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The effects of bilingualism on toddlers' executive functioning

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ABSTRACT

Bilingual children have been shown to outperform monolingual children on tasks measuring executive functioning skills. This advantage is usually attributed to bilinguals' extensive practice in exercising selective attention and cognitive flexibility during language use because both languages are active when one of them is being used. We examined whether this advantage is observed in 24-month-olds who have had much less experience in language production. A battery of executive functioning tasks and the cognitive scale of the Bayley test were administered to 63 monolingual and bilingual children. Native bilingual children performed significantly better than monolingual children on the Stroop task, with no difference between groups on the other tasks, confirming the specificity of bilingual effects to conflict tasks reported in older children. These results demonstrate that bilingual advantages in executive control emerge at an age not previously shown.

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Introduction

There has long been interest in determining whether bilingualism leads to linguistic or cognitive differences in both children and adults. Research over the past two decades has revealed a number of differences that emerge from growing up with at least two languages (Bialystok, 2009a; Grosjean, 1989). In the most general terms, bilingualism leads to the development of strategies that are adaptive to the unique problem space with which bilingual infants are faced. During the early stages of language acquisition, for example, recent research on speech perception in bilingual and monolingual infants has shown that bilingual infants learn similar sounding words in a word learning task a few

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months later than monolinguals (Fennell, Byers-Heinlein, & Werker, 2007). However, bilingual infants of the same age can outperform monolinguals in learning word–object associations when the phonetic conditions favor their input (Mattock, Polka, Rvachew, & Krehm, 2010).

Research on vocabulary development in bilingual first language acquisition has shown that bilingual children produce their first words at around the same time as monolingual children (Genesee, 2003; Patterson & Pearson, 2004; Petitto et al., 2001). However, the evidence for differences in vocabulary development in bilingual and monolingual children is mixed, depending on the ages of the children and whether receptive or productive vocabulary is assessed. A smaller receptive vocabulary in each language compared with monolinguals has been reported in samples of preschool- and school-aged children (Bialystok, Barac, Blaye, & Poulin-Dubois, *in press*; Bialystok, Luk, Peets, & Yang, 2010; Mahon & Crutchley, 2006), but other studies have shown that the receptive vocabulary of school-aged children is close to that of monolinguals (Cromdal, 1999; Yan & Nicoladis, 2009). With respect to measuring expressive language, school-aged bilinguals tend to have a smaller vocabulary even when both languages are combined (Yan & Nicoladis, 2009). In younger bilinguals (<3 years of age), receptive and expressive vocabulary have been reported to be comparable to that of monolinguals when total or conceptual (total minus translation equivalents) vocabularies are compared even if very young bilinguals tend to have fewer words in each of their productive languages (Junker & Stockman, 2002; Oller & Eilers, 2002; Pearson, Fernández, & Oller, 1993, 1995; Petitto & Kovelman, 2003).

Bilingualism also brings linguistic and cognitive advantages. Early studies showed that bilingual children performed better than monolingual children on a variety of tests of metalinguistic awareness (Ben-Zeev, 1977; Bialystok, 1987, 1988; Edwards & Christophersen, 1988; Galambos & Goldin-Meadow, 1990; Yelland, Pollard, & Mercuri, 1993). Although impressive, it is not completely surprising that a linguistic experience such as bilingualism would lead to an enhanced understanding of the structure and properties of language. More surprising is the evidence showing that bilingualism also leads to the precocious development of cognitive processes not confined to linguistic tasks. In a comprehensive review of the research on cognitive differences between bilingual and monolingual children, Bialystok (2001) concluded that there is growing evidence that bilingual children outperform monolingual children on a variety of tasks that require selective attention and cognitive flexibility tasks. Inhibitory processes are instrumental in such tasks because attention to misleading aspects of a stimulus must be suppressed to attend to the relevant ones. The inhibitory control recruited in such conflict situations is a key element of the executive function, a set of processes that are responsible for the conscious control of thought and action (Miyake et al., 2000; Posner & Rothbart, 2000). Other components of executive function include shifting of mental sets, updating information in working memory, and planning ability. Executive functioning shows age-related improvements well into adolescence, but the most significant enhancements happen during the preschool period (Carlson, 2005; Zelazo & Müller, 2002).

Research with children (Bialystok, 2005) and adults (Bialystok, Craik, Klein, & Viswanathan, 2004) has shown that bilinguals show better control over these executive processes than their monolingual counterparts. In children as young as 4 years of age, this advantage has been demonstrated with a range of tasks typically used to assess executive functioning. For example, Bialystok and her colleagues demonstrated a bilingual advantage in 4- and 5-year-olds using the Dimensional Change Card Sort (DCCS), a task in which children are given a series of cards to sort by one of two dimensions (color or shape) and then are asked to switch and sort by the other dimension (Bialystok, 1999; Bialystok & Martin, 2004). Thus, children need to ignore the color of the stimulus and attend to its shape to classify the cards correctly. This bilingual advantage in selectively attending to one cue in the context of a conflicting cue has also been reported for the Simon task (spatial conflict between stimulus and response) (Martin-Rhee & Bialystok, 2008), the ambiguous figure task (conflict between competing interpretations of a line drawing) (Bialystok & Shapero, 2005), and the global–local task (spatial competition between overall and constituent shapes) (Bialystok, 2010). A recent study by Carlson and Meltzoff (2008) comparing English–Spanish bilinguals with English 6-year-old monolinguals tested the generality of a bilingual advantage to a wide range of executive function measures by administering a battery of tasks. The main findings revealed a significant bilingual advantage on tasks that call for managing conflicting attentional demands (conflict tasks) but no such advantage on impulse control (delay tasks). It is noteworthy that the effect was robust even after controlling for socioeconomic

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