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Beyond typical learning: Variation in language experience as a lens to the developing mind

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Beyond typical learning: Variation in language experience as a lens to the developing mind

Infants are exposed to the language of the environment in which they are born and, in most instances, become native speakers of that language. Although the history of research on language acquisition provides a colorful debate on the specific ways that nature and nurture shape this process (e.g., MacWhinney, 1999; Pinker, 1995), its primary focus has been on typically developing children exposed to a single language from birth. Pierce, Genesee, Delcenserie, and Morgan (in press) turn the table on this discussion to argue that critically important lessons can be learned by shifting the focus from typically developing children to children for whom the trajectory of language learning follows a different course. Some of the variation in language development reflects attributes of child learners themselves, such as whether they are born hearing or deaf and whether they have conditions that disrupt their ability to fully perceive the speech input to which they are exposed. Other variation reflects attributes of the external conditions in which learners develop, including whether they remain in their country of birth or move to a location in which another language is spoken, whether exposure to the native language is continuous or disrupted, and whether they are exposed to a second language (L2) early or late in development. For deaf children, there is also variation in whether their parents or caregivers are themselves deaf or hearing and able to expose them to sign language during infancy. Pierce et al. use the diversity of early language experience as a tool to examine the relation between phonological working memory and language development and to begin to suggest how conditions that may produce costs or benefits in language learning may be related to one another.

The approach taken by Pierce et al. (in press) is ambitious. They exploit a comparison across groups of children whose trajectory of language learning varies widely as a means to identify a feature of the cognitive/linguistic interface that emerges as central in all cases, the

relationship between phonological working memory and language development itself. Although a causal model for relating working memory and language is not readily available, the correlational patterns observed under these different conditions provide an initial basis on which to generate hypotheses that may guide future research. Children who are denied an opportunity to fully acquire the phonology of the native language reveal deficits in phonological working memory that undermine other aspects of language development, including vocabulary and aspects of the morphosyntax. In contrast, bilingual children who acquire and achieve proficiency in two languages from early childhood, reveal advantages in working memory relative to their monolingual native language speaking counterparts. Critically, regardless of whether the early stages of language learning are altered relative to the typical trajectory, most children achieve adequate general language performance, suggesting that there may be many different routes to the same end. A fascinating aspect of the Pierce et al. discussion considers how alternative compensatory processes may be engaged, particularly under conditions of early disruption.

Recent studies of L2 learning and bilingualism in young adults converge with the conclusion that the native speaker model is limited in its ability to account for variation in patterns of language learning and in the dynamic state of language processes in mature speakers who are already proficient in all of the languages that they speak (e.g., Emmorey, Geizen, & Gollan, 2016; Kroll, Dussias, Bice, & Perrotti, 2015; Kroll & Navarro-Torres, in press). As Grojean (1989) observed many years ago, proficient bilinguals are not two monolinguals in one. The native language changes in response to learning and using an L2, with a continual flow of cross-language activation that influences not only language processing, but also the cognitive resources that are engaged during language use (e.g., Green & Abutalebi, 2013). A persistent question in the research on L2 learners and bilinguals also aligns with the question raised by

Pierce et al. (in press) about the direction of causality: Are cognitive resources required to enable language learning or do those cognitive resources develop as a consequence of language learning? The evidence on adult L2 learners and bilinguals, like the research on child learners, suggests interactions in both directions. Individual differences in working memory and executive function ability appear to modulate the course of L2 language learning and processing (e.g., Linck, Osthus, Koeth, & Bunting, 2014; Pivneva, Mercier, & Titone, 2013) but there are also consequences of L2 use that come to modify the neural networks that support cognitive control (e.g., Abutalebi & Green, in press; Bialystok, in press).

The course of initial language learning in children exposed to two languages from birth illustrates the two sides of variation. From one perspective, and one that historically has been misinterpreted (e.g., Kroll & Dussias, 2016), bilingually exposed children have been thought to be confused by the presence of two languages because their initial learning trajectory differs from that of monolingually exposed children (e.g., Werker & Byers-Heinlein, 2008). But the evidence suggests that not only do these children succeed in language learning but early exposure to two languages from birth tunes mechanisms for memory flexibility and attentional control (e.g. Brito & Barr, 2012; Pons, Bosch, & Lewkowicz, 2015; Sebastian-Galles et al., 2012) that may later enhance cognition and new language learning. It is not clear how these attentional and memory mechanisms relate precisely to phonological working memory, but the evidence is compelling that early delays relative to a typical standard do not predict later language and cognitive performance.

A goal of research for both child and adult language learning will be to develop models that isolate the course and consequence of the interactions between cognitive resources and language learning. Critically, it will be important to understand how the effects of age of

acquisition (AoA) constrain or enable these interactions, and whether constraints, when they exist, are attributable to domain general learning mechanisms or to language learning specifically. The enduring consequences of early exposure, even when interrupted by a shift in language context, as is the case for many international adoptees or deaf children, suggest that the initial tuning of speech or sign opens the networks that enable language learning and perhaps learning more generally across the lifespan.

There is a curious paradox in the past research that surfaces in the Pierce et al. (in press) review and that may merit additional consideration. Deficits in vocabulary knowledge have been reported for child learners across the varied groups for whom some disruption was present during the first years of life and also for bilinguals for whom the competition between the two languages early in life may create costs in the domain of lexical retrieval. At the same time, studies of adult word learning provide clear evidence that bilinguals are better word learners than monolinguals and that early bilinguals, in particular, may reveal more robust advantages in new learning (e.g., Kaushanskaya & Marian, 2009). How can variation in language experience produce a deficit and a benefit at the same time? Is it all a reflection of phonological working memory? As Pierce et al. note, there may be a range of compensatory mechanisms in place that enable language learning even when the initial trajectory of language development has been altered. If learners miss some or all aspects of early exposure during an hypothesized sensitive period, other mechanisms may provide compensatory support. That support may involve cognitive processes that would not otherwise be primary at the time of learning or later opportunities to re-open the mechanisms at play during the sensitive period. Recent training studies of adult language learners provide evidence for remarkable plasticity, even for older adults (e.g., Bak, Long, Vega-Mendoza, & Sorace, 2016).

An appealing hypothesis is that variation in language exposure may tune the neural networks that enable language regulation and control in specific ways which, depending on both the individual and the context of learning, may have positive consequences when generalized to new learning. Variation in exposure may induce processing costs and deviation to the initial trajectory of language learning, but at least some of those costs may be countered by later benefits. A long history of research on learning and memory on desirable difficulties demonstrates the benefits of learning conditions that tax cognitive resources in ways that enhance understanding and provide opportunities for self regulation (e.g., Bjork & Bjork, 2014). Variation in learning has itself been identified as a desirable difficulty, producing costs during initial study of novel material but benefits at later test. We know little at this point about how these domain general cognitive mechanisms are engaged during language learning and use and how they may play a role in training studies that aim to recreate the plasticity available early in life. Acknowledging the possibilities for new learning afforded by differences among individuals and across contexts of learning provides a much richer framework for understanding language development and its consequences than the dichotomous categories of typical vs. atypical. The focus on variation that is the theme in the Pierce et al. (in press) target article would seem to be precisely the right context for conceptualizing the next stage of research. The new methods available to examine language learning and its cognitive and neural underpinnings are likely to realize the promise of this approach.

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