The Relationship Between Language Proficiency and Attentional Control: Evidence from a Highly Proficient Multilingual Sub-Saharan African Population

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Introduction

- The Bilingual Advantage Effect is the reported finding that individuals who know and use more than one language develop enhanced executive control, or the ability to effectively manage higher cognitive processes. As a result, these individuals are better able to inhibit certain responses and are reported to show greater overall cognitive flexibility. This effect has been reported in both children and adults (see Bialystok, Craik, & Luk, 2008, 2012).
- In recent years, the robustness of this effect has come into question as several studies failed to find consistencies within the effect (Paap & Greenberg, 2013). Therefore, it has been suggested that advantages in bilingual executive functioning may only occur under certain circumstances (Paap, Johnson, & Sawi, 2015), and may be influenced by publication bias in the field (de Bruin, Treccani, & Della Sala, 2015).
- To date, very few studies have explored this effect in multilingual populations, yet the study of those who know and use multiple languages is essential to gaining more insight into this cognitive phenomenon. For this reason, the purpose of the current study is to explore the bilingual advantage effect in those who know and use multiple languages on a daily basis.

Current Study

The aim of the current experiment was to examine the bilingual advantage effect in a Sub-Saharan African population, where a high level of proficiency in multiple languages is the norm.

Questions of Interest:
(1) Would the effect be magnified in those who are highly multilingual (i.e., knowledge and daily use of 3-5 languages), as compared to those who know and use only two languages?
(2) Would the effect emerge as weak or nonexistent for these high frequency switchers, thereby supporting those studies that have suggested that the effect is not as robust as initially claimed?

Participants: 160 multilingual students from the United States International University, located in Kenya, East Africa

Experimental Tasks: Each participant completed the following during the individual experimental session
(1) Simon Task – responded to arrow flankers on the screen by making key presses to denote which direction the arrows were pointing in
(2) Working Memory Span (OSPAN) (Unsworth et al., 2005)
(3) Language History Questionnaire – contained questions focused on language history, demographic, socioeconomic, and task switching behavior

Simon Task Stimuli: In an effort to increase the sensitivity of the task (see Costa et al., 2009), a higher proportion of congruent trials as compared to incongruent trials were used, resulting in 100 congruent and 50 incongruent trials (with the left- and right-pointing arrows appearing equally on the left or right side of the screen).

Table 1. Language Skill Self Ratings and Age of Acquisition Means

<table>
<thead>
<tr>
<th>Age of Acquisition</th>
<th>Spoken Comp</th>
<th>Speaking</th>
<th>Reading</th>
<th>Writing</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>2.47 (.98)</td>
<td>5.49 (1.42)</td>
<td>4.90 (1.77)</td>
<td>4.45 (1.90)</td>
</tr>
<tr>
<td>L2</td>
<td>4.22 (2.07)</td>
<td>5.84 (1.31)</td>
<td>5.63 (1.43)</td>
<td>5.71 (1.44)</td>
</tr>
<tr>
<td>L3</td>
<td>8.69 (5.41)</td>
<td>5.07 (1.48)</td>
<td>4.68 (1.64)</td>
<td>4.83 (1.79)</td>
</tr>
<tr>
<td>L4</td>
<td>15.38 (5.83)</td>
<td>4.14 (1.60)</td>
<td>3.87 (1.55)</td>
<td>4.14 (1.71)</td>
</tr>
</tbody>
</table>

Note: standard deviations are in parentheses. AoA for L5 = 18.12 (4.29); self-rated proficiency was not collected for L5.

Results – General Outcomes

- Simon Effect was significant in both response time (+105 ms effect) and error rate data (both t > 6.53, ps < .001).
- Relationship between Simon Effect & OSPAN:
  - Participants with higher working memory scores were less likely to make errors in the Simon Task [OSPAN scores were negatively correlated with Simon Effects in error rates (-.27, p < .01), overall error rate (-.30, p < .01), and error rate in incongruent trials (-.30, p < .01)].
  - Higher L2 proficiency and earlier L2 AoA was correlated with higher working memory performance [OSPAN scores were negatively correlated with L2 AoA (-.15, p < .05)].
- Relationship between Simon Effect & SES:
  - The data revealed that socioeconomic status is likely a confounding variable when interpreting findings related to multilingual advantage in attentional control; a finding that supports previously published studies [socioeconomic status was negatively correlated with overall RT (-.18, p < .05), RT in incongruent trials (-.20, p < .05), and Simon Effect magnitudes in RT (-.18, p < .05)].

Relationship between Language Proficiency and Attentional Control

Figure 1. L1 AoA significantly predicted Simon Effect in error rates [t(154)=2.67, p < .05]
Figure 2. L2 proficiency significantly predicted working memory score [t(154)=2.33, p < .05]
Figure 3. L3 proficiency significantly predicted Simon Effect in error rates [t(154)=3.22, p < .05]

Conclusions

- After controlling for participants’ age, sex, and socioeconomic status, we observed that participants’ L1 AoA, L3 AoA, and L3 proficiency predicted their Simon Effect magnitude for error rates.
- Of greater interest, only weak relationships between language proficiency and Simon task performance emerged. Both L1 and L3 AOs showed larger Simon Effects in error rates, yet L2 and L4 AoA and proficiency did not appear to be correlated with any of the Simon task measures.
- In summary, when a nonverbal attention task is used and (1) the attentional demand of the task is high (i.e., proportion of congruent trials was intentionally high), and (2) the number of languages is higher than in previous bilingual studies (3-5 languages), there appears to be a small and nonsystematic multilingual advantage in attentional control.

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