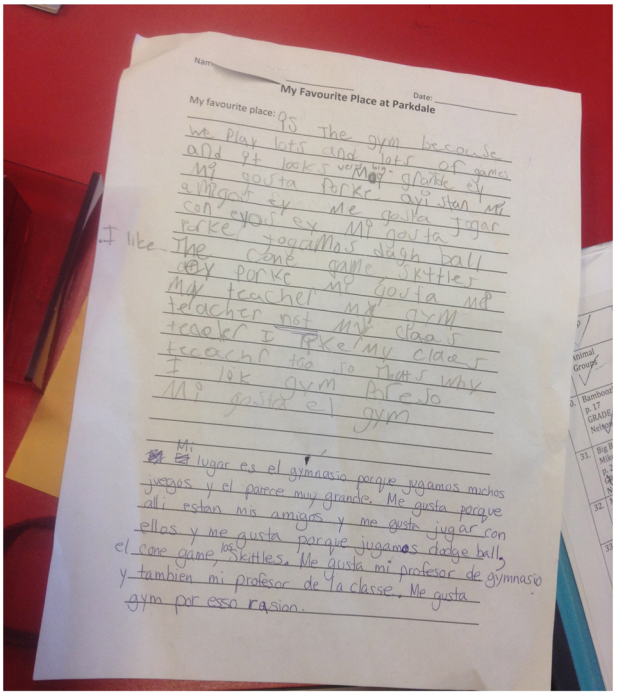


FIGURE 1 | Jose's narrative.

Pali [pseudonym] was a Roma student and English was quite new to him. Therefore, Pali, like the other Roma students in his class, chose to write his narrative (**Figure 2**) initially in Hungarian. (It is important to note here that Pali wrote in Hungarian as opposed to Romani because he had been schooled in Hungarian for a year before he arrived in Canada. Most of the Roma students in this class spoke "street Hungarian" to get by; like Pali, some had also been schooled in Hungarian.) Roma students then found ways to express themselves either in shorter sentences in English, or in a direct translation from Hungarian with the help of a school-based translator[7]. Using different digital technologies such as PowerPoint, iMovie, iPhoto, and iPads, students were also able to record their own voices reading these multilingual stories.

[7]In 2009, during the second year of the influx of Roma students, the principal hired a part-time Hungarian translator. A Hungarian, rather than Romani, translator was hired because there were no Romani translators available and, according to the Hungarian translator, Hungarian Romani is a particular type of Romani, different from the type of Romani that might be spoken in other countries. Since all students had some fluency in street Hungarian, and some had been schooled in Hungarian, the school was advised to hire a Hungarian translator.

FIGURE 2 | Pali's PowerPoint slide.

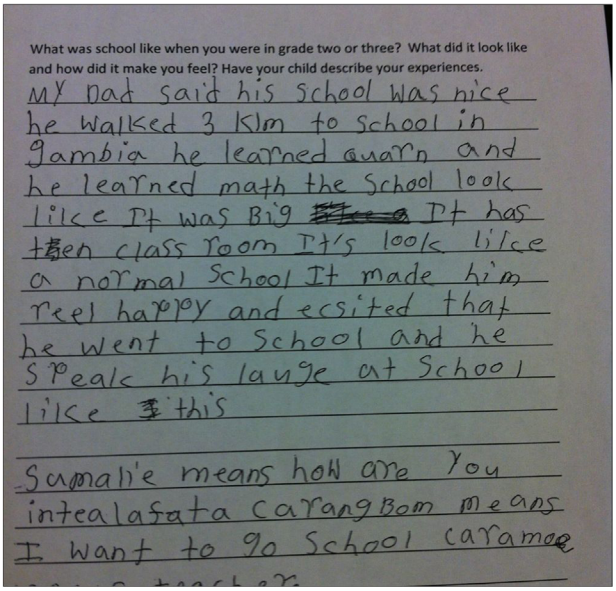


FIGURE 3 | Fatu's first draft.

They also added images, songs, sounds and other modes of representation. Some of these narratives were also turned into dramatic performances. Drama practice was a particularly important aspect of the revision process in the student's writing of their individual narratives because, as they were trying to embody the narrative that was represented on the page, they could test the print representation against what they meant to convey. This kind of dialogic feedback afforded through embodied multimodality (Yaman Ntelioglou, 2011, forthcoming) helped to immediately see what was working and what was not working with their writing.

Even students who did not have strong fluency in their home languages, because they were born in Canada and/or had been schooled here from the age of four, and who did not regularly speak their family's first language at home, responded positively to the invitation to use their home languages.

Because students were invited to write in multiple languages, some students like Fatu [pseudonym] —who said she sometimes understood her home language, Mandingo, but did not speak it — chose to include some Mandingo words in her writing. Fatu's parents are from Gambia and Fatu was born in Canada. At home the parents sometimes spoke Mandingo, but they resorted to English mostly when they spoke with Fatu and her siblings. As seen in Fatu's first draft (**Figure 3**), as well as a subsequent draft in PowerPoint (**Figure 5**), based on the interview that she did with her father, she wrote about how he walked three kilometers to school in Gambia and that he learned the Quran. She adds, "Sumalie" which she explains means "how are you;" "intelafta ta carambong" means "I want to go to school;" and "caramoe" means "teacher." This curiosity about her home language carried on past the time of the assignment. For example, one day she came to us and excitedly asked if we could videotape her with the iPad, because she now knew how to count in Mandingo. This is another example of how affirming students' multilingual and multicultural *funds* of knowledge (Gonzalez, 1995) can nurture their identities and their investment in learning, not only in their L2, but also in their L1, and in turn, foster learner autonomy (Benson, 2006; Jiménez Raya, 2009). Benson (2006) draws attention to the social dimensions of learner autonomy, and in reference to Toohey and Norton's (2003) conception of identity investment and agency, state that "agency can perhaps be viewed as a point of origin for the development of autonomy, while identity might be viewed as one of its more important outcomes" (30). As this project proceeded, Fatu became a very prolific writer and story-teller. According to her teachers, "she developed from a learner who showed initial enthusiasm for school work, but less carry-through, to a learner who was more engaged, autonomous and more able to see the work through to completion" (Teacher focus interview, February 2012). She completed the writing project and went beyond the basic requirements, adding a narrative in both of her languages as well as a song, making her narratives more multimodal as well as more representative of her identities. In the PowerPoint slides, as seen below in **Figure 4**, the two audio buttons on each slide were linked with the audio segments she recorded in English and Mandingo, even though as explained above, her proficiency in Mandingo was not advanced. It is also interesting to note that her Mandingo recordings are done in a much lower volume, which may also reflect her relative lack of confidence, but she persisted nevertheless. In the interview with Fatu, she explained that she wanted to show her audience who she is by including both of her languages, as well as a song (audio button 3), in her PowerPoint because she loves singing. She explained that for the moment she can only sing in English, but her goal is to also learn to sing in Mandingo. For her PowerPoint, when she was recording herself in Mandingo, and encountered words like "ocean" and "pool," for which she did not have equivalent Mandingo words, she altered English words by adding the final suffix –o, to make them sound more like Mandingo words. Her elder sibling, in an informal conversation, explained that the final vowel in most Mandingo words is –o. This simple translanguaging example and Fatu's explanations of this cognitive

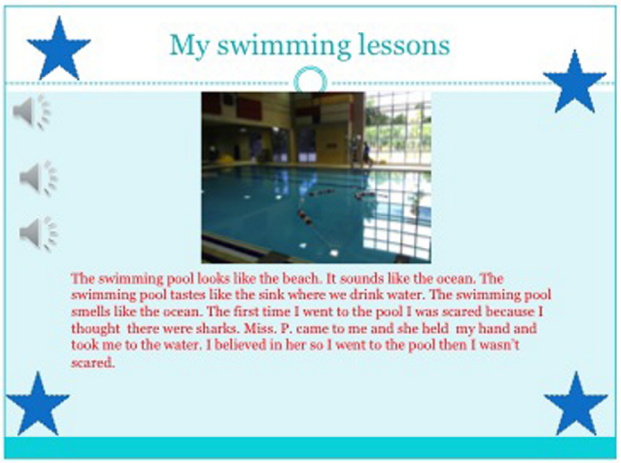


FIGURE 4 | A slide from Fatu's PowerPoint presentation.

FIGURE 5 | Another slide from Fatu's PowerPoint presentation.

process in the interview saying, "in Mandingo, most words for things end in –o" shows her metalinguistic awareness.

Mixing of languages (if conceptualized as "code-switching") can be seen as an error, a "dangerous flaw," when approached from a traditional bilingual perspective that assumes that the two languages of bilinguals are two separate monolingual codes. However, from the perspective of plurilingualism (Moore and Gajo, 2009)/multilingualism (García, 2009), Fatu's mixing of English word (pool) with the Mandingo suffix "-o" is a valuable translanguaging practice that illustrates that bilinguals have one linguistic repertoire from which they select different features strategically, to communicate more effectively.

Fatu's story was also one of the narratives that was turned into a dramatic performance. Students worked in groups and decided how they would like their individual narratives to be performed. They had options regarding which role to take on, which props they were going to use, and how they were going to bring the story alive. In the performance of her story, Fatu chose the role of storyteller, while three other classmates acted it out. Sequence one depicted her favorite place in school, and sequence two depicted her father's story. As a result of transferring the written text back and forth into the embodied, students were asked to consider "the content and context of the statements, and provided a forum that allowed for communication, restating and subsequent interaction" (Booth, 1991, p. 95). Students became aware of their own weaknesses and problems in writing by reading each others' writing and working collaboratively. The multiple voices of each of the four students (one Mandingo, one Spanish and two Tibetan speakers) informed the embodied collective creation. Fatu's group decided that since they were coming from multiple linguistic backgrounds, it would be a good idea to begin the performance by saying the title of the story in their multiple languages, and ending the performance by saying goodbye, using the words and gestures of their respective home languages and cultures.

In the classroom, having the opportunity to use their multiple languages, through multimodal texts, students had the opportunity to choose their multiple linguistic repertoires, their medium of choice(s) to express their meanings. Having these multiple options and choices allowed the students to make their texts/narratives their own, fostering learner autonomy, identity investment, and literacy engagement. Even though translanguaging practices were not explicitly taught in this class, because students were invited to use their multiple linguistic repertoires, some students naturally used translanguaging practices, drawing on all of their linguistic resources "to maximize understanding, (self-expression), and achievement. Thus, both languages (were) used in a dynamic and functionally integrated manner" (Lewis et al., 2012, p. 655), illustrating that the two or more languages of bilinguals or plurilinguals do not function as two or more separate monolinguingual codes; rather they exist as a holistic and interactive linguistic repertoire (García, 2009; Lewis et al., 2012).

CONCLUSION

As noted in our introductory section, there is a void with respect to language policy in schools, school boards, and Ministries of Education across Canada. This neglect is highly problematic because, in the absence of any coherent articulated policies, the "default option" will be to ignore students' languages, cultures, and background knowledge within schools and classrooms. Schools then become "English-only zones" (or "French-only zones" in Quebec, as well as in French-immersion programs in various provinces, Taylor, 2010; and Franco-Ontarian schooling, Russette and Taylor, in press), which reinforces the societal pattern of power relations whereby the cultural capital or funds of knowledge of dominant group communities are valued considerably more than the cultural capital of the many other communities that make up the Canadian social landscape.

However, educators have the power to exercise agency in relation to the ways in which they negotiate identities with their students (Cummins, 2001). As our case study documents, enlightened language policies can be implemented by individual teachers in their own classrooms. Furthermore, these policies are considerably more evidence-based than English-only zone policies insofar as they (a) promote students' literacy engagement, (b) scaffold comprehension and production of academic language,

(c) connect with students' lives and activate their background knowledge, (d) affirm students' identities as linguistically talented and intellectually accomplished, and (e) extend and deepen students' awareness of academic language. When teachers open up the instructional space for multilingual and multimodal forms of pedagogy, languages other than English or French are legitimized in the classroom and students' home languages and community connections become resources for learning.

ACKNOWLEDGMENTS

We would like to express our appreciation to Dr. Rahat Naqvi, University of Calgary, who collaborated in the research conducted with educators in Pinewood Junior and Senior Public School and provided important input to this project. Financial support for the project was provided by the Ontario Ministry of Education through its Knowledge Network for Applied Education Research (KNAER). Dr. Yaman Ntelioglou's involvement was supported by the Ontario Ministry of Research and Innovation, Ontario Post-Doctoral Fellowship Award.

REFERENCES

Alexander, B. (2008). Web 2.0 and emergent multiliteracies. *Theory Pract.* 47, 150–160. doi: 10.1080/00405840801992371

Anstey, M., and Bull, G. (2006). *Teaching and Learning Multiliteracies: Changing Times, Changing Literacies*. Newark: International Reading Association.

Armand, F., and Dagenais, D. (2012). S'ouvrir à la langue de l'Autre et à la diversité linguistique. *Education Canada* 52, 28–30.

August, D., and Hakuta, K. (eds). (1998). *Educating Language-Minority Children*. Washington: National Research Council, Institute of Medicine, National Academy Press.

Baca, L. M., and Cervantes, H. T. (2004). *The Bilingual Special Education Interface,* 4th Edn. Upper Saddle River, NJ: Prentice-Hall.

Baker, C. (2001). *Foundations of Bilingual Education and Bilingualism,* 3rd Edn. Clevedon: Multilingual Matters.

Beacco, J.-C., Byram, M., Cavalli, M., Coste, D., Cuenat, M. E., Gouiller, F., et al. (2010). *Guide for the Development and Implementation of Curricula for Plurilingual and Intercultural Education*. Strasbourg: Council of Europe.

Benson, P. (2006). Autonomy in language teaching and learning. *Lang. Teach.* 40, 21–40. doi: 10.1017/S0261444806003958

Bialystok, E., Craik, F. I. M., Klein, R., and Viswanathan, M. (2004). Bilingualism, aging, and cognitive control: evidence from the Simon Task. *Psychol. Aging* 19, 290–303. doi: 10.1037/0882-7974.19.2.290

Booth, D. (1991). "Our own words and the words of others," in *The Talk Curriculum*, eds D. Booth and C. Thornley-Hall (Portsmouth, NH: Heinemann), 90–105.

California Department of Education [CDE]. (2010). *Improving Education for English Learners: Research-Based Approaches*. Sacramento: California Department of Education.

Cenoz, J., and Gorter, D. (2013). Towards a plurilingual approach in English language teaching: softening the boundaries between languages. *TESOL Q.* 47, 591–599. doi: 10.1002/tesq.121

Chow, P., and Cummins, J. (2003). "Valuing multilingual and multicultural approaches to learning," in *Multilingual Education in Practice: Using Diversity as a Resource*, eds S. R. Schecter and J. Cummins (Portsmouth, NH: Heinemann), 32–61.

Chumak-Horbatsch, R. (2012). *Linguistically Appropriate Practice: A Guide for Working with Young Immigrant Children*. Toronto: University of Toronto Press.

Cochran-Smith, M., and Lytle, S. (2009). *Inquiry as Stance: Practitioner Research in the Next Generation*. New York, NY: Teachers College Press.

Collier, V. P. (1992). A synthesis of studies examining long-term language minority student data on academic achievement. *Biling. Res. J.* 16, 187–212. doi: 10.1080/15235882.1992.10162633

Collier, V. P. (1995a). *Acquiring a Second Language for School. Directions in Language and Education,* Vol. 1. Washington, DC: National Clearinghouse for Bilingual Education.

Collier, V. P. (1995b). *Promoting Academic Success for ESL Students: Understanding Second Language Acquisition for School*. NJ: New Jersey Teachers of English to Speakers of Other Languages-Bilingual Education.

Cope, B., and Kalantzis, M. (eds). (2000). *The 'What' of literacies: Literacies as Multimodal Designs for Meaning; Making Written Meanings; Making Visual Meanings; Making Spatial, Tactile and Gestural Meanings; Making oral Meanings. Multiliteracies: Literacy Learning and the Design of School Futures*, Part C: Chapter 7–11 (London: Routledge), 171–321.

Cope, B., and Kalantzis, M. (2009). "Multiliteracies": new literacies, new learning. *Pedagogies Int. J.* 4, 164–195. doi: 10.1080/15544800903076044

Coste, D., Moore, D., and Zarate, G. (2009). *Plurilingual and Pluricultural Competence. Studies Towards a Common European Framework of Reference for Language Learning and Teaching*. Strasbourg: Council of Europe Publishing.

Crookes, G. (1993). Action research for second language teachers: going beyond teacher research. *Appl. Linguist.* 14, 130–144. doi: 10.1093/applin/14.2.130

Cummins, J. (2000). *Language, Power and Pedagogy: Bilingual Children in the Crossfire*. Clevedon: Multilingual Matters.

Cummins, J. (2001). *Negotiating Identities: Education for Empowerment in a Diverse Society*, 2nd Edn. Los Angeles, CA: California Association for Bilingual Education.

Cummins, J. (2005). "Multiliteracies pedagogy and the role of identity texts," in *Teaching for Deep Understanding: Towards the Ontario Curriculum that we Need*, eds K. Leithwood, P. McAdie, N. Bascia, and A. Rodrigue (Toronto: Corwin Press), 68–74.

Cummins, J., Cohen, S., Leoni, L., Bajwa, M., Hanif, S., Khalid, K., et al. (2006). A language for learning: home languages in the multilingual classroom. *Contact* 32, 52–71. Available at: http://www.teslontario.org/new/publ/Vol32-No28.pdf

Cummins, J., and Early, M. (eds). (2011). *Identity Texts: The Collaborative Creation of Power in Multilingual Schools*. Stoke-on-Trent: Trentham Books.

Cummins, J., and Persad, R. (2014). Teaching through a multilingual lens: the evolution of EAL policy and practice in Canada. *Edu. Matters* 2.

Dagenais, D. (2005). Recognizing multilingual immersion students. *ACIE Newsletter* 8. Available at: http://www.carla.umn.edu/immersion/acie/vol8/Feb2005_research_recognizing.html

Dagenais, D., Walsh, N., Armand, F., and Maraillet, E. (2008). Collaboration and co-construction of knowledge during language awareness activities in Canadian elementary school. *Lang. Aware.* 17, 139–155. doi: 10.1080/09658410802146685

Duibhir, P. O., and Cummins, J. (2012). *Towards an Integrated Language Curriculum in Early Childhood and Primary Education (3–12 years)*. Available at: http://www.ncca.ie/en/Curriculum_and_Assessment/Early_Childhood_and_Primary_Education/Primary_School_Curriculum/Language_Curriculum_Research_Reports_/intlangreport.pdf

Early, M., and Yeung, C. (2009). Producing multimodal picture books and dramatic performances in core French: an exploratory case study. *Can. Mod. Lang. Rev.* 66, 299–223. doi: 10.3138/cmlr.66.2.299

Fullan, M. (2001). *The New Meaning of Educational Change*, 3rd Edn. Toronto: Irwin.

García, O. (2009). *Bilingual Education in the 21st Century: A Global Perspective*. Malden, MA: Blackwell. doi: 10.1111/j.1548-1395.2012.01130.x

García, O., Bartlett, L., and Kleifgen, J. A. (2007). "From biliteracy to pluriliteracies," in *Handbook of Applied Linguistics*, Vol. 5, *Multilingualism*, eds Peter Auer and Li Wei (Berlin: Mouton de Gruyter), 207–228.

Gee, J. P. (1996). *Social Linguistics and Literacies: Ideologies in Discourses,* 2nd Edn. New York: Falmer.

Gee, J. P. (2008). "Chapter 8, Discourses and literacies and Chapter 9, Language, individuals and discourses," in *Social Linguistics and Literacies: Ideology in Discourses*, 3rd Edn (London: Routlege), 256.

Gonzalez, N. (1995). The funds of knowledge for teaching project. *Pract. Anthropol.* 17, 3–6.

González, N., Moll, L., and Amanti, C. (2005). *Funds of Knowledge: Theorizing Practices in Households, Communities and Classrooms*. Mahwah, NJ: Erlbaum.

Heydon, R. (2012). Multimodal communication and identities options in an intergenerational art class. *J. Early Child. Res.* 10, 51–69. doi: 10.1177/1476718X11402751

Hibbert, K. (2013). Finding wisdom in practice: the genesis of the salty chip, a Canadian multiliteracies collaborative. *Lang. Lit.* 15, 23–38.

Hornberger, N. H. (1990). Creating successful learning contexts for bilingual literacy. *Teach. Coll. Rec.* 92, 212–229.

Hornberger, N. H. (Ed). (2003). *Continua of Biliteracy: An Ecological Frame-Work for Educational Policy, Research and Practice in Multilingual Settings.* Clevedon: Multilingual Matters.

Hull, G., and Schultz, K. (2001). Literacy and learning out of school: a review of theory and research. *Rev. Edu. Res.* 71, 575–612. doi: 10.3102/00346543071004575

Hull, G., and Schultz, K. (2002). *School's out! Bridging Out-of-School Literacies with Classroom Practice.* New York: Teachers College Press.

Jewitt, C. (2008). Multimodality and literacy in school classrooms. *Rev. Res. Edu.* 32, 241–267. doi: 10.3102/009173X0710586

Jiménez Raya, M. (2009). *Pedagogy for Autonomy in Modern Language Education: The EuroPAL contribution. Learner Autonomy in Language Learning.* Available at: http://ailarenla.org/lall/october2009/raya2009/

Leander, K., and Boldt, G. (2012). Rereading "A pedagogy of multiliteracies": bodies, texts and emergence. *J. Lit. Res.* 45, 22–46. doi: 10.1177/1086296X12468587

Lewis, G., Jones, B., and Baker, C. (2012).Translanguaging: developing its conceptualisation and contextualization. *Edu. Res. Eval.* 18, 655–670. doi: 10.1080/13803611.2012.718490

Lotherington, H. (2011). *Pedagogy of Multiliteracies: Rewriting Goldilocks.* New York: Routledge.

Lotherington, H. (2013). Creating third spaces in the linguistically heterogeneous classroom for the advancement of plurilingualism. *TESOL Q.* 47, 619–625. doi: 10.1002/tesq.117

Lotherington, H., Paige, C., and Holland-Spencer, M. (2013). *Using a professional learning community to support multimodal literacies. What works? Research into Practice.* Toronto: Literacy and Numeracy Secretariat. Available at: http://www.edu.gov.on.ca/eng/literacynumeracy/inspire/research/WW_Professional_Learning.pdf

Lotherington, H., and Sinitskaya Ronda, N. (2012). "Revisiting communicative competence in the multimedia ELT classroom," in *ESL and Digital Video Integration: Case Studies,* eds J. Li, N. Gromik, and N. Edwards (Alexandria, VA: TESOL International Association), 9–32.

Mills, K. A. (2010). A review of the 'Digital Turn' in the new literacy studies. *Rev. Edu. Res.* 80, 246–271. doi: 10.3102/0034654310364401

Moore, D. (2006). *Plurilinguismes et École.* Collection LAL (Langues et Apprentissage des Langues). Postface de Daniel Coste. Paris: Didier.

Moore, D., and Castellotti, V. (eds.) (2008). *La compétence plurilingue: Regards francophones. Collection Transversales. Langues, Sociétés, Cultures et apprentissages.* Berne: Peter Lang Éditions SA scientifiques européennes.

Moore, D., and Gajo, L. (2009). Introduction - French voices on plurilingualism and pluriculturalism: theory, significance and perspectives. *Int. J. Multiling.* 6, 137–153. doi: 10.1080/14790710902846707

Naqvi, R., McKeough, A., Thorne, K., and Pfitscher, C. (2012a). Dual language books as an emergent-literacy resource: culturally and linguistically responsive teaching and learning. *J. Early Child. Lit.* 13, 501–528. doi: 10.1177/1468798412442886

Naqvi, R., Thorne, K., Pfitscher, C., Nordstokke, D., and McKeough, A. (2012b). Reading dual language books: improving early literacy skills in linguistically diverse classrooms. *J. Early Child. Res.* 11, 3–15. doi: 10.1177/1476718X12449453

Naqvi, R., Schmidt, E., and Krickhan, M. (2014). Evolving 50%-50% bilingual pedagogy in alberta: what does the research say? *Front. Psychol.* 5:4. doi: 10.3389/fpsyg.2014.00413

New London Group. (1996). A pedagogy of multiliteracies: designing social futures. *Harvard Edu. Rev.* 66, 60–92.

Norton, B. (2000). *Identity and Language Learning: Gender, Ethnicity and Educational Change.* Harlow.: Pearson.

Organisation for Economic Cooperation and Development [OECD]. (2010). *PISA 2009 Results: Learning to Learn – Student Engagement, Strategies and Practices,* Vol. 3. Paris: OECD. Available at: http://www.oecd.org/dataoecd/11/17/48852630.pdf

Oller, D. K., and Eilers, R. E. (2002). "Balancing interpretations regarding effects of bilingualism: Empirical outcomes and theoretical possibilities," in *Language and Literacy in Bilingual Children,* eds D. K. Oller and R. E. Eilers (Clevedon: Multilingual Matters), 281–292.

Pahl, K., and Rowsell, J. (2005). *Literacy and Education: Understanding the New Literacy Studies in the Classroom.* London: Paul Chapman. doi: 10.1177/1468798407074841

Piccardo, E. (2013). Plurilingualism and curriculum design: towards a synergic vision. *TESOL Q.* 47, 600–614. doi: 10.1002/tesq.110

Portes, A., and Hao, L. (1998). E pluribus unum: bilingualism and loss of language in the second generation. *Soc. Edu.* 71, 269–294. doi: 10.2307/2673171

Roessingh, H. (2011). Family treasures: a dual language book project for negotiating language, literacy, culture and identity. *Can. Mod. Lang. Rev.* 67, 123–148. doi: 10.3138/cmlr.67.1.123

Russette, A., and Taylor, S. K. (in press). Pedagogy and learning environment in a Franco-Ontarian child care centre. Language and Literacy: A Canadian eJournal. (Special issue on "Literacy practices in the Francophone context").

Schecter, S., and Cummins, J. (2003). *Multilingual Education in Practice: Using Diversity as a Resource.* Portsmouth, NH: Heinemann.

Simon, R., Campano, G., Broderick, D., and Pantoja, A. (2012). Practitioner research and literacy studies: toward more dialogic methodologies. *Engl. Teach. Pract. Critiq.* 11, 5–24.

Statistics Canada. (2013). *Immigration and Ethnocultural Diversity in Canada.* Ottawa, ON: Ministry of Industry. Available at: http://www12.statcan.gc.ca/nhs-enm/2011/as-sa/99-010-x/99-010-x2011001-eng.pdf

Street, B. V. (2003). "What's 'new' in New Literacy Studies?" Critical approaches to literacy in theory and practice. *Curr. Issues Comp. Edu.* 5, 77–91.

Taylor, S. (2011). Identity texts as decolonized writing: beyond the cowboys and Indians meta-narrative. *Writ. Pedagogy* 3, 289–304. doi: 10.1558/wap.v3i2.289

Taylor, S. K. (2010). "The caste system approach to multilingual education in Canada: linguistic and cultural minority children in French immersion," in *Social Justice Through Multilingual Education,* eds T. Skutnabb-Kangas, R. Phillipson, A. K. Mohanty, and M. Panda (Clevedon: Multilingual Matters), 177–198.

Toohey, K., Day, E., and Manyak, P. (2007). "ESL learners in the early school years: identity and mediated classroom practices," in *International Handbook of English Language Teaching,* Vol. I, eds J. Cummins and C. Davison (New York: Springer Science + Business Media), 545–558.

Toohey, K., and Norton, B. (2003). "Learner autonomy as agency in sociocultural settings," in *Learner Autonomy Across Cultures: Language Eeducation Perspectives,* eds D. Palfreyman and R. Smith (Basingstoke: Palgrave Macmillan), 58–72.

Wong-Fillmore, L. W. (1991). When learning a second language means losing the first. *Early Child. Res. Q.* 6, 323–347. doi: 10.1016/S0885-2006(05)80059-6

Yaman Ntelioglou, B. (forthcoming). "Embodied multimodality framework: examining language and literacy practices of English language learners in drama classrooms," in *Methodologies of Embodiment: Inscribing Bodies in Qualitative Research* (Routledge Advances in Research Methods), eds M. Perry and C. Medina (New York: Routledge), 160.

Yaman Ntelioglou, B. (2011). 'But why do I have to take this class?' The mandatory drama-ESL class and multiliteracies pedagogy. *Res. Drama Educ. J. Appl. Theatre Perform.* 16, 595–615.

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 13 January 2014; accepted: 14 May 2014; published online: 18 June 2014.
*Citation: Yaman Ntelioglou B, Fannin J, Montanera M and Cummins J (2014) A multilingual and multimodal approach to literacy teaching and learning in urban education: a collaborative inquiry project in an inner city elementary school. Front. Psychol. **5**:533. doi: 10.3389/fpsyg.2014.00533*
This article was submitted to Language Sciences, a section of the journal Frontiers in Psychology.

frontiers in
PSYCHOLOGY

HYPOTHESIS AND THEORY ARTICLE
published: 07 May 2014
doi: 10.3389/fpsyg.2014.00358

To what extent are Canadian second language policies evidence-based? Reflections on the intersections of research and policy

Jim Cummins*

Department of Curriculum, Teaching and Learning, Ontario Institute for Studies in Education, The University of Toronto, Toronto, ON, Canada

Edited by:
Rahat Naqvi, University of Calgary, Canada

Reviewed by:
Olenka Bilash, University of Alberta, Canada
Bonny Norton, University of British Columbia, Canada

****Correspondence:***
Jim Cummins, Department of Curriculum, Teaching and Learning, Ontario Institute for Studies in Education, The University of Toronto, Toronto, ON M5S 1V6, Canada
e-mail: james.cummins@utoronto.ca

The paper addresses the intersections between research findings and Canadian educational policies focusing on four major areas: (a) core and immersion programs for the teaching of French to Anglophone students, (b) policies concerning the learning of English and French by students from immigrant backgrounds, (c) heritage language teaching, and (d) the education of Deaf and hard-of hearing students. With respect to the teaching of French, policy-makers have largely ignored the fact that most core French programs produce meager results for the vast majority of students. Only a small proportion of students (<10%) attend more effective alternatives (e.g., French immersion and Intensive French programs). With respect to immigrant-background students, a large majority of teachers and administrators have not had opportunities to access the knowledge base regarding effective instruction for these students nor have they had opportunities for pre-service or in-service professional development regarding effective instructional practices. Educational policies in most jurisdictions have also treated the linguistic resources that children bring to school with, at best, benign neglect. In some cases (e.g., Ontario) school systems have been explicitly prohibited from instituting enrichment bilingual programs that would promote students' bilingualism and biliteracy. Finally, with respect to Deaf students, policy-makers have ignored overwhelming research on the positive relationship between academic success and the development of proficiency in natural sign languages, preferring instead to leave uncorrected the proposition that acquisition of languages such as American Sign Language by young children (with or without cochlear implants) will impede children's language and academic development. The paper reviews the kinds of policies, programs, and practices that could be implemented (at no additional cost) if policy-makers and educators pursued evidence-based educational policies.

Keywords: core French, French immersion, identity, language policy, multilingualism, second language learning

THE CANADIAN POLICY CONTEXT

Although Canada enjoys a strong international reputation as a leader in the area of second language teaching, primarily as a result of the implementation of French immersion programs in the 1960s, the development of policies at federal and provincial levels with respect to language teaching has been largely incoherent. Because education falls under provincial jurisdiction, different policies and provisions in relation to language teaching exist in different provinces. All provinces strongly support the learning of the second official language (French in English Canada, and English in Quebec) and they also provide support for newcomer students to learn the language of school instruction but few have developed coherent policies regarding the multilingual realities of schools and communities. Similarly, at the federal level, the 1971 policy of *multiculturalism within a bilingual framework* omitted any meaningful consideration of languages other than the two official languages, substituting positive rhetoric in relation to the *cultural contributions of the other ethnic groups* for any concrete action to foster Canada's multilingual resources. In the 1970s and 1980s, some funds were provided by the federal government to community groups for purposes of heritage language teaching but those funds were discontinued in the early 1990s. No province has articulated an educational language policy that addresses in a positive way the multilingual realities of its schools, although Alberta at least did consider the issue in the 1980s (Alberta Government, 1988). Some provinces (e.g., Ontario) have articulated restrictive policies in relation to multilingualism by prohibiting use of languages other than English and French as mediums of instruction except on a short-term transitional basis.

The lack of coherence with respect to policy is compounded by the fact that many of the programs and provisions that have been implemented are inconsistent with the empirical evidence regarding effective practice. In this paper, I review this evidence with respect to four spheres of dual language learning: (a) teaching French as a second language (FSL) in English Canada; (b) teaching English and French as additional languages to newcomer students in English Canada and Quebec; (c) teaching heritage languages; and (d) teaching American Sign Language (ASL) to Deaf students in English Canada. I refer to students in these contexts collectively as dual language learners (DLL).

TEACHING FRENCH AS A SECOND LANGUAGE

CORE FRENCH PROGRAMS

Core FSL programs typically teach French for 30–40 min each day. Starting grades vary from province to province, and within provinces school boards typically have some discretion regarding the starting grade level. In many parts of Ontario, for example, FSL starts in Grade 4 and continues until at least Grade 9, when it is a compulsory subject for all students.

Results of Core FSL programs have been disappointing. Canadian Parents for French, a federally funded advocacy group, summarized the outcomes as follows: "Only 3% of [Ontario] grade nine core French students continue with the program to Grade 12, most graduating with little ability to converse in, or understand French" (Canadian Parents for French, 2008, p. 17). Research has also shown minimal improvement in students' French proficiency as a function of length of time in the program. Harley et al. (1988), for example, examined the French proficiency (speaking, listening, reading, and writing) of 574 students in 25 different classes in seven provinces or territories. They found that, with some minor exceptions, performance at the Grade 8 level was unrelated to the starting grade and the length of time the students had been learning French. Few differences were observed regardless of whether students started learning French in Kindergarten, Grade 1, 3, 4, 6, or 8. In other words, one year of Core FSL produced equivalent outcomes to 7+ years, suggesting that core FSL during those years was not particularly effective (see Lapkin et al., 2009, for a more complete review of FSL outcomes).

The persistent failure of Core FSL programs to develop even minimal communicative proficiency in French among a large proportion of participating students highlights the need for a change in policy. There is no empirical support for continuing to pour considerable funds into a program that yields such paltry academic outcomes. Yet, policy-makers across Canada have shown no interest in radically changing Core FSL provision. The ideological commitment to teach both official languages, regardless of the success of this endeavor, trumps the evidence of ineffectiveness.

Much stronger outcomes have been attained both by French immersion and Intensive French (a literacy-oriented half-year immersion in French starting at the Grade 6 level, Netten and Germain, 2005). Extended French programs, where one or more subjects are taught through French (similar to content and language integrated learning, CLIL programs), have also shown much more promising outcomes than Core FSL. However, more than 90% of students studying French in Canada are enrolled in Core FSL rather than in one of these more successful alternatives.

Another program that has demonstrated much more promising outcomes than traditional Core French is the accelerated integrative method (AIM) developed by Canadian educator Wendy Maxwell. AIM is a form of Core French insofar as it is taught for approximately 30–40 min per day but its pedagogical assumptions and outcomes are radically different. AIM has been implemented in more than 4,000 schools across Canada as well as in some international contexts (Arnott, 2011).

ACCELERATED INTEGRATIVE METHOD

Accelerated integrative method adopts a very different approach to the scope and sequence of L2 teaching than the typical Core French program, which has traditionally been organized around themes (e.g., going to the supermarket, animals in the zoo, etc.). In contrast, AIM integrates the teaching of French with the arts (e.g., drama) and literacy (extensive reading and writing in addition to speaking and listening). AIM scaffolds meaning initially through gestures which enable students to understand full sentences in which each word is represented by a gesture. Basic grammatical markers (e.g., masculine, feminine, past tense, etc.) are also represented by gestures. Reading skills are developed through the use of big books read to the class and supported by gestures. These stories are dramatized by the teacher and students together. Finally, writing is developed after students have mastered the story. Students answer comprehension questions in writing and, with increasing proficiency, script their own dramatizations on the basis of the story.

Maxwell (2004) describes the approach as follows:

> Through this approach, all target vocabulary to be learned by the student is taught kinesthetically, visually, and in an auditory manner, thus responding to a variety of learning styles. Because words are kinesthetically represented through gesture, and contextualized through story and drama, students learn to see and feel the language.. . . Fluency is built by systematically scaffolding the presentation of new vocabulary, beginning with words of highest frequency and widest scope. Words targeted for presentation through gesture and story in this program have been selected . . . according to frequency, function and ease of acquisition. This target vocabulary, termed pred down language (PDL), places a high emphasis on verbs, but also includes other vocabulary and structures important for beginning fluency development[1].

Arnott (2011, p. 157) points out that research carried out on the effectiveness of AIM has shown positive results in a number of small scale studies "while larger-scale quantitative and mixed method research suggested that merely using AIM does not make students significantly more proficient in French (Bourdages and Vignola, 2009; Mady et al., 2009)." Her own research focused on exploring the ways in which teachers implemented AIM rather than attempting to compare AIM and non-AIM methods. She points out that comparison of methods is problematic because of significant variation among teachers in the ways in which they implement particular methods.

This reality is evident in the research which failed to find differences between AIM and non-AIM classrooms. For example, in the Mady et al. (2009) study, which reported no differences in French proficiency between AIM and non-AIM Grade eight classrooms, characteristics of the AIM methodology were found in classrooms designated as both AIM and non-AIM. The authors point out: "Observation data used for selecting the sample (Mady et al., 2007) suggest that. . . characteristics deemed central to AIM were not exclusive to AIM classrooms" (Mady et al., 2009, p. 716). Teachers in each group had attended some AIM training sessions and were using some AIM materials in their classrooms. Thus, the comparison is not particularly robust in assessing the impact of AIM.

The findings of the Bourdages and Vignola (2009) study are also interpreted in very problematic ways by the authors. They interpreted their results as showing "few significant differences

[1] www.caslt.org/pdf/aim.pdf

between the AIM group and the non-AIM group" (p. 731) in oral interviews conducted with 18 AIM and 16 non-AIM Grade 3 students. In actual fact, there are highly significant differences between the groups in the amount of oral language students produced in French and in the extent to which the students were capable of using French exclusively in the interviews rather than reverting to English. Specifically, the AIM students produced 1751 utterances compared to 811 for the non-AIM students – more than twice as much. The AIM students also produced 1662 utterances completely in French (95%) compared to 306 for the non-AIM group (38%). It is worth noting that teachers of both AIM and non-AIM groups used French exclusively in their instruction so these huge differences cannot be attributed to differential exposure to French.

The authors' claim that there were few differences between the groups is based on the percentages of utterances produced by each group that had various types of grammatical errors (e.g., gender, verb agreement, etc.). The authors chose to focus on the fact that both groups of early stage learners were making similar grammatical errors rather than on the fact that AIM students demonstrated much greater fluency in French and ability to continue speaking French rather than revert to English when attempting to express themselves. The logic entailed in the conclusions of the Bourdages and Vignola (2009) study is equivalent to claiming that there are no differences in French proficiency between a student who produced more than 20 utterances in the interview, the vast majority of which were in French only, compared to a student who produced only 10 utterances, only four of which were exclusively in French, just because a similar proportion of utterances of each student contained errors of various kinds.

In short, the Bourdages and Vignola (2009) study, contrary to the claims of its authors, provides strong support for the findings of smaller-scale studies showing that the AIM methodology can significantly increase students' fluency in French. As Arnott (2011) points out, it is not possible to identify which components of AIM are most effective in scaffolding comprehension and production of French but there is clearly a case to be made for incorporating elements of AIM into both Core FSL and French immersion programs.

FRENCH IMMERSION PROGRAMS

A common finding from L2 immersion programs across a variety of contexts is that students gain a reasonable level of fluency and literacy in L2 at no apparent cost to their academic skills in the socially dominant language. In the Canadian French immersion context, students catch up in most aspects of English standardized test performance within a year of the introduction of formal English language arts. With respect to French skills, students' receptive skills in French are better developed (in relation to native speaker norms) than are their expressive skills. By the end of elementary school (Grade 6, age 12) students are close to the level of native speakers in understanding and reading of formal French (assessed by standardized tests), but there are significant gaps between them and native speakers in spoken and written French. The gap is particularly evident with respect to accuracy of grammar and range of vocabulary knowledge and use.

These gaps are clearly related to the restricted input that students receive in French. Typically students experience little contact or interaction with French outside the school context. Very few students watch French television or read for pleasure in French. After the initial grades, reading in French tends to be primarily textbook reading, which is typically not particularly engaging for students. Thus, there are few opportunities for students to extend their exposure to French and expand their vocabulary knowledge and grammatical command. Writing also tends to be carried out only within the school context and applied to academic tasks that are often not highly engaging for students.

Despite the fact that there is overwhelming evidence for strong relationships between the development of academic skills in French and English (e.g., Cummins, 2001), there has been little attempt within French immersion programs to teach for transfer across languages. This is because monolingual instructional assumptions have dominated practice within immersion. The rationale for developing bilingualism by means of monolingual instruction was clearly expressed by Lambert (1984, p. 13):

> No bilingual skills are required of the teacher, who plays the role of a monolingual in the target language... and who never switches languages, reviews materials in the other language, or otherwise uses the child's native language in teacher-pupil interactions. In immersion programs, therefore, bilingualism is developed through two separate monolingual instructional routes.

Since the time of the initial St. Lambert program some aspects of the strict separation of languages have become somewhat more relaxed. For example, the same teacher frequently teaches both the French and English parts of the day in Grades 4 through 6. However, the principle of linguistic separation and a total ban on any kind of translation across languages remains largely unchallenged within French immersion theory and practice. I have termed this the *two solitudes assumption* and highlighted its problematic instructional consequences (Cummins, 2007). Among these consequences are (a) the inability to draw students' attention to the many cognate relationships between French and English, (b) inability to enable students to create and web-publish dual language books that might showcase students' emerging bilingual skills, (c) inability to pursue partner class projects with French L1 students who are learning English in which the Internet is used to connect learners of each language. The "two solitudes" assumption also discourages educators from coordinated planning that would integrate curriculum objectives in French and English. For example, in teaching writing in French and English, the rules and conventions for paragraph formation could be taught at a similar time in French and English language arts, thereby reinforcing the learning of this content (see Ó Duibhir and Cummins, 2012).

Is there any empirical evidence supporting the two solitudes assumption? During the 50 years that French immersion programs have been in existence, researchers have found no evidence to support this assumption. Even researchers who have been in the forefront of French immersion program evaluations during the past 40 years have advocated more instructional flexibility with respect to bringing the two languages into productive contact (e.g., Swain and Lapkin, 2000, 2013). As a result of the two solitudes

assumption, immersion programs have needlessly avoided teaching for transfer across languages and at least some of the limitations observed in students' French proficiency can be attributed to the failure to exploit the learning efficiencies afforded by bringing the two languages into productive contact. Initial research exploring instructional approaches that promote transfer of morphological and broader literacy skills across French and English in the Canadian context has produced promising results (Lyster et al., 2009, 2013).

In summary, a variety of gaps between research evidence and instructional policies and practices are evident with respect to the teaching of French in Canada. These gaps apply to both Core FSL and to French immersion.

TEACHING ENGLISH AND FRENCH TO NEWCOMER STUDENTS

A synthesis of research findings from Montreal, Toronto and Vancouver demonstrates that, in general, DLL students from immigrant backgrounds tend to perform relatively well in Canadian schools (McAndrew et al., 2009). However, this apparent success masks considerable variation in DLL students' academic outcomes. Studies in Alberta (Derwing et al., 1999; Watt and Roessingh, 1994, 2001) revealed that large proportions of DLL students failed to graduate with a high school diploma (60% in the Derwing et al. (1999) study and 74% in the Watt and Roessingh, 1994 study). More recent studies from British Colombia also show a high "disappearance" or non-completion rate among DLL high school students (Gunderson, 2007; Toohey and Derwing, 2008). Immigrant students from higher socioeconomic backgrounds tended to perform considerably better than those from refugee and/or low socioeconomic backgrounds.

Although a stable infrastructure for providing language support services to newcomer students has been established in most provinces, there remain significant gaps in the extent to which educational policies and practices conform to what is implied by the research evidence. For example, there has been a lack of serious policy consideration at all levels of the educational system (provincial ministries, school boards, university-level teacher education programs, and individual schools) regarding the pedagogical implications and opportunities of linguistic diversity. Home languages other than English or French are still viewed by many educators as largely irrelevant to children's schooling. Consequently, many schools do not encourage bilingual students to showcase their linguistic accomplishments, thereby missing an important opportunity both to enable students to use their L1 as a cognitive tool and develop their L1 abilities to the level of literate competence.

Most classroom teachers at the elementary level and content teachers at the secondary level have had no pre-service or professional development preparation focused on appropriate instruction for DLL students. Educational policies and structures (e.g., teacher education) across Canada have articulated no expectation or requirement that *mainstream* teachers should have any knowledge regarding appropriate ways of scaffolding instruction for second language learners in their classrooms. The implicit assumption in English Canada has been that ESL teachers will take care of "fixing" the language problems of English language learners. This assumption ignores the fact that typically at least five years are required for DLL students to catch up academically in the school language (e.g., Cummins, 1981; Klesmer, 1994). Thus, content teachers will inevitably be teaching DLL students over the course of several years while students are still in the process of catching up to grade expectations in academic English (or French). In an education context characterized by linguistic diversity and high rates of immigration, it is no longer sufficient to be an excellent Science or Mathematics (or other content areas) teacher in a generic sense; excellence must be defined by how well a teacher can teach Science or Mathematics to the students who are in his or her classroom, many of whom may be in the early or intermediate stages of English (or French in Quebec) language acquisition. Toohey and Derwing (2008), similarly highlight the "untenable situation" whereby "many ESL learners are now taught by teachers who have no training at all in second-language education techniques and approaches" (p. 190).

There is also no articulated expectation that school principals and vice-principals should know anything about appropriate instruction for DLL students from immigrant backgrounds. Principals' courses typically include no content relating to effective leadership in linguistically diverse schools. Furthermore, the decision-making process within school boards regarding promotion to administrative positions rarely takes account of an individual's ability to provide instructional leadership in schools with large numbers of linguistically diverse students. One of the duties of administrators in schools is to inspect teachers at regular intervals to ensure that they are delivering effective instruction. If the principal or vice-principal has little awareness of appropriate scaffolding strategies to support DLL students in understanding instruction, how can they assess the extent to which teachers are implementing these strategies effectively?

Solutions to this issue are surprisingly simple and cost-effective. Any school system that wanted to build its capacity to teach effectively in a linguistically diverse context could implement two "no-cost" initiatives that would quickly generate results. First, they could publicly specify the knowledge and expertise they expect of all new teachers they are planning to hire. For example, they could articulate the expectation that all teachers should know how to teach their content areas effectively to students who are in the early and later stages of acquiring English (or French in Quebec). They could also specify that content teachers should know how to articulate and teach linguistic objectives as well as content objectives in their teaching practice. The announcement of this initiative could also include a sample of the kinds of questions regarding appropriate instruction for DLL students that applicants for teaching positions could expect to be asked. These policies would put immediate pressure on Faculties of Education to ensure that new teachers have the opportunity to develop this expertise.

Second, school systems characterized by linguistic diversity could institute criteria for advancement within the school system (e.g., to principal or vice-principal positions) that would *explicitly* require either formal qualifications in ESL or demonstrated expertise in issues related to effective instruction of linguistically diverse students. Specific questions regarding these issues should be asked in interviews for appointment or advancement. For

example, school systems might specify that school leaders should be familiar with the core knowledge base regarding (a) trajectories of school language acquisition among newcomer students, (b) the positive role of students' L1 in facilitating L2 development, (c) instructional strategies (e.g., scaffolding) required to teach academic content effectively to students who are in the process of developing academic English proficiency.

The reluctance of most school systems across Canada to even discuss, let alone institute such policies, together with the inertia that has characterized most Faculties of Education with respect to preparing teachers to teach DLL students, is inconsistent with the commitment to equity and social justice that these institutions claim to endorse.

TEACHING HERITAGE LANGUAGES

As it has been used in the Canadian context, the term *heritage languages* usually refers to all languages other than the two official languages (English and French), the languages of First Nations (Native) and Inuit peoples, and the languages of the Deaf community (ASL and langue des signes québécoise, LSQ). The term *heritage languages* came into widespread use in 1977 with the establishment of the Heritage Languages Program in the province of Ontario. Funded by the provincial government, this program provides support for the teaching of heritage languages for up to two-and-one-half hours per week outside of the regular 5-hour school day. All students can enroll in these programs regardless of the specific language spoken at home. In the early 1990s, the term heritage languages was changed to international languages by the Ontario provincial government, reflecting misgivings among ethnocultural communities that the notion of "heritage" entailed connotations of learning about past traditions rather than acquiring language skills that have significance for children's overall educational and personal development. In western Canadian provinces, the term *international* languages is commonly used to refer to languages taught within the public school system (either as subjects of instruction or through bilingual programs) while the term *heritage* languages usually refers to languages taught in programs organized by ethnocultural communities. The terms *heritage* and *international* languages are used interchangeably in the present article.

In Quebec, the government provides funding for the *programme d'enseignement des langues d'origine* (PELO), which was originally introduced in 1977. The rationale for PELO has gone beyond simply promoting skills in students' home languages; PELO is currently seen by school boards and the Quebec government as a stimulus to enable students to transfer knowledge and skills from one language to the other and from one culture to the other, thereby supporting students in learning French and succeeding academically.

Considerably more openness to the use of heritage/international languages as mediums of instruction is evident in the western Canadian provinces (Alberta, British Colombia, Manitoba, and Saskatchewan) than in eastern Canadian provinces. Bilingual programs involving heritage/international languages exist in all four western provinces. As noted in a previous section, Alberta has been a leader in actively supporting the establishment of bilingual programs in a variety of languages. In 1971, Alberta became the first province to legalize languages other than English or French as mediums of instruction in the public school system. An amendment to the Education Act stated that a "board may authorize (a) that French be used as a language of instruction, or (b) that any other language be used as a language of instruction, in addition to the English language, in any or all of its schools" (Aunger, 2004). In 1973, the Edmonton Public School Board introduced the English-Ukrainian program at the Kindergarten level and an English-German program followed in the fall of 1978. Currently, Alberta offers 50/50 English/heritage language bilingual programs in ASL, Arabic, German, Hebrew, Mandarin, Polish, Spanish, and Ukrainian. The Spanish program has grown significantly in recent years and currently serves more than 3,000 students. First Nations Band-operated bilingual programs are also offered in Blackfoot and Cree (see Alberta Government, 2006).

It is interesting to relate the teaching of international languages to the teaching of French discussed in an earlier section. The international language bilingual programs have been evaluated as highly successful in developing moderately strong heritage language skills at no cost to students' English proficiency (see Cummins and Danesi, 1990, for a review). In this respect they parallel the outcomes of French immersion and CLIL programs. No formal evaluation has been carried out on heritage language programs taught as a subject outside the school day but indications are that both the quality of teaching and outcomes are mixed (Cummins and Danesi, 1990). This is not surprising in view of the limited success of Core FSL programs which have much higher status and institutional support.

Thus only the western provinces (particularly Alberta) have implemented evidence-based programs to support the teaching of heritage languages. In Ontario, as noted in a previous section, it is illegal to teach through the medium of a heritage language except on a short-term transitional basis to help students learn English. It is instructive to examine the reasoning of the Royal Commission on Learning (1994) which considered this issue in its report. The Commissioners acknowledged the range of submissions they received supporting an amendment to the Education Act to permit heritage languages to be used as mediums of instruction and they also acknowledged that enrichment bilingual programs were in operation in several other provinces. However, they went on to note:

> We do not recommend a change in Ontario's legislation with respect to languages of instruction at this time. We strongly support the use of other languages as a transitional strategy, which is already permitted... We also support a learning system that places more value on languages as subjects, and we hope that many more students will learn third (and fourth) languages, and take courses in them at secondary and post-secondary levels.... But we are very concerned that all students in Ontario be truly literate in one of the official languages. In our view, the school system is obliged to help students function at a high level in English or French, and to gain a reasonable knowledge of the other official language. We appreciate the value of the existing, optional International- (formerly Heritage-) Language program, elementary, but we are not prepared to go well beyond that by suggesting that students be educated in an immersion or bilingual program in any one of a vast number of non-official languages (Royal Commission on Learning, 1994, pp. 106–107).

The Commissioners' failure to engage with the research evidence on this issue is, unfortunately, very obvious. They imply that students who enroll in a bilingual program involving English and a heritage language (such as the Alberta programs outlined above) will fail to become "truly literate" in English or French despite the fact that there is not a shred of evidence from the Alberta programs or any other bilingual program for minority group students to support this assumption (Cummins and Danesi, 1990). They raise the specter of demands for bilingual programs from speakers of a "vast number of non-official languages" despite the fact that the demand for heritage language bilingual programs in both the Prairie provinces and in Ontario has been modest.

In summary, with the notable exception of the province of Alberta, and to a lesser extent the other western provinces, Canadian provinces have shown little interest in imaginative approaches to heritage language education. Because there has been little sustained demand from ethnocultural communities to implement bilingual programs, governments have stood on the sidelines and declined to show any leadership regarding the promotion of Canada's linguistic resources.

DENYING DEAF CHILDREN BILINGUAL OPPORTUNITIES

Several phases can be identified in the history of Deaf children's education. The first phase emerged from the initial founding of a school for Deaf students by Abbé de l'Epée in Paris, France in 1760. As pointed out by Gibson et al. (1997), "a natural outgrowth was the emergence of a Deaf community, the essential circumstance in which a language – sign language – could develop" (p. 231). In the early 1800s Thomas Gallaudet, an American educator, went to Paris to learn more about the methods of educating Deaf students that had been developed in the French context. Later, he returned to the United States and, with Laurent Clerc, a Deaf master teacher from the Paris school, founded the first school for Deaf students in the United States in 1817. ASL evolved as the French sign language used by Clerc merged with the sign language used by local Deaf people.

What many Deaf communities regard as the "Golden Age" of Deaf education ended with the adoption of an exclusively oral instructional approach by delegates at the 1880 International Congress of Educators of the Deaf in Milan, Italy. This approach dominated the education of the Deaf for almost 100 years and continues to be implemented in a shrinking number of schools internationally. The auditory/oral approach emphasizes the development of any residual hearing with the assistance of hearing aids and the development of speech-reading skills and speech production. A major part of the rationale for an exclusive reliance on the auditory/oral modality was that children will not make the effort to develop oral language if they are permitted to use the "crutch" of sign language.

Gibson et al. (1997) point out that by the early 1970s, educators began to realize "the disastrous effects the oral, monolingual approach had on the spoken and written English of the students, many of whom graduated from oral programs illiterate in both ASL and English" (p. 232). Swanwick (2010) similarly notes that research in the United Kingdom and elsewhere showed that "deaf pupils left school with median reading ages of nine; with poor speech intelligibility and with lip-reading skills no better than those of the hearing population, despite focused training in this" (p. 149).

The Total Communication approach began to replace an exclusively auditory/oral approach during the 1970s. This approach involves the simultaneous use of spoken language together with a signed form of the spoken language. These signed forms of spoken languages have been controversial both among educators and Deaf communities in many countries. In some countries many members of the Deaf community use a signed form of the spoken language but in others (e.g., Canada) a significant proportion of the Deaf community rejects this form of manually coded language as an artificial imposition from hearing educators and policy-makers.

This skepticism in relation to the effectiveness of Total Communication approaches is reinforced as a result of the fact that these programs have failed to increase the academic achievement of Deaf students in any significant way. As pointed out by Allen (1986, p. v): "After 25 years of Total Communication the average deaf high school graduate had achieved a third to fourth grade level education (Allen, 1986)."

As a result of the failure of Total Communication approaches, debate has shifted to the feasibility and rationale for implementing bilingual/bicultural approaches that would use a natural sign language together with the dominant spoken/written language as mediums of instruction. Initial implementation of bilingual instructional approaches took place in Sweden in the early 1980s and bilingual programs have spread to other contexts (e.g., in Europe, North American, and Japan) since that time. However, there remain many areas of controversy with respect to the theoretical and empirical rationale for bilingual/bicultural programs and the appropriate ways of implementing them. For example, within North America and elsewhere there is debate about whether the development of ASL fluency might impede spoken English acquisition among Deaf children who have received cochlear implants. There is also the question as to whether cross-lingual transfer will occur between a manual signed language and a spoken/written language in the same way that it does between two spoken/written languages.

Research provides a definitive answer to this latter question. Many studies (reviewed by Hermans et al., 2010; Cummins, 2011) have consistently demonstrated significant relationships between students' proficiency in ASL and their development of English reading and writing skills. Transfer between sign language and written/spoken language has been reported at lexical, morphological, syntactic, and pragmatic levels (e.g., Padden and Ramsey, 1998; Menéndez, 2010). These positive relationships can be attributed to transfer of conceptual elements (knowledge of the world) across languages, transfer of metacognitive and metalinguistic elements, and some specific linguistic elements (e.g., fingerspelling, initialized signs).

To what extent does this pattern hold for Deaf children who have undergone cochlear implants? This question is important because currently in Ontario and most other parts of Canada, children who receive cochlear implants are required to forgo the opportunity to learn ASL/LSQ if they wish to receive audio/verbal therapy (AVT), considered necessary to train the brain to hear and

comprehend spoken language. AVT professionals mandate that children receiving AVT not acquire ASL and they discontinue the program if children are exposed to ASL input or instruction. Their rationale is that ASL will interfere with children's ability and motivation to acquire speech by causing auditory areas of the brain to be reallocated to visual processing. As Snoddon (2008) points out, there is absolutely no evidence to support this policy. In fact, although research on the issue is limited, the existing evidence supports the development of bilingualism (e.g., ASL/English) among students who have received cochlear implants. In Swedish research (Preisler et al., 2002) children with cochlear implants who had developed fluency in Swedish sign language showed better speech production than similar students who had not developed sign language fluency. This is consistent with the more general research on ASL/English relationships showing positive transfer across languages. In contrast to Canada, Sweden strongly encourages children who receive cochlear implants to acquire Swedish sign language (Preisler and Ahlström, 1997; Bagga-Gupta, 2004).

In short, once again we find a language education context in Canada where evidence-free assumptions rather than research findings determine policy and practice. Not only are children who receive cochlear implants denied the opportunity to develop bilingualism, crucial time during their early years is spent learning how to decode speech instead of engaging in genuine communication that develops concepts and expands their minds.

SOME POSITIVE DEVELOPMENTS

Although the discussion to this point has focused on *gaps* between the research evidence and Canadian policies and practice in language education, some emerging positive directions should be noted. Across Canada, a series of collaborations between educators and university researchers has begun to explore two orientations which we (Cummins and Persad, in press) have termed (a) *teaching through an EAL (English-as-an-additional-language) lens* and (b) *teaching through a multilingual lens.* These complementary orientations to pedagogy reflect school-based language policies that articulate all teachers' responsibility to provide effective and comprehensible instruction across the curriculum to DLL students rather than view this role only as the responsibility of the language specialist teacher. They also articulate the opportunities that all teachers have to expand students' language awareness and expertise in the context of subject matter instruction. Thus, at the secondary level, the science teacher would see herself not only as a teacher of science but also a teacher of the language of science. This implies that she articulates language objectives as well as content objectives in her lesson plans.

Teaching through a multilingual lens incorporates the philosophy and pedagogical practices of teaching through an EAL lens but broadens the pedagogical orientation to position students' multilingual abilities as personal, cognitive, and academic resources for learning. Teachers explicitly orient their instruction to promote two-way transfer across languages and communicate to students that their language talents represent intellectual accomplishments that are valued by the school and, by implication, the wider society. Thus, teachers actively challenge the devaluation of Canada's multilingual resources that is implicit in the intellectual inertia of policy-makers and educational leaders in relation to this issue. Imaginative leadership from administrators is essential for the school to move in a coordinated and coherent way in the direction of teaching through EAL and multilingual lens.

The principles underlying teaching through EAL and multilingual lens have been articulated in a variety of ongoing projects that have documented the classroom implementation and outcomes of concrete instructional strategies (e.g., Armand et al., 2008; Dagenais et al., 2008a,b; Marshall and Toohey, 2010; Cummins and Early, 2011; Lotherington, 2011; Roessingh, 2011; Chumak-Horbatsch, 2012; Naqvi et al., 2012; Stille and Cummins, 2013; Ntelioglou et al., submitted). Rather than attempting to review these projects in any detail (see Cummins and Persad, in press), I will simply list the kinds of classroom activities that are implied by these pedagogical orientations. Four categories of activity or project work are described, ranging from the very simple to the more elaborate. It is noteworthy that implementation of these projects requires no additional financial or material resources; they simply entail some instructional imagination and a commitment to teach the whole child.

SIMPLE EVERYDAY PRACTICES TO MAKE STUDENTS' LANGUAGES VISIBLE AND AUDIBLE WITHIN THE SCHOOL

- Each day, one or two students bring a word from their languages into the classroom and explain why they chose that word and what it means. All students and the teacher learn that word. The multilingual words that the class has learned can be displayed on a word wall that rotates every month. The words can also be included into a computer file that can be printed out on a regular basis for review by students and teachers.
- All students including the teacher learn simple greetings (hello, thank you, etc.) in the languages of the classroom. Students who speak these languages are the "teachers." The "teachers" can also show their peers and teacher how to write a few simple expressions in different scripts (e.g., Arabic, Chinese, Greek, etc.).
- During the morning announcements, students give greetings and say a few words in different languages (with follow-up translation in English).
- At school assemblies, teachers who speak additional languages (including French) say a few words in a language other than English and a student also gives greetings in a language other than English.
- Examples of students' work in English and L1 are prominently displayed in school corridors and at the entrance to the school in order to reinforce the message to parents and students that students' linguistic talents are seen as educational and personal assets within the school.

These simple activities have the potential to sensitize students to the sounds and writing systems of different languages and counteract the ambivalence and even shame that many students develop in relation to their languages. The unveiling of students' languages within the classroom can also be linked to other curricular content. For example, if a Sri Lankan Tamil student has brought a word from her language to share with the teacher and her classmates, this could be extended to demonstrating where Sri Lanka

is on a map of the world and explaining some salient aspects of its culture and history.

ENCOURAGING STUDENTS TO USE THEIR L1s FOR READING, RESEARCH, NOTE-TAKING ETC.

- Beyond the early grades, newcomer and bilingual students could be encouraged to activate their background knowledge of content (e.g., science content) and expand that knowledge by accessing L1 resources that might be available on the Internet (e.g., researching the concept of *photosynthesis* in L1). Building up this L1 knowledge will make L2 content and texts more comprehensible and promote two-way transfer across languages.
- Encourage DLL students to use L1 for group planning of projects which will be presented to the wider class in English. In these cases, L1 is used as a stepping stone to better performance in English where limited English skills do not impede students' ability to engage with the project.
- Encourage parents (and/or students) to read and/or tell stories in L1 in the home both as a means of expanding L1 knowledge into literate spheres and also expanding knowledge of the world.
- Ensure that the school library has a good collection of L1 and dual language books for students to read and parents to check out for reading at home.
- Invite community members to come to class to read and/or tell stories in community languages (see Naqvi et al., 2012).
- In social studies at intermediate or high school levels, encourage students to research issues and current affairs using Internet sources in their L1s. Parents can assist in this process. Students then bring this information back to class and differences in perspectives across different languages, cultures, and ideologies can be discussed.

USING TECHNOLOGY IN CREATIVE WAYS TO BUILD AWARENESS OF LANGUAGE, GEOGRAPHY, AND INTERCULTURAL REALITIES

- Google Translate[2] can be used for a wide variety of purposes – for example, to aid in the "language teaching" outlined above or to assist newcomer students in creating dual language books or projects. For example, students write in L1 and then use Google Translate to generate a rough version in English. The teacher and/or other students can then help the newcomer student edit this rough version into coherent English prose.
- Google Earth can be used to "zoom into" the towns and regions of students' countries of origin. Students can adopt a comparative approach to compare aspects of their countries of origin to Canadian realities that are incorporated into the curriculum expectations of the social studies curriculum (see Cummins and Persad, in press, for examples). Obviously, parents can participate in this process by describing aspects of the culture and landscape and supplying additional artifacts.
- Students' languages can be integrated in creative ways into a variety of content instruction. For example, Grade 5 teacher, Tobin Zikmanis, in the Peel District School Board addressed the Ministry curriculum expectations in the Data Management Unit of the Math curriculum by having students carry out a language survey of the entire school and then using spreadsheet software to generate a variety of graphs (e.g., pie charts, bar graphs) to display and disseminate their findings.

DUAL LANGUAGE PROJECT WORK

- Students can write and web-publish dual language stories or projects (see Lotherington, 2011 for examples and also[3,4]). Where students are learning French, the book or project production can be trilingual (L1, English, French). An excellent resource for facilitating the web-publication of multilingual books is the website and iPad application *Scribjab* [5] developed by Simon Fraser University researchers Dr. Diane Dagenais and Dr. Kelleen Toohey. Scribjab allows students to upload their creative writing and audio recordings of this writing and to read and listen to other students' stories[6].
- Students can collaborate with partner classes in distant locations (across the world or across the city) to carry out a variety of projects involving dual or multiple languages. These projects could focus on social justice issues (e.g., environmental policies, income disparities, etc. in different countries) or other substantive curriculum-relevant content.

These examples are illustrative of the pedagogical options that open up when educators adopt a multilingual lens. Many other examples of "translanguaging" have been described in the publication *Translanguaging* (Celic and Seltzer, 2011; available for free download at[7]). Dr. Roma Chumak-Horbatsch (2012) of Ryerson University has also documented a wide variety of multilingual instructional activities for early childhood education and primary grades in her book *Linguistically Appropriate Practice* (see also her website at[8]).

CONCLUSION

The critique of Canadian educational provision in relation to language development issues in this paper is not in any sense intended to undermine the commitment to quality education that educators and policy-makers alike have pursued over several decades. Canadian education has generally avoided the dysfunctional ideological battles that have characterized education in the United States during this period (e.g., in relation to reading instruction, bilingual education, school funding, etc.). Achievement outcomes of Canadian education also compare well with those of other countries (e.g., OECD, 2010).

However, Canadian policy-makers have not responded adequately to the instructional challenges and opportunities afforded

[2]www.translate.google.com

[3]http://schools.peelschools.org/1363/pages/dual.aspx

[4]http://www.multiliteracies.ca/index.php/folio/viewProject/8

[5]www.scribjab.com

[6]http://www.sfu.ca/education/newsevents/foe-news/2014/january-2014/diane-dagenais-speaks-to-radio-canada-about-scribjab.html

[7]http://www.nysieb.ws.gc.cuny.edu/publicationsresources/

[8]www.mylanguage.ca

by Canadian multilingual realities. With respect to the education of immigrant-background students, we have failed to ensure that Canadian school administrators and educators in mainstream classrooms have had opportunities and incentives to develop the instructional expertise to teach these students effectively. For more than 40 years of consistently high levels of immigration to Canada since the early 1970s, Faculties of Education in English Canada have viewed the job of teaching DLL students as the job of the specialist ESL teacher. There are indications of a change in thinking in relation to this issue in some provinces but there is still a long way to go before the well-worn mantra of "capacity-building" is extended to include building the capacity of all teachers and administrators to educate DLL students in an evidence-based way.

Similarly, with the notable exception of the province of Alberta, there has been a policy vacuum with respect to imaginative educational responses to Canada's multilingual resources. For the most part, we have been content to stand on the sidelines as observers while children's home languages slip away from them in the early years of schooling. The exercise in imaginative thinking that generated French immersion programs as well as more recent initiatives such as Intensive French and AIM, has been largely stifled by restrictive provincial policies and administrative inertia that continue to frustrate parents and community members who attempt to initiate effective programs for the teaching of languages other than English and French.

On a positive note, the seeds of educational change have been planted in cities across Canada by educators in individual schools who have not waited either for community pressure or top-down mandates to implement instruction that is truly imaginative and inspirational. School/university collaborations in communities across Canada have articulated and field-tested imaginative instructional strategies that build language awareness and proactively communicate to students that their multilingual abilities contribute significantly to their own identities, their communication with family members, and to the cultural richness of their school communities. The commitment of these educators to repudiate the notion of the school as an English-only zone (or French-only zone in Quebec) in favor of teaching through a multilingual lens is identity-affirming both for them as educators and for their students whose intellectual, cultural, and linguistic resources are being constructed rather than constricted by their educational experiences. The challenge of the next decade is to scale up these initiatives so that they become institutionalized as educational policy rather than just the inspired teaching of exceptional educators.

ACKNOWLEDGMENTS

Discussions with colleagues and students (too numerous to name) have contributed to the ideas elaborated in this paper. I would also like to acknowledge the Social Sciences and Humanities Research Council whose Canada Research Chair award (2006–2013) supported the research underlying the development of this paper.

REFERENCES

Alberta Government. (1988). *Language Education Policy for Alberta.* Edmonton, AB: Alberta Government.

Alberta Government. (2006). *Learning Languages in Alberta: Now We're Talking! Tool Kit for Teachers, Schools, and School Authorities.* Available at: https://education.alberta.ca/media/486205/intro.pdf (accessed January 15, 2014).

Allen, T. E. (1986). "Patterns of academic achievement among hearing impaired students: 1974–1983," in *Deaf Children in America*, eds A. N. Schildroth and M. A. Karchmer (San Diego, CA: College Hill Press), 161–206.

Armand, F., Sirois, F., and Ababou, F. (2008). Entrée dans l'écrit en contexte plurilingue et défavorisé: développer les capacités métaphonologiques et sensibiliser à la diversité linguistique. *Can. Mod. Lang. Rev.* 65, 61–87. doi: 10.3138/cmlr.65.1.61

Arnott, S. (2011). Exploring the dynamic relationship between the accelerative integrated method (AIM) and the core French teachers who use it: why agency and experience matter. *Can. J. Appl. Linguist.* 14, 156–176.

Aunger, E. A. (2004). Legislating language use in Alberta: a century of incidental provisions for a fundamental matter. *Alta. Law Rev.* 42, 463–497.

Bagga-Gupta, S. (2004). *Literacies and Deaf Education: A Theoretical Analysis of the International and Swedish literature. Forskning i Fokus nr. 23.* Stockholm: The Swedish National Agency for School Improvement.

Bourdages, J., and Vignola, M. J. (2009). AIM: la communication orale chez les élèves de l'élémentaire en français de base. *Can. Mod. Lang. Rev.* 65, 731–755. doi: 10.3138/cmlr.65.5.731

Canadian Parents for French. (2008). *French Second Language Education in Ontario.* Report and Recommendations to the Ontario Minister of Education, Mississauga, ON.

Celic, C., and Seltzer, K. (2011). *Translanguaging: A CUNY-NYSIEB Guide for Educators.* Available at: http://www.nysieb.ws.gc.cuny.edu/files/2012/06/FINAL-Translanguaging-Guide-With-Cover-1.pdf (accessed April 20, 2012).

Chumak-Horbatsch, R. (2012). *Linguistically Appropriate Practice: A Guide for Working with Young Immigrant Children.* Toronto, ON: University of Toronto Press.

Cummins, J. (1981). Age on arrival and immigrant second language learning in Canada: a reassessment. *Appl. Linguist.* 2, 132–149. doi: 10.1093/applin/2.2.132

Cummins, J. (2001). *Negotiating Identities: Education for Empowerment in a Diverse Society*, 2nd Edn. Los Angeles, CA: California Association for Bilingual Education.

Cummins, J. (2007). Rethinking monolingual instructional strategies in multilingual classrooms. *Can. J. Appl. Linguist.* 10, 221–240.

Cummins, J. (2011). "A dialogue between theory and practice: the education of Deaf and hard-of-hearing students," in *Promoting Academic Achievement among Minority Group Students*, ed. J. Cummins (Keio: Keio University Press Inc.).

Cummins, J., and Danesi, M. (1990). *Heritage Languages: The Development and Denial of Canada's Linguistic Resources.* Toronto, ON: Our Schools/Our Selves and Garamond Press.

Cummins, J., and Early, M. (eds). (2011). *Identity Texts: The Collaborative Creation of Power in Multilingual Schools.* Stoke-on-Trent, UK: Trentham Books.

Cummins, J., and Persad, R. (in press). Teaching through a multilingual lens: the evolution of EAL policy and practice in Canada. *Education Matters.*

Dagenais, D., Walsh, N., Armand, F., and Maraillet, E. (2008a). Collaboration and co-construction of knowledge during language awareness activities in Canadian elementary school. *Lang. Aware.* 17, 139–155. doi: 10.1080/09658410802146685

Dagenais, D., Moore, D., Lamarre, S., Sabatier, C., and Armand, F. (2008b). "Linguistic landscape and language awareness," in *Linguistic Landscape: Expanding the Scenery*, eds E. Shohamy and D. Gorter (New York: Routledge/Taylor & Francis Group), 253–269.

Derwing, T. M., DeCorby, E., Ichikawa, J., and Jamieson, K. (1999). Some factors that affect the success of ESL high school students. *Can. Mod. Lang. Rev.* 55, 532–547. doi: 10.3138/cmlr.55.4.532

Gibson, H., Small, A., and Mason, D. (1997). "Deaf bilingual bicultural education," in *Bilingual Education,* Vol. 5, *Encyclopedia of Language and Education,* eds J. Cummins and D. Corson (Dordrecht: Kluwer Academic Publishers), 231–240.

Gunderson, L. (2007). *English-Only Instruction and Immigrant Students in Secondary Schools: A Critical Examination.* Mahwah, NJ: Lawrence Erlbaum.

Harley, B., Lapkin, S., Scane, J., Hart, D., and Trépanier, C. (1988). *Testing Outcomes in Core French: The Development of Communicative Instruments for Curriculum Evaluation and Research.* Toronto, ON: Ontario Institute for Studies in Education, Modern Language Centre.

Hermans, D., Ormel, E., and Knoors, H. (2010). On the relation between the signing and reading skills of deaf bilinguals. *Int. J. Biling. Edu. Biling.* 13, 187–199. doi: 10.1080/13670050903474093

Klesmer, H. (1994). Assessment and teacher perceptions of ESL student achievement. *English Q.* 26, 8–11. doi: 10.1080/15235882.2006.10162883

Lambert, W. E. (1984). "An overview of issues in immersion education," in *Studies on Immersion Education: A Collection for United States Educators*, ed. California State Department of Education (Sacramento: California State Department of Education), 8–30.

Lapkin, S., Mady, C., and Arnott, S. (2009). Research perspectives on Core French: a literature review. *Can. J. Appl. Linguist.* 12, 6–30.

Lotherington, H. (2011). *Pedagogy of Multiliteracies: Rewriting Goldilocks*. New York: Routledge.

Lyster, R., Collins, I., and Ballinger, S. (2009). Linking languages through a bilingual read-aloud project. *Lang. Aware.* 18, 366–383. doi: 10.1080/09658410903197322

Lyster, R., Quiroga, J., and Ballinger, S. (2013). The effects of biliteracy instruction on morphological awareness. *J. Immers. Content Based Lang. Edu.* 1, 169–197. doi: 10.1075/jicb.1.2.02lys

Mady, C., Arnott, S., and Lapkin, S. (2007). *A Comparison of AIM and Non-AIM Grade 8 Core French in the Bluewater District School Board: Students' French Proficiency and Teacher and Student Perceptions.* Unpublished report. Toronto: University of Toronto.

Mady, C., Arnott, S., and Lapkin, S. (2009). Assessing AIM: case study of Grade 8 students in an Ontario School Board. *Can. Mod. Lang. Rev.* 65, 731–755. doi: 10.3138/cmlr.65.5.703

Marshall, E., and Toohey, K. (2010). Representing family: community funds of knowledge, bilingualism, and multimodality. *Harvard Edu. Rev.* 80, 221–241.

Maxwell, W. (2004). The Accelerated Integrated Method: a holistic approach to the teaching of French as a second language. Réflexions. *J. Can. Assoc. Sec. Lang. Teach.* Available at: http://www.caslt.org/resources/french-sl/research-articles-core-french_aim_en.php (accessed January 15, 2014).

McAndrew, M., Anisef, P., Garnett, B., Ledent, J., and Sweet, R. (2009). *Educational Pathways and Academic Performance of Youth of Immigrant Origin: Comparing Montreal, Toronto and Vancouver. Ottawa: Canadian Council on Learning.* Available at: http://www.ccl-cca.ca/pdfs/OtherReports/CIC-CCL-Final12aout2009EN.pdf (accessed December 10, 2010).

Menéndez, B. (2010). Cross-modal bilingualism: language contact as evidence of linguistic transfer in sign bilingual education. *Int. J. Biling. Edu. Biling.* 13, 201–223. doi: 10.1080/13670050903474101

Naqvi, R., Thorne, K., Pfitscher, C., Nordstokke, D., and McKeough, A. (2012). Reading dual language books: improving early literacy skills in linguistically diverse classrooms. *J. Early Child. Res.* doi: 10.1177/1476718X12449453

Netten, J., and Germain, C. (2005). Pedagogy and second language learning: lessons learned from intensive French. *Can. J. Appl. Linguist.* 8, 183–210.

Ó Duibhir, P., and Cummins, J. (2012). *Towards an Integrated Language Curriculum in Early Childhood and Primary Education (3-12 years)*. Research report number 16. Dublin: National Council for Curriculum and Assessment.

OECD. (2010). *Closing the Gap for Immigrant Students: Policies, Practice and Performance. OECD Reviews of Migrant Education.* Paris: OECD. doi: 10.1787/9789264075788-en

Padden, C., and Ramsey, C. (1998). Reading ability in signing deaf children. *Topics Lang. Disord.* 18, 30–46. doi: 10.1097/00011363-199808000-00005

Preisler, G., and Ahlström, M. (1997). Sign language for hard of hearing children: a hindrance or a benefit for their development? *Eur. J. Psychol. Edu.* 12, 465–477. doi: 10.1007/BF03172805

Preisler, G., Tvingstedt, A., and Ahlström, M. (2002). A psychosocial follow-up study of deaf preschool children using cochlear implants. *Child Care Health Dev.* 28, 403–418. doi: 10.1046/j.1365-2214.2002.00291.x

Roessingh, H. (2011). Family treasures: a dual language book project for negotiating language, literacy, culture and identity. *Can. Mod. Lang. Rev.* 67, 123–148. doi: 10.3138/cmlr.67.1.123

Royal Commission on Learning. (1994). *For the Love of Learning. Volume II. Learning: Our Vision for Schools.* Toronto, ON: Queen's Printer for Ontario.

Snoddon, K. (2008). American Sign Language and early intervention. *Can. Mod. Lang. Rev.* 64, 581–604.

Stille, S., and Cummins, J. (2013). Foundation for learning: engaging plurilingual students' linguistic repertoires in the elementary classroom. *TESOL Q.* 47, 630–638. doi: 10.1002/tesq.116

Swain, M., and Lapkin, S. (2000). Task-based second language learning: the uses of the first language. *Lang. Teach. Res.* 4, 253–276. doi: 10.1177/136216880000400304

Swain, M., and Lapkin, S. (2013). A Vygotskian sociocultural perspective on immersion education: the L1/L2 debate. *J. Immersion Content Based Edu.* 1, 101–129. doi: 10.1075/jicb.1.1.05swa

Swanwick, R. (2010). Policy and practice in sign bilingual education: development, challenges and directions. *Int. J. Biling. Edu. Biling.* 13, 147–158. doi: 10.1080/13670050903474069

Toohey, K., and Derwing, T. M. (2008). Hidden losses: how demographics can encourage incorrect assumptions about ESL high school students' success. *Alta. J. Edu. Res.* 54, 178–193.

Watt, D. L. E., and Roessingh, H. (1994). Some you win, most you lose: tracking ESL student dropout in high school (1988–1993). *English Q.* 26, 5–7.

Watt, D. L. E., and Roessingh, H. (2001). The dynamics of ESL dropout: plus ça change. *Can. Mod. Lang. Rev.* 58, 203–222. doi: 10.3138/cmlr.58.2.203

Conflict of Interest Statement: The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 12 February 2014; paper pending published: 09 March 2014; accepted: 05 April 2014; published online: 07 May 2014.

*Citation: Cummins J (2014) To what extent are Canadian second language policies evidence-based? Reflections on the intersections of research and policy. Front. Psychol. **5**:358. doi: 10.3389/fpsyg.2014.00358*

This article was submitted to Language Sciences, a section of the journal Frontiers in Psychology.