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Brief article

The impact of late, non-balanced bilingualism on cognitive performance

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ABSTRACT

We present a study examining cognitive functions in late non-balanced bilinguals with different levels of second language proficiency. We examined in two experiments a total of 193 mono- and bilingual university students. We assessed different aspects of attention (sustained, selective and attentional switching), verbal fluency (letter and category) as well as picture–word association as a measure of language proficiency. In Experiment 2 we also compared students in their first/initial (Y1) and fourth/final (Y4) year of either language or literature studies. There were no differences between both groups in category fluency. In selective attention, bilinguals outperformed monolinguals in Y1 and this difference remained significant in Y4 despite overall improvement in both groups. Contrasting results were found in attentional switching and letter fluency: while no differences were found in Y1 in both tasks, in Y4 there was an advantage for bilinguals in attentional switching and for monolinguals in letter fluency. We conclude that overall late-acquisition non-balanced bilinguals experience similar cognitive effects as their early-acquisition balanced counterparts. However, different cognitive effects may appear at different stages of adult second language acquisition.

1. Introduction

1.1. The cognitive effects of bilingualism

Substantial evidence suggests that bilingualism can influence cognitive functions (Costa & Sebastián-Gallés, 2014). In the linguistic domain, bilinguals show a disadvantage compared to monolinguals in reaction time and accuracy in lexical access tasks such as picture naming (Gollan, Fennema-Notestine, Montoya, & Jernigan, 2007; Gollan, Montoya, Fennema-Notestine, & Morris, 2005; Ivanova & Costa, 2008), attributed to either parallel activation of words from different languages and the necessity to inhibit competing non-target items (Green, 1998) or to a reduced-frequency of use of each of the bilingual's language (Gollan, Montoya, Cera, & Sandoval, 2008; Gollan et al., 2011). In contrast, a bilingual advantage has been reported for tests of executive functions, such as attentional control (Bialystok, 1999; Bialystok, Craik, Klein, & Viswanathan, 2004; Bialystok & Majumder, 1998; Bialystok & Martin, 2004; Bialystok & Senman, 2004), inhibition (Bialystok & Martin, 2004) and switching (Costa, Hernández, Costa-Faidella, & Sebastián-Gallés, 2009; Hernández, Martin, Barceló, & Costa, 2013). These differences continue across the lifespan (Alladi et al., 2013; Bak, Nissan, Allerhand, & Deary, 2014; Bialystok et al., 2004; Kavé, Eyal, Shorek, & Cohen-Mansfield, 2008) and might contribute to a later onset of dementia in bilinguals (Alladi et al., 2013; Bak & Alladi, 2014; Bialystok, Craik, & Freedman, 2007). It has been hypothesised that these effects come from higher demands posed on executive control through inhibition and switching between languages associated with

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bilingualism (Green, 1998). In some tasks, such as verbal fluency (VF), bilingual performance has shown both advantages and costs. In some category fluency studies, bilinguals have been reported to underperform (Gollan, Montoya, & Werner, 2002; Portocarrero, Burright, & Donovick, 2007; Rosselli et al., 2000), while in others to outperform monolinguals (Obler, Albert, Lozowick, & Vaid, 1986). Other authors have reported no influence of bilingualism on category fluency (Bialystok, Craik, & Luk, 2008). A similar pattern of conflicting results exists in letter fluency (Bialystok et al., 2008; Rosselli et al., 2000).

While current debates often focus on the specific nature of the tasks employed (Bak, Vega-Mendoza, & Sorace, 2014; Costa et al., 2009; Hernández et al., 2013; Hilchey & Klein, 2011; Paap & Greenberg, 2013), less attention has been paid to the characteristics of the bilingual speakers and their bilingualism. Most research has been devoted to "classical" bilingualism: a simultaneous or early consecutive childhood acquisition and balanced command of two or more languages. It remains unclear to what extent bilingualism effects can also be detected in individuals who acquire their second language in late childhood or adulthood without reaching native-like proficiency. Studies of late-acquisition bilingualism produced so far conflicting results. Luk, De Sa, and Bialystok (2011) found a bilingual advantage only in early-acquisition bilinguals, while other studies found it in early as well as late-acquisition bilinguals (Bak et al., 2014; Pelham & Abrams, 2014; Tao, Marzecová, Taft, Asanowicz, & Wodniecka, 2011; Bak et al., 2014). Also regarding the importance of the number of languages involved, previous studies came to conflicting results (Freedman et al., 2014). Some found a beneficial effect only in multi- but not in bilinguals (Chertkow et al., 2010) or reported a correlation between the number of languages and cognitive performance (Kavé et al., 2008). Others found only a weak effect of multilingualism (Bak et al., 2014) or no effect at all (Alladi et al., 2013).

Against this background, our study set out to examine non-balanced bilinguals who acquired their second language in late childhood/early adulthood. We employed non-verbal auditory tests assessing different aspects of attention (Bak et al., 2014) and examined the difference in performance in students in their first/initial and fourth/final year, relating cognitive changes to the increase in L2 proficiency.

2. Experiment 1

2.1. Methods

2.1.1. Participants

Sixty-six University of Edinburgh students (mostly in their 4th year) took part in this experiment. All were native English speakers.

The *Monolingual participants* ($N = 18$) did not speak any language other than English beyond basic level. The *Bilingual participants* ($N = 16$) had Spanish as their second language (L2) and no knowledge of other languages. *The Multilingual participants* ($N = 17$) knew at least one more language in addition to English and Spanish, but their knowledge of Spanish, as indicated in the language questionnaire (Appendix), was better/comparable to that of other foreign language(s). Fourteen participants were excluded because Spanish was not their main L2, one because of incomplete data. Age and gender differences were not significant (chi-square and *t*-tests all $ps > .05$) (Table 1).

2.1.2. Tasks

2.1.2.1. Picture Name Verification Task (PNVT). The PNVT measures accuracy and speed with which a picture-name combination is judged to be correct or not and provides, therefore, an objective measure of L2 proficiency. The stimuli were 42 pictures depicting clothing, furniture and body parts with corresponding written names in English and Spanish respectively. None of the words were cognates. There was no difference in the number of graphemes between English ($M = 5.36$) and Spanish ($M = 5.57$) words ($t(41) = -1.013$, $p > .05$). Colour pictures of the objects were displayed on a white background for 350 ms. before the word appeared next to the image. Both picture and word remained on the screen until the participant responded. The presentation order was randomised. The task was produced and administered using E-prime 2.

2.1.2.2. Test of Everyday Attention (TEA). The TEA (Robertson, Ward, Ridgeway, & Nimmo-Smith 1994) is a well-established clinical assessment tool, recently applied to measure executive functions in bilinguals (Bak et al., 2014). We selected three subtests, examining different aspects of attention: *Elevator Task (ET), Elevator Task with Distraction (ETD)* and *Elevator Task with Switching (ETS).* ET assesses sustained attention: prompted by recording, participants count seven strings of tones, presented at irregular intervals. ETD measures selective attention asking participants to count low tones while ignoring high-pitch ones over ten trials. ETS requires switching: participants have to use high and low pitch tones as cues for the direction (upwards and downwards, respectively) in which to count ten strings of tones. All tasks were presented through loudspeakers.

2.1.2.3. Verbal fluency (VF). The VF tasks consisted of letter and category fluency. Participants were asked to produce as many words as possible within 60 s. Beginning with the letter F, M and P (letter fluency) or belonging to the category of animals, foods and degree courses (category fluency) (Rosselli et al., 2000; Gollan et al., 2002; Gasquoine, Croyle, Cavazos-Gonzalez, & Sandoval, 2007; Roberts & Le Dorze, 1997).

2.1.2.4. Language questionnaire. Participants completed a language questionnaire (Appendix), rating their command of each language in expression, comprehension, reading and writing on a 5-point scale (basic/weak/moderate/advanced/fluent). Total proficiency score was calculated by adding proficiency levels in all domains. The questionnaire was completed after all other tasks.