The bilingual advantage in the language processing domain: Evidence from the Verbal Fluency Task

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Abstract

Several cognitive advantages in the non-verbal domain have been associated with bilingualism. However, it remains debated whether this advantage also extends to the language processing domain in bilingual children. To assess this, monolingual and bilingual eight-year-old children performed a letter (or phonemic) and a category (or semantic) Verbal Fluency Task (VFT) in order to observe executive functioning under language processing demands. Results showed that bilinguals significantly outperformed monolinguals in both versions of the VFT, demonstrating enhanced lexical processing abilities for bilinguals. These findings will be discussed in view of the bilingual advantage controversy.
Index Terms: bilingualism, children, verbal fluency task, executive functioning, bilingual advantage, attentional control.

1. Introduction

Previous studies claim that bilinguals exhibit more efficient cognitive processes than monolinguals [1, 2]. In fact, abundant research has concluded that bilingual speakers, at specific ages and throughout the lifespan, possess enhanced executive functioning skills when compared to monolinguals [1-3]. Attentional control has been proposed to be the component of executive functioning responsible for this cognitive advantage in bilinguals. This component is the ability to focus on important aspects of a task, overcoming irrelevant distractions [4-6]. Therefore, it has been suggested that bilinguals' constant selection and use of lexical forms from only one of their languages while inhibiting lexical forms of the other, enhances their capacity to process competing responses [1, 2, 6]. This bilingual advantage has been mostly observed using non-language processing tasks, which demand executive functioning in the non-verbal domain [7-11].

However, limited research has been carried out to investigate a possible bilingual advantage in the verbal domain, whereby performance relies not only on participants' attentional control skills but also their lexical competence and lexical retrieval skills. Therefore, the present study investigated whether bilingual children exhibit an enhanced attentional control under lexical processing demands using Verbal Fluency Tasks (VFTs) in two different versions, category (or semantic) and letter (or phonemic) [12-14].

VFTs have been widely used in children [12, 15-17] and adults [13, 18, 19] to measure attention and executive functions that involve lexical processing and retrieval [12, 15]. There are two modalities of the VFT, and each of them activates lexical knowledge, semantic memory, and executive control on different levels [13, 14]. The first modality is category (or semantic), which requires the participant to list words from a semantic category (e.g., clothing items, animals, fruits) in a set period of time (e.g., 1 minute). The executive requirements of VFT-category are similar as the ones for regular speech, and this VFT version is also an effective measure of productive vocabulary size [13, 14]. The second modality is letter (or phonemic). The VFT-letter requires the participant to list words beginning with a letter (e.g., f, m, or p) often imposing restrictions on acceptable responses (e.g., to avoid people and places' names and morphologically related words). The VFT-letter is more effective to measure higher demands of attentional control, along with other executive skills that affect capacity of organisation, monitoring and shifting [13, 14].

Studies in adults using VFT [13, 14] have shown a slight bilingual advantage in the letter version of the task. Luo et al. tested three groups of adults with VFT; i) high vocabulary bilingual group, ii) low vocabulary bilingual group, and iii) a monolingual group [13]. In the VFT-letter, the highly proficient bilingual group performed better than the low vocabulary bilinguals and monolinguals. However, no significant differences were found between groups in the VTF-category. The authors suggest that the letter part of the test incites retrieval interference at a higher processing level, confirming higher cognitive skills in bilinguals [13].

However, recent studies that have used both versions of VTF with bilingual and monolingual children have yielded mixed results [14, 20]. For instance, Kormi-Nouri et al. (2012) tested 1600 Persian monolingual and bilingual children with VTF. Children were recruited from school grades 1 through 4 and were divided in three groups: Turkish–Persian bilinguals, Kurdish–Persian bilinguals, and Persian monolinguals. Results showed a slight bilingual advantage for the Turkish-Persian bilinguals in the letter version of the task. However, the VFT-letter conducted in this study was simplified by not including restrictions on potential answers. In the VTF- category version, monolinguals outperformed both bilingual groups [20]. However, the Kurdish–Persian bilingual group was not as proficient in Persian as the Turkish-Persian group, so that a bilingual advantage could not be found in the former group [14].

The recruitment method adopted and the large number of participants in the study described above may have led to difficulties in controlling for variables such as age, socio-economic status (SES) and level of bilingualism [14], as well as language proficiency in the language tested. Careful control of these variables in experimental designs is essential, as children develop their language and cognitive skills at

different time rates. Furthermore, important milestones can occur even in short periods of time. For instance, even at 12 years of age, cognitive processes required for language processing tasks have not yet reached adult performance [12, 16].

With respect to the effect of age, Friesen and colleagues [14] tested bilinguals (of English and another language) and English-speaking monolinguals with the VFT at four different age-groups: seven-year-olds, ten-year-olds, young adults, and older adults [14]. Again, in this study the VFT letter also did not include restrictions for the two younger age groups. It was found that seven-year-old bilingual and monolingual children, with similar English proficiency performed similarly in both versions of the task (i.e., letter and category). In the ten-year-old group, the authors matched low vocabulary (LV) bilinguals with monolinguals because they were not able to collect a sample of high vocabulary ten-year-old bilinguals. Although the ten-year-old LV bilinguals had a lower vocabulary than monolinguals, both groups performed similarly in VTF-letter task. This suggests that LV bilinguals compensated for their smaller vocabulary size with enhanced executive function that aided a more efficient lexical access. Ten-year-old bilinguals also showed effortless word retrieval in comparison with the seven-year-old bilingual group [14]. Finally, in the young adult group that was comprised of high vocabulary (HV) proficient bilinguals and monolinguals, bilinguals performed similarly to monolinguals in VTF-category, but bilinguals outperformed monolinguals in the VFT-letter task. Bilinguals' higher performance was held through to the older adult group; decreasing only slightly with age.

Friesen et al.'s [14] findings suggest that performance in VTF category is related to age and vocabulary knowledge; in contrast, performance in VTF letter is closely related to the degree of bilingualism (i.e., high vs. low proficiency). Their findings also suggest a possible developmental trajectory for the bilingual advantage in the verbal domain, emerging sometime after the age of seven years and before young adulthood.

VFT tasks may yield mixed results in children due to differences in English language proficiency between monolinguals and bilinguals [14]. Indeed, bilingual children's receptive vocabulary in their dominant language is often smaller when compared to monolingual children's vocabulary [18, 19, 21, 22], which poses a challenge for this line of research. However, by the age of eight years, English receptive vocabulary in bilingual children has been reported to reach a similar level as the vocabulary of same-age monolingual peers [22]. Therefore, the present study included eight-year-old children to ensure that differences in performance were not due to differences in English proficiency.

We aimed to investigate whether bilingual children exhibit an enhanced attentional control under lexical processing demands in comparison with their monolingual counterparts. VFT letter and category were used to observe attentional control in the verbal domain. It was expected to find a bilingual advantage in the VFT-Letter because this test requires higher demands on executive functions, which have been observed previously in bilinguals [13, 14]. Contrastingly, it was expected to find similar performances in bilinguals and monolinguals in the VFT-category task because this test requires lower demands of executive functioning, which resemble ordinary speech demands [13, 14].

2. Method

2.1. Participants

Thirty-two children participated in the present study. Sixteen Australian-English (AusE) monolingual children (*M* age = 7 years 10 months, *SD* = 3.5 months) and 16 simultaneous highly proficient bilingual children of AusE and another language (*M* age = 7 years 10 months, *SD* = 3.4 months). Children were recruited from a database of parents who have volunteered to participate in child language research at a university laboratory and through flyers and word of mouth. Groups of monolingual and bilingual children were carefully matched in age, gender (bilinguals: 8 female, 8 male; monolinguals: 8 female, 8 male). The bilingual children were proficient in AusE and one of the following languages: Arabic (5), Spanish (3), Cantonese (2), Mandarin (1), Malay (1), Russian (1), Italian (1), Indonesian (1), and Hindi (1).

2.2. Tasks and procedure

All children completed the VFT task and a test of receptive vocabulary. Two versions of the VFT task were administered: VFT-letter to assess the high-order demands of attentional control and VFT-category to assess the low-order demands of attentional control and lexical access. All testing sessions were conducted in a child-friendly laboratory room. All participants were tested in English by a female Australian English native speaker in order to avoid non-target language intrusion. The experimenter was not involved in the design of the present study or in the recruitment of the participants, and was therefore unaware of each participant's language background.

2.2.1. Vocabulary and language background measures

For the purposes of the present study, the criteria for the selection of the participants included in the bilingual group were:

1. Australian bilingual children of AusE and another language. Participants were eligible if they used the language other than English (in comprehension and production) on an average rate of at least 20% per week;
2. To have been in contact with two different languages from birth (AusE and any other language);
3. To have at least one parent who speaks their heritage language at home on a daily basis;
4. To have a similar proficiency in receptive English vocabulary as their aged-matched monolingual counterparts.

Parents were asked about their children's language exposure to check the eligibility criteria before being invited to take part in the study. Additionally, parents completed a language and family background questionnaire to obtain more detailed information related to language exposure, domains of exposure and parental education, as well as a mean of obtaining further confirmation that participants fulfill the selection criteria.

In order to control for AusE vocabulary proficiency across bilingual and monolingual groups, the standardised Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4) [23] was administered. In this test the child is asked to point or say the number of the picture (out of four pictures) that corresponds to the word spoken by the research assistant. The procedure is repeated in every page of the easel, beginning by the age appropriate set, until reaching eight errors in a set. This test took between 15 and 25 minutes to complete, depending on

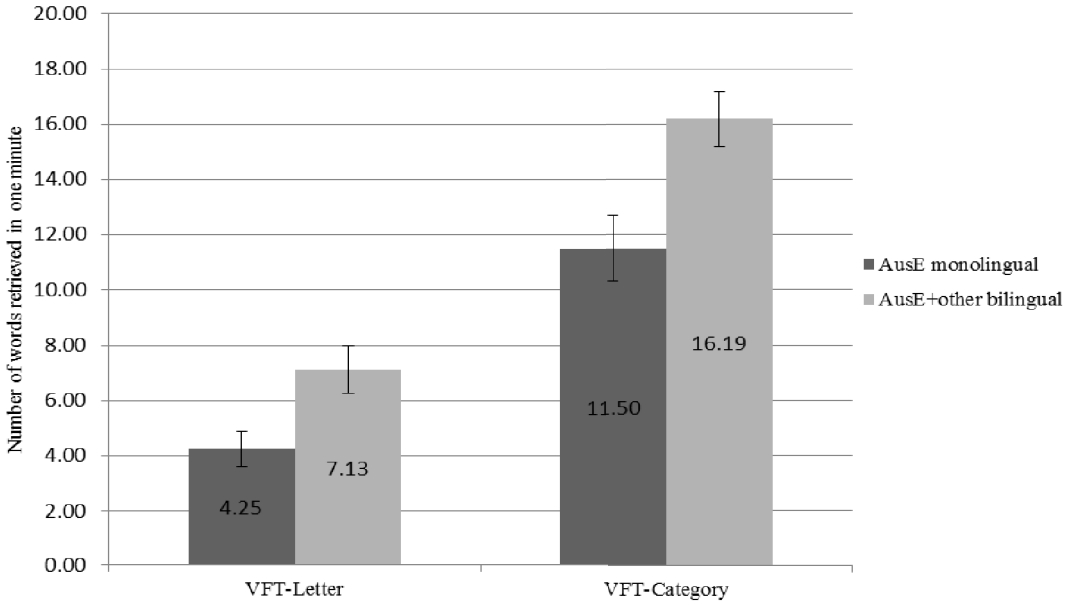

Figure 1: *Number of words retrieved in one minute in the Verbal Fluency letter and category tasks (error bars represent SEM).*

the child's speed and receptive vocabulary proficiency. Standard scores were calculated. No significant differences were found between the bilingual (M = 106.38, SD = 16.12) and the monolingual groups' (M = 107.13, SD = 15.47) receptive vocabulary size, $t(30) = .13$, $p = .89$.

2.2.2. Verbal Fluency Task (VFT)

In the VFT-category task (or semantic), participants were asked to name all different animals they could think of in one minute. The number of items that the child mentioned in the one minute time frame was counted for the data analysis. Wrong (e.g., words that do not represent an animal) or repetitive answers were excluded from the total score. During the VFT-letter (or phonemic) task, participants were asked to name any word they could think of starting with the letter "f". In addition, they were asked to omit names for people and places, and morphologically related words (e.g., fast, faster, fastest). The number of items that the child mentioned in the one minute time frame was counted for the data analysis.

The order of administration of the tasks was counterbalanced within and across the two language groups (bilinguals: VFT-letter first n = 8, VFT-Category first n = 8; monolinguals: VFT-letter first n = 8, VFT-Category first n = 8).

3. Results

The number of correct words retrieved in each VFT task was calculated for the monolingual and bilingual groups, as showed in Figure 1. A repeated measures Analysis of Variance was conducted with VFT condition (VFT-letter, VFT-Category) as the within-subjects factor and language group (monolingual, bilingual) and order of administration of the VFT tasks (VFT-letter first, VFT-Category first) as the two between-subjects factors. Results showed a main effect of VFT condition, $F(1, 28) = 115.6$, $p < .001$, and a main effect of language group $F(1, 28) = 11.58$, $p = .002$. The main effect of task order and all interactions did not reach significance, all $p > .1$.

That is, all children obtained significantly higher scores on the VFT category (M = 13.84, SE = .778) than the VFT letter task (M = 5.69, SE = .549), and bilingual children (M = 11.66, SE = .786) outperformed monolinguals (M = 7.88, SE = .786). In order to further investigate the effect of language group on each task, one-way Analyses of Variance with language group as the independent variable were conducted. The ANOVA for the VFT – letter task showed a significant effect of language group, $F(1, 31) = 7.168$, $p = .012$. Similarly, for the VFT – category task, the ANOVA showed a significant effect of language group, $F(1, 31) = 9.054$, $p = .005$, confirming that bilinguals outperformed their monolingual counterparts in both versions of the VFT.

4. Discussion

The present study aimed to assess whether bilingual children exhibit an enhanced attentional control under lexical processing demands, specifically in the VFT-letter and VFT-category tasks. Our findings showed that bilingual children who were comparable to monolingual children in AusE receptive vocabulary performed better in the two versions of the VFT.

VFT (letter and category) is well known for observing attentional control at different levels [13, 14]; however, VFT also poses a demand for lexical skills, so controlling for vocabulary allowed us to reveal a bilingual advantage in both, the higher and the lower level attentional control conditions. Therefore bilinguals were more efficient than their monolingual counterparts in accessing their lexical repertoire and producing the required words under the different conditions.

Our findings that bilingual children outperformed monolinguals not only in the VFT-letter, but also in the VFT-category task differ significantly from previous studies [14, 20]. However, it is noteworthy that the recruitment criteria in the present study were strict by controlling for English language proficiency, age, and gender across language groups. Additionally, the VFT-letter used for the present study

included restrictions such as requiring children to avoid proper nouns and morphologically related words, which made it a more demanding task. Thus, it is possible that this challenging version of the task was more effective in allowing us to detect the differences in performance between the two language groups.

A possible source of these effects is the fact that bilinguals' two languages are permanently activated in the brain requiring them to focus on the target language and disregard the irrelevant language's cues in order to produce speech [1, 3, 5, 6, 24]. Although the VFT is well known for observing attentional control at different levels, it is difficult to disregard other dimensions of executive function involved during this task such as shifting, working memory, and organisation [5, 25-27]. Therefore, it would be interesting to integrate VFT and non-verbal tasks (that are specifically dedicated to testing attentional control) to directly compare the manifestation of the bilingual advantage across the verbal and non-verbal domains.

In summary, it was observed that bilingual children displayed enhanced executive functioning under language processing demands, which indicates a bilingual advantage in the verbal domain. It was also suggested that the bilingual effect on attentional control is more apparent when other variables are controlled. This includes matching for English language proficiency, age, and gender across groups, as well as including highly proficient bilinguals in the bilingual group.

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