Journal of Experimental Child Psychology 159 (2017) 296–309

Contents lists available at ScienceDirect

Journal of Experimental Child Psychology

journal homepage: www.elsevier.com/locate/jecp

Cognitive advantages of immersion education after 1 year: Effects of amount of exposure

Danka Purić [a,*], Jasmina Vuksanović [b], Vasiliki Chondrogianni [c]

[a] Department of Psychology, Faculty of Philosophy, University of Belgrade, 11000 Belgrade, Serbia
[b] Institute for Medical Research, University of Belgrade, 11000 Belgrade, Serbia
[c] School of Philosophy, Psychology, and Language Sciences, University of Edinburgh, Edinburgh EH8 9AD, UK

ARTICLE INFO

Article history:
Received 27 January 2016
Revised 3 February 2017
Available online 27 March 2017

Keywords:
Second-language acquisition
Bilingualism
Working memory
Inhibition
Shifting
Executive functions

ABSTRACT

Previous studies with bilingual children have shown that the nature of their second-language instruction has an effect on the development of their cognitive abilities. The aim of this study was to determine whether children who acquire a second language in two different immersion programs for a period of 1 year show advantages in executive functions and to examine how the amount of *daily exposure* affects executive functions. A group of Serbian-speaking second-grade children exposed to the second language for about 5 h each day (high exposure group, HEG) and a low-exposure group (LEG) exposed to the second language for about 1.5 h each day were compared with an age-matched control group (CG) of monolingual peers on working memory, inhibition, and shifting. Significant group differences were found for working memory, with the HEG performing better than the CG and LEG even after controlling for individual differences in terms of age and intelligence. The three groups did not differ in terms of inhibition and overall shifting abilities, although the control group had a marginally significant advantage on one of the two shifting tasks. Our findings extend previous research by demonstrating that the amount of daily exposure is a significant factor affecting executive functions in early immersion programs for second-language acquisition. In addition, they show that early intensive second-language acquisition can be advantageous for performance on tasks that require a higher level of executive control.

* Corresponding author.
E-mail address: dpuric@f.bg.ac.rs (D. Purić).

http://dx.doi.org/10.1016/j.jecp.2017.02.011
0022-0965/

Introduction

A large body of research has shown that bilingualism has a positive effect on cognitive development (Bialystok, 2011; Carlson & Meltzoff, 2008; Martin-Rhee & Bialystok, 2008; Poarch & Van Hell, 2012; Poulin-Dubois, Blaye, Coutya, & Bialystok, 2011). The positive impact of bilingualism has been observed in a variety of tasks that require cognitive control components such as selective attention (Bialystok, 2001), cognitive flexibility (Poulin-Dubois et al., 2011), and engagement of working memory (WM) (Morales, Calvo, & Bialystok, 2013). All of these cognitive control components fall under the umbrella term *executive functions* (EFs), which encompass three core abilities: *inhibition*, defined as either inhibition of prepotent responses or incoming interference; *shifting*, which comprises mental set shifting or switching; and *working memory*, which involves information updating and monitoring (Miyake et al., 2000).

How could one explain this positive effect of bilingualism on EFs? There is now overwhelming evidence that when we speak both languages are active to some degree, even in contexts that clearly support only one of the languages (Francis, 1999; Kroll, Bobb, & Wodniecka, 2006; Marian, Spivey, & Hirsch, 2003; Rodriguez-Fornells, Rotte, Heinze, Nosselt, & Munte, 2002; Thierry & Wu, 2007). These studies suggest that there is a high probability of interference from the nonrelevant language when the other one is in use as the two languages potentially compete for cognitive resources. In order not to erroneously use the unintended language or lose fluency in either of the languages, bilinguals must acquire a way to control or regulate that competition (Bialystok, 2001; Kroll, Dussias, Bice, & Perrotti, 2015). In other words, bilingual individuals are placed in a situation where executive control is required; while speaking, the speaker plans the content of his or her utterance taking into consideration the current topic and context (which requires WM), selects relevant linguistic structures in one language (which requires inhibiting the competing structure of another language), monitors the progress of the interaction within a certain topic and removes from the storage system all content that was used but is no longer relevant for the conversation (which also requires WM), and potentially switches between languages (which requires shifting).

To date, studies with bilingual children have primarily focused on one specific component—inhibition. However, the results from these studies have been controversial. Studies using the Stroop and Simon tasks have found significantly better performance in bilinguals compared with their monolingual counterparts (e.g., Bialystok, Craik, Klein, & Viswanathan, 2004; Hernández, Costa, & Humphreys, 2012). Martin-Rhee and Bialystok (2008), however, reported that bilinguals outperform monolinguals on a variety of tasks that require control over attention to competing cues (interference suppression), but not on tasks requiring inhibition of a habitual or prepotent response. Results obtained from recent studies with large sample sizes have further challenged the earlier research findings by showing no bilingual advantage in inhibitory control in either children or adults (Antón et al., 2014; Duñabeitia et al., 2014; Gathercole et al., 2014; see Valian, 2015, for a review of the relevant issues).

Recently, a shift has been made from viewing inhibition as the only cognitive control component relevant for bilingual language use to taking a more global overview of all EF components. Some of these studies have provided supporting evidence for bilingual advantages in shifting ability (Bialystok, 2010; Okanda, Moriguchi, & Itakura, 2010; Prior & MacWhinney, 2010), although these findings have not been replicated across studies (Paap & Greenberg, 2013). A carefully conducted study by Xie (2014) suggested a more complex picture by showing that language use and language-switching experience, but not proficiency in the second language, significantly contribute to performance on tasks tapping shifting ability.

The controversy regarding bilingual advantages also extends to the third component of EFs, namely WM (Engel de Abreu, 2011; Engel de Abreu, Cruz-Santos, Tourinho, Martin, & Bialystok, 2012). According to Baddeley (1998), WM is a multicomponent, capacity-limited system that handles current demands for temporarily storing and managing the information required to carry out complex cognitive tasks. It is well established that WM performance is strongly related to language acquisition and processing (Archibald & Gathercole, 2006; Majerus, Poncelet, Greffe, & van der Linden, 2006). The central executive component is a flexible system responsible for the control and regulation of cognitive