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Bimodal bilingualism reveals mechanisms of cross-language interaction*

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In the recent swell of research on bilingualism and its consequences for the mind and the brain, there has been a warning that we need to remember that not all bilinguals are the same (e.g., Green & Abutalebi, 2013; Kroll & Bialystok, 2013; Luk & Bialystok, 2013). There are bilinguals who acquired two languages in early childhood and have used them continuously throughout their lives, bilinguals who acquired one language early and then switched to another language when they entered school or emigrated from one country to another, and others who only acquired a second language (L2) as an adult. Among these forms of bilingualism there are differences in both the context and amount of time spent in each language and differences in the status of the languages themselves. The L2 may be a majority language, spoken by almost everyone in the environment, or a minority language, spoken only by a few. The native or first language (L1) may also be the dominant language or may have been overtaken by the influence of the L2 given the circumstances imposed by the environment. Likewise, the L1 and L2 may vary in how similar they are structurally, whether they share the same written script, or whether one language is spoken and the other signed.

In this keynote article, Emmorey, Giezen and Gollan (Emmorey, Giezen & Gollan) review what we have learned about bilingualism in the past decade by the study of bimodal bilinguals for whom one language is spoken and the other signed. They focus on hearing bimodal bilinguals but evidence on deaf bimodal bilinguals is also considered. The resulting review is impressive because it illustrates the way that the precise form of bilingualism can be exploited to reveal the mechanisms that enable or constrain interactions across a bilingual's two languages. The review is not simply a list of interesting empirical phenomena. The fundamental insight is that having a means of production that engages a different articulatory system functionally liberates the bilingual to use the two languages together in code blends that are unique to bimodal bilingualism. The freedom to use two different forms of output provides a context in which fundamental questions about bilingualism can be posed. Does being bilingual necessarily mean juggling simultaneous activation of two languages and negotiating the resulting cross-language competition? Are both sign and speech alternatives available in parallel the way that two spoken languages appear to co-activate one another? Does the form of bilingualism and the ability to code blend reduce competition across the two languages? Are bimodal bilingual required to select the language they intend to use or are both languages available for free? Are the same sort of consequences for cognition and the brain evident for bimodal bilinguals that have been documented for unimodal bilinguals?

The research program that is reviewed in this paper considers all of these questions. The answers, of course, are not simple, but two themes emerge. The first, and perhaps most profound, is that there are interactions across a bilingual's two languages regardless of the form that bilingualism takes. The evidence on bimodal bilingualism concerning the interactions between sign and speech converges closely with the evidence on unimodal bilingualism where the two languages do not share the same written script (e.g., Hoshino & Kroll, 2008; Thierry & Wu, 2007). These observations suggest the architecture of the language system is organized around a set of principles that transcend the perceptual form that language takes. If only monolingual speakers were the subject of study, we would not know that there are abstract principles that transcend language-specific organization.

At the same time, the nature of the observed cross-language interactions for bimodal bilinguals is not identical to those reported for unimodal bilinguals. Form differences do not prevent cross-language interactions but they modulate them. Bimodal bilingualism thus becomes a unique tool to test models of bilingual comprehension and production. Emmorey et al. (Emmorey et al.) do a masterful job of illustrating the idea that co-activating sign and speech may be cost free in a way that reduces the requirement to actively inhibit the non-target language.

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For language production, the implication is that bimodal bilinguals do not have to select the language in which they will speak. For language comprehension, the absence of ambiguity at the level of lexical form opens the system to interactions that will pattern differently from those for unimodal bilinguals for whom the input in written or spoken form may generate ambiguity.

What more might we want to know? In the discussion of language selection and inhibitory control, it would be helpful to frame the discussion more broadly. The studies that are reviewed focus narrowly on performance in the language switching task (e.g., Meuter & Allport, 1999). The logic of using language switching to reveal inhibitory control has a well-documented history in the literature on bilingual production (e.g., Green, 1998). But recent behavioral and neuroscience studies suggest that there are multiple components of inhibitory control that are revealed in bilingual production (e.g., Guo, Liu, Misra & Kroll, 2011; Van Assche, Duyck & Gollan, 2013; Wodniecka, Bobb, Szewczyk, Zeelenberg, Timmer, Marzecova, Taft, Green, & Kroll, under review). Wodniecka et al. demonstrated that language dominance may be critical in determining the presence of switch cost asymmetries in the language switching paradigm but that both L1-dominant and more balanced and proficient bilinguals alike reveal inhibitory costs in a competitor priming paradigm and similar costs under conditions of language mixing. Some aspects of inhibitory control appear to be local and tied to specific patterns of lexical activation whereas others are more global and sustained and associated with the control of the language itself. We might predict that bimodal bilinguals might be more likely to differ from unimodal bilinguals on precisely the lexical switching tasks that have been examined in the literature that Emmorey et al. (Emmorey et al.) review. To our knowledge, the differences between bimodal and unimodal bilinguals have not been examined systematically with respect to other components of inhibitory control that may be similar or different across the groups.

A second issue, and one that potentially holds implications for all of the evidence on bimodal bilinguals who are CODAs, is that CODAs are heritage speakers who acquired ASL early in life and were then educated in English as the dominant language of the environment. Psycholinguistic research on heritage speakers has only begun to consider how that pattern of bilingual history might influence language processing in both languages (see Gollan, Starr & Ferreira, 2015, for a discussion of heritage language use and proficiency). Similarly, there has been little consideration of how heritage language experience might differentially engage the mechanisms of executive function and control that characterize other bilingual groups (e.g., Green & Abutalebi, 2013). In the recent literature there has been a great deal of discussion about the consequences of bilingual language use for tuning the brain networks that support language and cognitive control. From this perspective, bimodal bilinguals, despite their ability to maintain the activation of the two languages in parallel, might be identified as prime candidates for revealing the benefits of inhibitory control because they are likely to find themselves in contexts in which they may often be the only bimodal bilingual. The fact that benefits have not been uniformly reported for bimodal bilinguals in the realm of cognitive control may support the argument made by Emmorey et al. (in press) that bimodal bilinguals are free to have both languages active with little cost. Alternatively, the failure to observe clear benefits for inhibitory control may reflect their status as heritage speakers who function with two languages that are typically used in different contexts.

The analysis presented by Emmorey et al. (Emmorey et al.) provides a basis to stimulate future research and to better understand the multiple ways in which an individual may become and function as a bilingual. This review will benefit not only research on hearing and deaf bimodal bilinguals but research on all bilinguals whose language experience has been shaped by the circumstances of their development and by the context in which the two languages are used.

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