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RESEARCH NOTE

Bilingualism reveals fundamental variation in language processing*

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Although variation in the ways individuals process language has long been a topic of interest and discussion in the psycholinguistic literature, only recently have studies of bilingualism and its cognitive consequences begun to reveal the fundamental dynamics between language and cognition. We argue that the active use of two languages provides a lens through which the interactions between language use, language processing, and the contexts in which these take place can be fully understood. Far from bilingualism being considered a special case, it may provide the common basis upon which the principles of language learning and use can be modeled.

Keywords: Bilingualism, individual differences in language processing, cognitive control

A recent trend in the language sciences has been to pursue a more nuanced understanding of individual differences in language processing. Armed with increasingly sophisticated tools for statistical modeling and data collection, researchers have turned their attention to the systematicity hidden within the "noise" of processing behavior. In this paper, we argue that, while this shift has been occurring slowly but surely over the past few decades, relatively little explicit consideration has been given to the implicit assumptions motivating this endeavor, namely, that variation in language processing is a fundamental aspect of language as a cognitive system, and that a better understanding of the sources of this variation will reveal the architecture of the system itself. In this respect, studies of language processing in bilingual speakers have made an important contribution. The use of two or more languages is perhaps the most common characterization of language use in the world today. Combined with the rapid development of neuroscientific methods, bilingualism can act as a lens to illuminate the relations between language and its cognitive and neural underpinnings (e.g., De Groot, 2011; Kroll, Dussias, Bice & Perrotti, 2015).[1]

This paper is not intended as a comprehensive review of the current literature on bilingualism, nor of individual difference approaches to language processing. Rather, we intend to illustrate how research on bilingualism has contributed to the current reorientation toward and reinterpretation of variation in language processing. We define "variation" as the way in which individuals differ in how they employ cognitive and linguistic skills. We first consider what has been learned about the acquisition and use of two languages that reflects the inherent variability of the language system, and we then discuss recent findings that reveal the contextual and cognitive factors that modulate the dynamics of this variation. Finally, we point to recent discussion about the cognitive consequences of bilingualism (e.g., García-Pentón, Fernández García, Costello, Duñabeitia & Carreiras, 2016; Valian, 2015) as an example of how language science may benefit by considering the ways that individual variability gives rise to stable patterns of results across seemingly disparate studies.

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[1] For the purpose of this discussion we consider bilingualism broadly to include all speakers who actively use two or more languages, regardless of age of acquisition. The consequences of the form of bilingualism and level of proficiency and dominance in each language have been reviewed elsewhere (e. g., Luk & Bialystok, 2013).

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1. Variation in second language (L2) acquisition reveals a dynamic system

Not all bilinguals are the same and not all contexts of language use incur the same cognitive demands (Luk & Bialystok, 2013). Recent proposals (e.g., Green & Abutalebi, 2013) underscore the idea that some language contexts may engage cognitive resources differentially, with distinct consequences for bilinguals whose cognition has been "tuned" by a respectively demanding environment. Although lifelong bilinguals are likely to adapt to such demands, adults who have acquired the L2 later in life are also impacted by differences in the context of language learning and use, and various proposals have been offered to account for the variation seen in learners' mastery and use of the L2 (Flege, 2007; Flege & Eefting, 1987; Hawkins & Chan, 1997; Franceschina, 2001, 2005). Traditionally, two assumptions have been made about the trajectory of L2 acquisition: (1) that the native or first language (L1) remains stable throughout the lifespan; and (2) that the L2 is biologically constrained. Under these assumptions, adult L2 learners must attempt the seemingly insurmountable feat of constructing a new language system, with transfer from L1 that may be only partly successful (e.g., Clahsen & Felser, 2006; but see MacWhinney, 2005). Historically, this framing left little room for a nuanced discussion of individual variation, as successful L2 learning was assumed to decline with increasing age (Johnson & Newport, 1989; Flege, Munro & MacKay, 1995). However, recent neuroscience research shows that late L2 learning is highly dynamic (McLaughlin, Tanner, Pitkanen, Frenck-Mestre, Inoue, Valentine & Osterhout, 2010), can result in native-like grammatical processing (Morgan-Short, Steinhauer, Sanz & Ullman, 2012), and can have consequences for both brain structure and function (Li, Legault & Litcofsky, 2014). Below, we highlight the discoveries that illustrate how the study of individual differences allows us to further our understanding of the path that L2 learners take to becoming proficient language users.

1.1 The L1 is affected by L2 learning

Successful language learning has been argued to depend on the degree of overlap between the L1 and L2 (Flege & Davidian, 1984; Hancin-Bhatt, 1994; Hatzidaki, Branigan & Pickering, 2011; Sabourin, Stowe & de Haan, 2006; Sabourin & Stowe, 2008), with the underlying assumptions that the native L1 should be relatively static and the primary direction of transfer should be from the L1 to the L2. These assumptions have been questioned by studies showing that the L1 is subject to influence from the L2, not only for learners (Baus, Costa & Carreiras, 2013; Chang, 2012, 2013; Linck, Kroll & Sunderman, 2009; Namjoshi, Tremblay, Spinelli, Broersma, Martínez-García, Connell, Cho & Kim, 2015) and highly proficient bilinguals (Dussias & Sagarra, 2007; Valdés Kroff, Dussias, Gerfen & Perrotti, 2012; Dussias, Perrotti, Brown & Morales, 2014; Van Hell & Dijkstra, 2002), but even for monolinguals immersed in another language environment (Caramazza & Yeni-Komshian, 1974). While L2 immersion enhances the influence of L2 on L1, this relationship can also be observed for students learning L2 in the classroom (e.g., Herd, Walden, Knight & Alexander, 2015, Huffman & Schuhmann, 2015; Schuhmann & Huffman, 2015). Crucially, in some instances, these effects are detectable only if a sensitive measure is used (e.g., Event Related Potentials; ERPs) and if individual differences are considered (Bice & Kroll, 2015). The emerging evidence suggests that the influence of L2 learning on L1 may vary depending on the individual and context under consideration, and further, that pursuing a more complete understanding of the L1-L2 relationship may be informative with respect to issues of language and domain general cognition, as well as neuroplasticity across the lifespan (Baum & Titone, 2014).

1.2 L2 and L1 processing are highly variable

Achieving native-like processing ability in the L2 is considered difficult for late learners (Clahsen & Felser, 2006; Ullman, 2005), and data on age of acquisition has been used to argue this point. Recent work has taken a different approach by using measures of proficiency, lexical knowledge, and executive function to track whether particular learners will be sensitive to aspects of L2 syntax (Hopp, 2014; 2016; Steinhauer, 2014). These studies indicate that L2 learners with higher working memory capacity are capable of parsing complex structures like relative clauses in a manner similar to native speakers, and that individual differences in working memory are correlated with qualitatively similar parsing strategies across both groups (Hopp, 2014; see also Kim, 2010). Moreover, monolingual performance may not serve as the best benchmark for successful L2 attainment; while some monolinguals use efficient parsing strategies to revise syntactic ambiguities, others simply do not (Ferreira, 2003; Townsend & Bever, 2001). There is much still to be learned about how syntactic processing ability changes over the course of L2 acquisition. What we know is that monolinguals and L2 learners can show comparable performance, suggesting that L1 and L2 processing share some fundamental properties. Only by examining the factors that underlie processing variability in both native and nonnative speakers (Pakulak & Neville, 2010; Tanner, Inoue & Osterhout, 2014) have these commonalities have been brought to light.

2. Differences in L1-L2 competition show how the language system adapts

When bilinguals read or speak a word, they must select among competing alternatives in the L1 and L2. The ability to manage this competition has been highlighted as a potential factor underlying the consequences of bilingual language use for cognition. When this immediate competition is absent, as is the case for bimodal bilinguals who are not required to select a single lexical form, the effects on cognition and the brain can be quite different (Emmorey, Luk, Pyers & Bialystok, 2008; Olulade, Jamal, Koo, Perfetti, LaSasso & Eden, 2016). We next consider some ways in which cross-language competition during lexical access can influence language processing across individuals and language contexts.

2.1 Language production

Multiple factors affect the extent to which dual-language activation impacts language production. The relative proficiency or dominance of a bilingual's two languages undoubtedly plays a role. For example, Costa and Santesteban (2004) demonstrated an asymmetrical cost when switching from naming pictures in the L2 into the L1 for lower proficiency speakers, but a symmetrical switching cost for higher proficiency speakers. This result was taken to mean that the stronger L1 must be suppressed in order to gain access to a weaker L2, and then subsequently de-regulated in order to allow L1 naming to occur. Other studies suggest that proficiency may affect only some components of inhibitory control and that even highly proficient bilinguals inhibit the L1 to plan speech in the L2 (Misra, Guo, Bobb & Kroll, 2012; Van Assche, Duyck & Gollan, 2013). These regulatory mechanisms may be differentially impacted by the context in which language use takes place (see Kroll, Bobb & Wodniecka, 2006). To illustrate, Jacobs, Fricke, and Kroll (2016) demonstrated that the cross-language activation that L2 learners experience in production could be influenced by the language immersion context. Independent of L2 proficiency, learners immersed in the L1 showed cross-language influence in their phonetic production, while those immersed in the L2 did not. While greater L2 proficiency and the ability to appropriately regulate the L1 typically go hand in hand, these factors appear to be dissociable under certain circumstances. Different stages of speech planning may also be differentially affected by patterns of activation and inhibition, as cross-language activation in this study was shown to influence naming times across groups, but not necessarily qualitative aspects of articulation. Other aspects of the production context also play a role; Olson (2013) found that the proportion of other-language trials impacted the degree of cross-language phonological influence on picture naming, and Gustafson, Engstler, and Goldrick (2013) reported greater cross-language phonological influence during picture naming as compared to verbal shadowing.

Even within the same production context, bilinguals' ability to flexibly recruit cognitive resources is important. Simply encouraging different lexical selection strategies during a picture-naming task, for example, may affect the magnitude of language switching costs (Kleinman & Gollan, 2016). Festman, Rodriguez-Fornells, and Münte (2010) reported that young adult, late bilinguals who performed relatively poorly on a range of domain-general cognitive tasks also tended to produce more unintended language intrusions. This suggests a relationship between domain-general cognitive function and efficient lexical selection, and raises the possibility that variation in language task demands may be associated with long-term, adaptive changes to the cognitive system (Green & Abutalebi, 2013). However, more work is needed to fully appreciate how L1 dominance and regulatory ability impact the manifestation of cross-language activation during speech planning.

2.2. Language comprehension

Effective language comprehension relies on the ability to support relevant information in prior context and suppress irrelevant information (Gernsbacher & Faust, 1991; Gernsbacher, Varner & Faust, 1990). When individuals experience more difficulty suppressing, interference can occur, making efficient processing and successful comprehension more effortful. In spoken discourse comprehension, Boudewyn, Long, and Swaab (2012) found that individual performance on a Stroop interference task predicted whether monolingual listeners were able to suppress competing and less relevant information in local discourse (within the same sentence) in order to maintain more relevant information over time (from prior sentences in the discourse). Cognitive control has also been shown to support the comprehension of sentences containing syntactic ambiguities. Novick, Hussey, Teubner-Rhodes, Harbison, and Bunting (2014) trained participants on the N-back task to improve their ability to resolve non-linguistic conflict. Participants who gained the most from N-back training also saw the greatest gains in resolving syntactic ambiguities from pre- to post-training.

Studies of non-native bilingual comprehension support the claim that there is a relationship between language processing and cognitive control. Teubner-Rhodes, Mishler, Corbett, Andreu, Sanz-Torrent, Trueswell, and Novick (2016), for example, found that the degree of improvement in a high conflict N-back task was significantly correlated with improvement in sentence comprehension for bilinguals as well as monolinguals. Moreover, bilingual readers performed

better than monolinguals overall on the high conflict N-back and in their comprehension of syntactically ambiguous sentences, suggesting that previous experience in negotiating conflict due to cross-language activation can be applied to other cognitive training contexts, as well as to language comprehension itself.

Cross-language influence from the unintended language has repeatedly been demonstrated to play a role in bilingual language comprehension (Kroll, Gullifer & Zirnstein, 2016; Van Hell & Tanner, 2013), meaning that language regulation ability may be critical for successful comprehension. Similarly to language production, results suggest that individual differences both in cognitive resources and sensitivity to contextual constraints help to predict the circumstances under which bilinguals will evince greater cross-language modulation. Whitford and Titone (2012) showed that individual differences in the degree of L2 exposure itself has consequences for the accessibility of words in each language, with a decline in L1 accessibility as L2 exposure increases (and see Whitford & Titone, 2015). Pivneva, Mercier, and Titone (2014) found that when bilingual readers encountered interlingual homographs, which share form but not meaning across languages (e.g., *chat*, which means "cat" in French), inhibitory control ability attenuated the amount of interference observed, irrespective of L2 proficiency. The findings with respect to contextual influences are somewhat mixed, with some studies showing that language-specific constraining information can reduce cross-language activation (Chambers & Cooke, 2009; Fricke, Kroll & Dussias, 2016; Schwartz & Kroll, 2006), while others show no such effects (Gullifer, Kroll & Dussias, 2013; Van Assche, Drieghe, Duyck, Welvaert & Hartsuiker, 2011), although individual variability in this area is not yet well understood (see Gullifer, 2015, for evidence concerning syntactic constraints and cognitive control). Further research may reveal interactions between language- and task-specific constraining information, on the one hand, and individual differences in cognitive control ability on the other.

3. How individual variation can inform current debates

We have argued that accounting for a wide array of language use is key to understanding the fundamental dynamics of the language system. What we have yet to address is how this type of approach can impact the field more broadly. A potentially critical application concerns the recent debate on the impact of bilingual language use on cognition. Some research has suggested that the effort required to appropriately switch languages, between speakers and contexts, can change or tune the neural networks that support this complex behavior (see Green & Abutalebi, 2013, on the Adaptive Control Hypothesis) and provide protection against cognitive decline during aging and in the face of pathology (Alladi, Bak, Mekala, Rajan, Chaudhuri, Mioshi, Krovvidi, Surampudi, Duggirala & Kaul, 2015). In particular, multiple studies show that bilinguals tend to outperform matched monolingual controls on tasks of executive function (e.g., Bak, Vega-Mendoza & Sorace, 2014; Gold, Kim, Johnson, Kryscio & Smith, 2013). However, advantages for bilinguals tend to be more robust in early childhood and older adulthood (Baum & Titone, 2014; Bialystok, 2017; Kroll & Bialystok, 2013). In young adults, these consequences for cognition are not always found, and some argue that this level of inconsistency calls into question all cognitive consequences attributed to bilingualism (de Bruin, Treccani & Della Sala, 2015; García-Pentón et al., 2016; Valian, 2015; but see Bialystok, 2017 and Bialystok, Kroll, Green, MacWhinney & Craik, 2015). Notably, there is variation not only across the lifespan, but also for different indices of processing, with some evidence suggesting that measures of brain activity may be more likely to detect the consequences of bilingualism than behavior alone (Kousaie & Phillips, 2017). How can we place these varied findings in a larger context in the literature?

3.1 Individual differences in language processing: the bigger picture

When investigating the potential cognitive consequences of bilingualism, it is important not only to take individual variability into account, as we have argued, but also to acknowledge that the hypothesized interaction between language and cognition has been the focus of research on individual differences in monolingual language use for decades (see Boudewyn, 2015, Long, Johns & Morris, 2007; and Prat, 2011 for reviews). This includes a range of research that has reported multiple influences of individual-level skill on language processing, including word-decoding (e.g., the Lexical Quality Hypothesis; Perfetti, 2007), working memory (Daneman & Carpenter, 1980; Just & Carpenter, 1992), inhibition/suppression (e.g., the Structure-Building framework; Gernsbacher, 1996, 1997), speed of processing (Traxler, Long, Tooley, Johns, Zirnstein & Jonathan, 2012), experience (Ericsson & Kintsch, 1995; as measured by vocabulary and print exposure, e.g., Braze, Tabor, Shankweiler & Mencl Tabor, W., Shankweiler, D. P., & Mencl, 2007), susceptibility to memory interference (Van Dyke & Johns, 2012), and complex interactions between these skills (Hamilton, Freed & Long, 2013). Together, this work indicates not only variability but also malleability in language processing. Rather than interpreting this complex relationship as an impediment to "parsimonious" explanations for language performance, we propose that the principled investigation of inter-individual variation

in bilingual language processing can provide a creative solution to what appear to be discrepant findings across populations and laboratories.

Even if one is highly skeptical of the impact that bilingualism might have on domain-general cognition, it is not unreasonable to suspect that individual-level variability could play a large role in determining performance on tasks of executive function. As a repercussion, differences between and within bilinguals may often be masked by group-level analyses. As Baum and Titone (2014) suggest, research on bilingualism, in particular, could benefit from considering both types of variance.

4. Summary and conclusions: Opportunistic processors and creatures of habit

Language processing is inherently variable, and the contexts in which bilinguals acquire and use language afford unique opportunities to observe the consequences of this variability. Bilingualism has the potential to reveal the fundamental breadth and underlying nature of variation in language processing (for a similar approach to language development see Pierce, Genesee, Delcenserie & Morgan, 2017). We have briefly discussed research that suggests that bilingual language processing is, at its core, plastic: proficient speakers, listeners, readers, and learners all appear capable of exploiting multiple strategies to regulate their languages, flexibility that may benefit cognition more generally. Recent proposals hypothesize a link between a speaker's history of language regulation and the adaptation of cognitive control processes to the linguistic contexts in which they have most commonly been engaged (Green & Abutalebi, 2013; Green & Li, 2014). Future research promises to elucidate the ways in which accumulated experience with specific modes of language control may impact both linguistic and cognitive processing. In this sense, bilinguals are model subjects of study for those interested in the dynamics between language and cognition and their neural bases.

References

Alladi, S., Bak, T. H., Mekala, S., Rajan, A., Chaudhuri, J. R., Mioshi, E., Krovvidi, R., Surampudi, B., Duggirala, V., & Kaul, S. (2015). Impact of bilingualism on cognitive outcome after stroke. *Stroke, 47*, 258–261.

Bak, T. H., Vega-Mendoza, M., & Sorace, A. (2014). Never too late? An advantage on tests of auditory attention extends to late bilinguals. *Frontiers in Psychology, 5*, 485.

Baum, S., & Titone, D. (2014). Moving toward a neuroplasticity view of bilingualism, executive control, and aging. *Applied Psycholinguistics, 35*, 857–894.

Baus, C., Costa, A., & Carreiras, M. (2013). On the effects of second language immersion on first language production. *Acta Psychologica, 142*, 402–409.

Bialystok, E. (2017). The bilingual adaptation: How minds accommodate experience. *Psychological Bulletin, 143*, 233–262.

Bialystok, E., Kroll, J. F., Green, D. W., MacWhinney, B., & Craik, F. I. M. (2015). Publication bias and the validity of evidence: What's the connection? *Psychological Science, 26*, 944–946.

Bice, K., & Kroll, J. F. (2015). Native language change during early stages of second language learning. *NeuroReport, 26*, 966–971.

Boudewyn, M. A. (2015). Individual differences in language processing: Electrophysiological approaches. *Language and Linguistics Compass*, *9/10*, 406–419.

Boudewyn, M. A., Long, D. L., & Swaab, T. Y. (2012). Cognitive control influences the use of meaning relations during spoken sentence comprehension. *Neuropsychologia, 50*, 2659–2668.

Braze, D., Tabor, W., Shankweiler, D. P., & Mencl, W. E. (2007). Speaking up for vocabulary reading skill differences in young adults. *Journal of Learning Disabilities, 40*, 226–243.

Caramazza, A., & Yeni-Komshian, G. H. (1974). Voice onset time in two French dialects. *Journal of Phonetics, 2*, 239–245.

Chambers, C. G., & Cooke, H. (2009). Lexical competition during second-language listening: Sentence context, but not proficiency, constrains interference from the native lexicon. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *35*(*4*), 1029–1040.

Chang, C. B. (2012). Rapid and multifaceted effects of second-language learning on first-language speech production. *Journal of Phonetics, 40*, 249–268.

Chang, C. B. (2013). A novelty effect in phonetic drift of the native language. *Journal of Phonetics, 41*, 520–533.

Clahsen, H., & Felser, C. (2006). Grammatical processing in language learning. *Applied Psycholinguistics*, *27*, 3–42.

Costa, A., & Santesteban, M. (2004). Lexical access in bilingual speech production: Evidence from language switching in highly proficient bilinguals and L2 learners. *Journal of Memory and Language*, *50*(*4*), 491–511.

Daneman, M., & Carpenter, P. A. (1980). Individual differences in working memory and reading. *Journal of Verbal Learning and Verbal Behavior, 19*, 450–466.

De Bruin, A., Treccani, B., & Della Sala, S. (2015). Cognitive advantage in bilingualism: An example of publication bias? *Psychological Science, 26*, 99–107.

De Groot, A. M. (2011). *Language and Cognition in Bilinguals and Multilinguals: An Introduction*. Psychology Press.

Dussias, P. E., & Sagarra, N. (2007). The effect of exposure on syntactic parsing in Spanish–English bilinguals. *Bilingualism: Language and Cognition, 10*, 101–116.

Dussias, P. E., Perrotti, L., Brown, M., & Morales, L. (2014). Re-learning to parse a first language: The role of experience in sentence comprehension. Presented at the 27th Annual CUNY Conference Human Sentence Processing, Columbus, OH.

Emmorey, K., Luk, G., Pyers, J. E., & Bialystok, E. (2008). The source of enhanced cognitive control in bilinguals: Evidence from bimodal bilinguals. *Psychological Science*, *19*, 1201–1206.

Ericsson, K. A., & Kintsch, W. (1995). Long-term working memory. *Psychological Review, 102*, 211.

Ferreira, F. (2003). The misinterpretation of noncanonical sentences. *Cognitive Psychology, 47*, 164–203.

Festman, J., Rodriguez-Fornells, A., & Münte, T. F. (2010). Individual differences in control of language interference in late bilinguals are mainly related to general executive abilities. *Behavioral and Brain Functions*, *6*, 1.

Flege, J. (2007). Language contact in bilingualism: phonetic system interactions. In J. Cole & J. I. Hualde (Eds.), *Laboratory Phonology, 9th edition*, pp. 353–82. Berlin: Mouton de Gruyter.

Flege, J., & Davidian, R. (1984). Transfer and developmental processes in adult foreign language speech production. *Applied Psycholinguistics, 5*, 323–347.

Flege, J., & Eefting, W. (1987). Cross-language switching in stop consonant production and perception by Dutch speakers of English. *Speech Communication*, *6*, 185–202.

Flege, J., Munro, M., & MacKay, I. (1995). The effect of age of second language learning on the production of English consonants. *Speech Communication*, *16*, 1–26.

Franceschina, F. (2001). Against an L2 morphological deficit as an explanation for the differences between native and non-native grammars. In S. H. Foster-Cohen & A. Nizegorodcew (Eds.), *EUROSLA Yearbook*, *vol. 1*, pp. 143–58. Amsterdam: Benjamins.

Franceschina, F. (2005). *Fossilized Second Language Grammars: The Acquisition of Grammatical Gender*. Amsterdam: Benjamins.

Fricke, M., Kroll, J. F., & Dussias, P. E. (2016). Phonetic variation in bilingual speech: A lens for studying the production–comprehension link. *Journal of Memory and Language*, *89*, 110–137.

García-Pentón, L., García, Y. F., Costello, B., Duñabeitia, J. A., & Carreiras, M. (2016) The neuroanatomy of bilingualism: how to turn a hazy view into the full picture. *Language, Cognition and Neuroscience, 31*, 303–327.

Gernsbacher, M. A. (1996). The structure-building framework: what it is, what it might also be, and why. In B. K. Britton, & A. C. Graesser, (Edss), *Models of text understanding* (pp. 289–311). Hillsdale, NJ: Erlbaum.

Gernsbacher, M. A. (1997). Two decades of structure building. *Discourse processes, 23*, 265–304.

Gernsbacher, M. A., & Faust, M. E. (1991). The mechanism of suppression: A component of general comprehension skill. *Journal of Experimental Psychology: Learning, Memory and Cognition, 17*, 245–262.

Gernsbacher, M. A., Varner, K. R., & Faust, M. E. (1990). Investigating differences in general comprehension skill. *Journal of Experimental Psychology: Learning, Memory and Cognition, 16*, 430–445.

Gold, B. T., Kim, C., Johnson, N. F., Kryscio, R. J., & Smith, C. D. (2013). Lifelong bilingualism maintains neural efficiency for cognitive control in aging. *The Journal of Neuroscience, 33*, 387–396.

Green, D. W., & Abutalebi, J. (2013). Language control in bilinguals: The adaptive control hypothesis. *Journal of Cognitive Psychology, 25*, 515–530.

Green, D. W., & Li, W. (2014). A control process model of code-switching. *Language, Cognition and Neuroscience*, *29*, 499–511.

Gullifer, J. W. (2015). Using syntactic priming to identify cross-language constraints in bilingual language processing. *Unpublished doctoral dissertation*, The Pennsylvania State University, University Park, PA.

Gullifer, J. W., Kroll, J. F., & Dussias, P. E. (2013). When language switching has no apparent cost: Lexical access in sentence context. *Frontiers in psychology*, *4*, 278.

Gustafson, E., Engstler, C., & Goldrick, M. (2013). Phonetic processing of non-native speech in semantic vs non-semantic tasks. *The Journal of the Acoustical Society of America*, *134*, EL506–EL512.

Hamilton, S. T., Freed, E. M., & Long, D. L. (2013). Modeling reader- and text-interactions during narrative comprehension: A test of the lexical quality hypothesis. *Discourse Processes, 50*, 139–163.

Hancin-Bhatt, B. (1994). Segmental transfer: a natural consequence of a dynamic system. *Second Language Research. 10*, 242–270.

Hatzidaki, A., Branigan, H. P., & Pickering, M. J. (2011). Co-activation of syntax in bilingual language production. *Cognitive Psychology*, *62*,123–150.

Hawkins, R., & Chan, C. Y. (1997). The partial availability of universal grammar in second language acquisition: The 'failed functional features hypothesis'. *Second Language Research, 13*, 187–226.

Herd, W. J., Walden, R. L., Knight, W. L., & Alexander, S. N. (2015). Phonetic drift in a first language dominant environment. *Proceedings of Meetings on Acoustics, 23*, 060005.

Hopp, H. (2014). Working memory effects on the L2 processing of ambiguous relative clauses. *Language Acquisition, 21*, 250–278.

Hopp, H. (2016). The timing of lexical and syntactic processes in second language sentence comprehension. *Applied Psycholinguistics*, *37*, 1253–1280.

Huffman, M. K., & Schuhmann, K. (2015). Effect of early L2 learning on L1 stop voicing. *Proceedings of Meetings on Acoustics, 23*, 060007.

Jacobs, A., Fricke, M., & Kroll, J. F. (2016). Cross-language activation begins during speech planning and extends into second language speech. *Language Learning, 66*, 324–353.

Johnson, J. S., & Newport, E. L. (1989) Critical period effects in second language learning: the influence of maturational state on the acquisition of English as a second language. *Cognitive Psychology, 21*, 60–99.

Just, M. A., & Carpenter, P. A. (1992). A capacity theory of comprehension: Individual differences in working memory. *Psychological Review, 99*, 122–149.

Kim, J. H. (2010). The influence of sentence complexity and working memory on relative clause ambiguity resolution. *Language and Linguistics, 48*, 1–26.

Kleinman, D., & Gollan, T. H. (2016). Speaking two languages for the price of one: Bypassing language control mechanisms via accessibility-driven switches. *Psychological Science*, *1*, 15.

Kousaie, S., & Phillips, N. A. (2017). A behavioural and electrophysiological investigation of the effect of bilingualism on aging and cognitive control. *Neuropsychologia, 94*, 23–35.

Kroll, J. F., Bobb, S. C., & Wodniecka, Z. (2006). Language selectivity is the exception, not the rule: Arguments against a fixed locus of language selection in bilingual speech. *Bilingualism: Language and Cognition*, *9*, 119–135.

Kroll, J. F., & Bialystok, E. (2013). Understanding the consequences of bilingualism for language processing and cognition. *Journal of Cognitive Psychology, 25*, 497–514.

Kroll, J. F., Dussias, P. E., Bice, K., & Perrotti, L. (2015). Bilingualism, mind, and brain. In M. Liberman & B. H. Partee (Eds.), *Annual Review of Linguistics*, *1*, 377–394.

Kroll, J. F., Gullifer, J., & Zirnstein, M. (2016). Literacy in adulthood: Reading in two languages, Chapter 12. In Montanari, S., & Nicoladis, E. (Eds.), *Bilingualism across the lifespan: Factors moderating language proficiency*. Washington, DC: American Psychological Association.

Li, P., Legault, J., & Litcofsky, K. A. (2014). Neuroplasticity as a function of second language learning: anatomical changes in the human brain. *Cortex*, *58*, 301–324.

Linck, J. A., Kroll, J. F., & Sunderman, G. (2009). Losing access to the native language while immersed in a second language: Evidence for the role of inhibition in second language learning. *Psychological Science, 20*, 1507–1515.

Long, D. L., Johns, C. L., & Morris, P. E. (2007). Comprehension ability in mature readers. In M. Traxler & M. Gernsbacher (Eds.), *Handbook of Psycholinguistics* (pp. 801–834). Burlington, MA: Academic Press.

Luk, G., & Bialystok, E. (2013). Bilingualism is not a categorical variable: Interaction between language proficiency and usage. *Journal of Cognitive Psychology, 25*, 605–621.

MacWhinney, B. (2005). A unified model of language acquisition. In J. F. Kroll & A. M. B. de Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches* (pp. 49–67). New York: Oxford University Press.

McLaughlin, J., Tanner, D., Pitkanen, I., Frenck-Mestre, C., Inoue, K., Valentine, G., & Osterhout, L. (2010). Brain potentials reveal discrete stages of L2 grammatical learning. *Language Learning, 60*, 123–150.

Misra, M., Guo, T., Bobb, S. C., & Kroll, J. F. (2012). When bilinguals choose a single word to speak: Electrophysiological evidence for inhibition of the native language. *Journal of Memory and Language*, *67*, 224–237.

Morgan-Short, K., Steinhauer, K., Sanz, C., & Ullman, M. T. (2012). Explicit and implicit second language training differentially affect the achievement of native like brain activation patterns. *Journal of Cognitive Neuroscience*, *24*, 933–947.

Namjoshi, J., Tremblay, A., Spinelli, E., Broersma, M., Martínez-García, M. T., Connell, K., Cho, T., & Kim, S. (2015). Speech segmentation is adaptive even in adulthood: Role of the linguistic environment. In the Scottish Consortium for ICPhS 2015 (Eds.), *Proceedings of the 18th International Congress on Phonetic Sciences*. Glasgow, Scotland: University of Glasgow.

Novick, J. M., Hussey, E., Teubner-Rhodes, S., Harbison, J. I., & Bunting, M. F. (2014). Clearing the garden-path: Improving sentence processing through cognitive control training. *Language, Cognition and Neuroscience, 29*, 186–217.

Olulade, O. A., Jamal, N. I., Koo, D. S., Perfetti, C. A., LaSasso, C., & Eden, G. F. (2016). Neuroanatomical evidence in support of the bilingual advantage theory. *Cerebral Cortex, 26*, 3196–3204.

Pakulak, E., & Neville, H. J. (2010). Proficiency differences in syntactic processing of monolingual native speakers indexed by event-related potentials. *Journal of Cognitive Neuroscience*, *22*, 2728–2744.

Perfetti, C. A. (2007). Reading ability: lexical quality to comprehension. *Scientific Studies of Reading, 11*, 357–383.

Pierce, L. J., Genesee, F., Delcenserie, A., & Morgan, G. (2017). Linking early language experiences and language learning outcomes. *Applied Psycholinguistics, 38*, 1265–1300.

Pivneva, I., Mercier, J., & Titone, D. (2014). Executive control modulates cross-language lexical activation during L2 reading: evidence from eye movements. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 40*, 787–796.

Prat, C. S. (2011). The brain basis of individual differences in language comprehension abilities. *Language and Linguistics Compass, 5/9*, 635–649.

Sabourin, L., Stowe, L., & de Haan, G. J. (2006). Transfer effects in learning a second language grammatical gender system. *Second Language Research*, *22*, 1–29.

Sabourin, L., & Stowe, L. (2008). Second language processing: When are first and second languages processed similarly? *Second Language Research*, *24*, 397–430.

Schwartz, A. I., & Kroll, J. F. (2006). Bilingual lexical activation in sentence context. *Journal of Memory and Language*, *55*, 197–212.

Schuhmann, K. S. & Huffman, M. K. (2015). L1 drift and L2 category formation in second language learning. In the Scottish Consortium for ICPhS 2015 (Ed.), *Proceedings of the 18th International Congress of Phonetic Sciences* (paper number 0850). Glasgow, UK: University of Glasgow.

Steinhauer, K. (2014). Event-related potentials (ERPs) in second language research: A brief introduction to the technique, a selected review, and an invitation to reconsider critical periods in L2. *Applied Linguistics*, *35*, 393–417.

Tanner, D., Inoue, K., & Osterhout, L. (2014). Brain-based individual differences in online L2 grammatical comprehension. *Bilingualism: Language and Cognition*, *17*, 277–293.

Teubner-Rhodes, S. E., Mishler, A., Corbett, R., Andreu, L., Sanz-Torrent, M., Trueswell, J. C., & Novick, J. M. (2016). The effects of bilingualism on conflict monitoring, cognitive control, and garden-path recovery. *Cognition, 150*, 213–231.

Townsend, D. J., & Bever, T. G. (2001). *Sentence comprehension: The integration of habits and rules*. Cambridge, MA: MIT Press.

Traxler, M. J., Long, D. L., Tooley, K. M., Johns, C. L., Zirnstein, M., & Jonathan, E. (2012). Individual differences

in eye-movements during reading: Working memory and speed-of-processing effects. *Journal of Eye Movement Research*, *5*(*1*): *5*, 1–16.

Ullman, M. T. (2005). A cognitive neuroscience perspective on second language acquisition: The declarative/procedural model. In C. Sanz (Ed.), *Mind and context in adult second language acquisition: Methods, theory and practice* (pp. 141–178). Washington, DC: Georgetown University Press.

Whitford, V., & Titone, D. (2012). Second-language experience modulates first-and second-language word frequency effects: Evidence from eye movement measures of natural paragraph reading. *Psychonomic Bulletin & Review, 19*, 73–80.

Whitford, V., & Titone, D. (2015). Second-language experience modulates eye movements during first- and second-language sentence reading: Evidence from a gaze-contingent moving window paradigm. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 41*, 1118–1129.

Valdés Kroff, J. R., Dussias, P. E., Gerfen, C., & Perrotti, L. (2012). The dynamic nature of real-time grammatical gender processing. *Paper presented at the 37th Annual Boston University Conference on Language Development*. Boston, MA.

Valian, V. (2015). Bilingualism and cognition. *Bilingualism: Language and Cognition, 18*, 3–24.

Van Assche, E., Drieghe, D., Duyck, W., Welvaert, M., & Hartsuiker, R. J. (2011). The influence of semantic constraints on bilingual word recognition during sentence reading. *Journal of Memory and Language*, *64*(*1*), 88–107.

Van Assche, E., Duyck, W., & Gollan, T. H. (2013). Whole-language and item-specific control in bilingual language production. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 9*, 1781–1792.

Van Dyke, J. A., & Johns, C. L. (2012). Memory interference as a determinant of language comprehension. *Language and Linguistics Compass, 6*, 193–211.

Van Hell, J. G., & Dijkstra, T. (2002). Foreign language knowledge can influence native language performance in exclusively native contexts. *Psychonomic Bulletin & Review*, *9*, 780–789.

Van Hell, J. G., & Tanner, D. (2013). Second language proficiency and cross-language lexical activation. *Language Learning, 62*, 148–171.