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Vocabulary matters! The relationship between verbal fluency and measures of inhibitory control in monolingual and bilingual children



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ABSTRACT

The role of early bilingual experience in the development of skills in the general cognitive and linguistic domains remains poorly understood. This study investigated the link between these two domains by assessing inhibitory control processes in school-aged monolingual and bilingual children with similar English receptive vocabulary size. The participants, 8-year-old monolinguals and bilinguals, completed two Verbal Fluency Tasks (VFTs), letter and category, and two measures of inhibitory control. Results showed that bilinguals outperformed monolinguals on the VFTs, but performance was similar on the inhibitory control measures approaching ceiling for both monolingual and bilingual children. Importantly, it was shown that both vocabulary proficiency and general inhibitory control skills underlie monolingual and bilingual children's performance on VFTs. These results demonstrate that vocabulary proficiency plays a fundamental role in comparing monolingual and bilingual VFT performance. The bilingual advantage found in this study seems to have escaped previous studies that did not account for vocabulary size in populations of bilingual and monolingual school-aged children.

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Introduction

Whereas a bilingual advantage has been shown across various cognitive domains (see Bialystok, 2001, 2015, 2017, and Costa & Sebastián-Gallés, 2014, for reviews), bilinguals tend to show poorer performance on a number of language processing tasks compared with their monolingual peers (Sandoval, Gollan, Ferreira, & Salmon, 2010). However, recent research has demonstrated that bilingual adults do not always show lower performance in language processing tasks compared with monolinguals (Friesen, Luo, Luk, & Bialystok, 2015; Luo, Luk, & Bialystok, 2010). These studies show that successful bilingual performance can be related to a number of factors, including linguistic proficiency in each of the bilingual's languages, degree of bilingualism, and domain-general cognitive abilities such as inhibitory control. The current study specifically investigated the interplay of these factors and the ability to rely on general inhibitory control skills in language processing tasks among bilingual and monolingual school-aged children.

When compared with their monolingual peers, bilinguals demonstrate a disadvantage in lexical processing tasks when assessed in only one of their languages (see Gollan & Kroll, 2001, for a review). For instance, when administered with single-language tasks, children and adults who are proficient bilinguals tend to obtain lower receptive vocabulary scores than monolinguals (Bialystok, 2006; Bialystok & Luk, 2012; Bialystok, Luk, Peets, & Yang, 2010). This finding is usually attributed to bilinguals' tendency to receive less exposure to each of their languages compared with monolinguals and to spend less time using each of their languages (Byers-Heinlein, Fennell, & Werker, 2013). However, when bilinguals' vocabulary size in the two languages is considered, no bilingual disadvantage is observed, and indeed bilinguals' combined vocabulary sizes often surpass monolinguals' single-language vocabulary sizes (Pearson, Fernandez, & Oller, 1993). The bilingual disadvantage is even more pronounced in tasks that rely on productive skills, especially those targeting lexical retrieval. For instance, bilinguals perform slower in picture naming tasks (Bialystok, Craik, & Luk, 2008b; Ivanova & Costa, 2008), exhibit more tip-of-the-tongue states (Gollan & Acenas, 2004), and obtain lower verbal fluency scores (Gollan, Montoya, & Werner, 2002; Rosselli et al., 2002). Aside from differences in language proficiency, these difficulties in production tasks have been attributed to nontarget language intrusion. That is, the two languages of a bilingual are constantly active, resulting in greater demands for suppression of cross-linguistic competition during the production process (Bialystok, Craik, & Luk, 2008a; Bialystok et al., 2008b; Rodriguez-Fornells et al., 2005). In addition, bilingual performance can be affected by a number of individual and environmental factors such as age of acquisition of each language (Valian, 2015), proficiency in each language and patterns of language use (MacLeod, Castellanos-Ryan, Parent, Jacques, & Séguin, 2017), and socioeconomic status (SES) among others (Calvo & Bialystok, 2014). Thus, it appears that bilinguals' performance in language processing tasks is dependent simultaneously on their ability to overcome the cognitive demands of the specific task and their lexical competence in the target language.

A commonly used measure of lexical retrieval is the Verbal Fluency Task (VFT). It has been successfully used as a neuropsychological measure of efficiency in lexical retrieval in diverse typical and clinical populations (Anderson, Anderson, Northam, Jacobs, & Catroppa, 2001; Bialystok, Craik, Green, & Gollan, 2009; Filippetti & Allegri, 2011; Friesen et al., 2015; Korkman, Kemp, & Kirk, 2001; Luo et al., 2010; Malek, Hekmati, Amiri, Pirzadeh, & Gholizadeh, 2013; Matute, Rosselli, Ardila, & Morales, 2004; Ostrosky-Solis et al., 2007). This task usually comprises two conditions, category and letter, where participants are asked to produce as many words as possible either belonging to a semantic category (category VFT; e.g., list animal names) or starting with a particular letter (letter VFT; e.g., list words that start with the letter *f*) in a specified period of time, usually 60 s. The two conditions recruit both lexical and semantic knowledge. That is, the VFTs require participants to retrieve words from their lexicon in the case of monolinguals or from one of their lexicons in the case of bilinguals.

Aside from assessing lexical and semantic competence, the two VFTs rely on executive functioning skills, which is of particular interest for the current study. Executive functioning refers to general self-regulation and control processes that involve working memory, monitoring, and inhibitory control (Miyake et al., 2000). More precisely, the two VFTs have been shown to engage two different cognitive

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