

The Effects of Bilingualism on Executive Control Functions in Auditory Selective Attention

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Introduction

Numerous studies have shown the beneficial effects of bilingualism on executive functions, with bilinguals outperforming monolinguals on visual executive control tasks which require conflict resolution (Bialystok et al., 2009; Costa et al., 2009; Bialystok & Craik, 2010). In a study where the Simon task was used to assess the effects of language on performance, young children were significantly faster than their monolingual counterparts (Bialystok, 2008). Research with older adults has found that bilingualism minimizes the effects of cognitive decline in older adults by contributing to cognitive reserve (Bialystok et al., 2004). Results suggest that the bilingual advantage appears in situations with high processing demands and reduces age-related cognitive decline. Studies examining the bilingual advantage in younger adults have either not been able to replicate these results or found no difference between bilinguals and monolinguals (Paap & Greenberg, 2013).

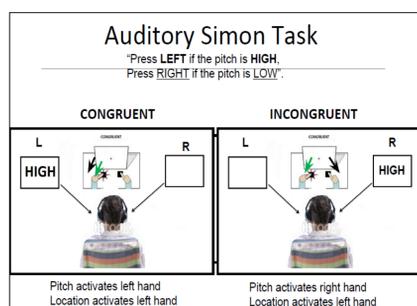
Despite these advantages in executive functioning, previous research has shown that bilinguals are worse than monolinguals at detecting speech in noisy environments. Thus, one might predict a monolingual advantage in auditory perception, especially for language stimuli such as speech. This study, however, aimed to look at the effect of executive control functions in auditory selective attention tasks by taking a nonverbal approach, using tones to control for language intelligibility effects by administering an auditory version of the visual Simon and flanker task, and a speech-in-noise task (QuickSIN) to a young adult population. **It is hypothesized that (1) bilinguals would outperform monolinguals on the auditory Simon task and (2) bilinguals would perform relatively worse than monolinguals on the QuickSIN task.**

Materials and Methods

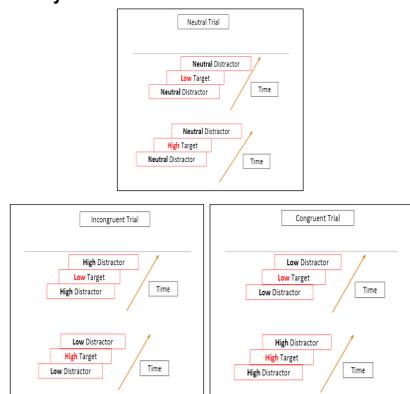
Participants: Twenty City College undergraduates between the ages of 18 and 34 participated in this experiment. Nine were monolinguals with no exposure to any language other than English. Eleven participants were Spanish-English bilinguals with the average age of exposure to their second language (English) at the age of 6.

Materials: An auditory version of the Simon task, an auditory version of the flanker task, an auditory single tone task, a task to detect speech signals in noise (QuickSIN), and several personality inventories were used. In addition, an English and Spanish grammar test was given to participants to measure their proficiency.

Auditory Simon Task:



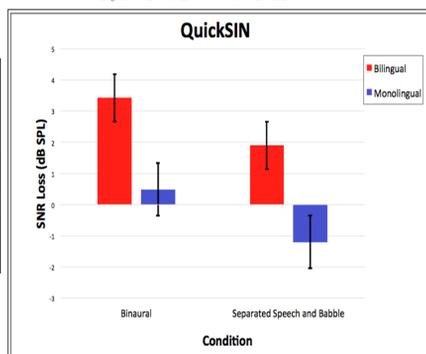
Auditory Flanker Task:



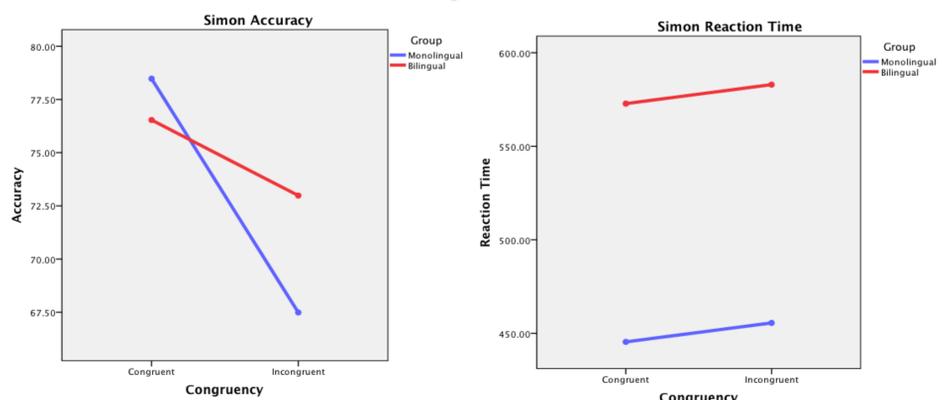
Questionnaire Data

Group	N	Grammar Test		Average Age of Exposure to Language	
		English	Spanish	L1(years)	L2(years)
Monolingual	9	93.75	0	1.00	--
Bilingual	11	90.083	82.867	0.8	7.2

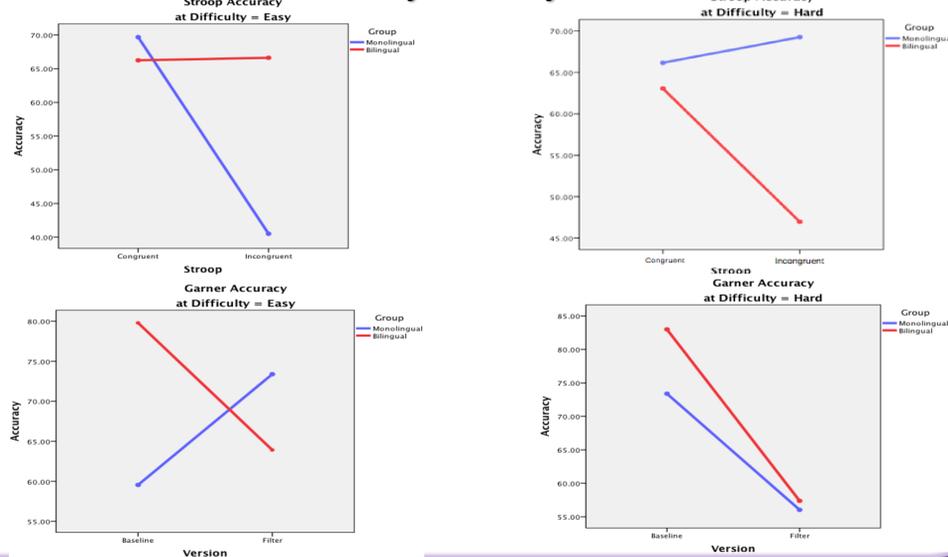
QuickSIN Data



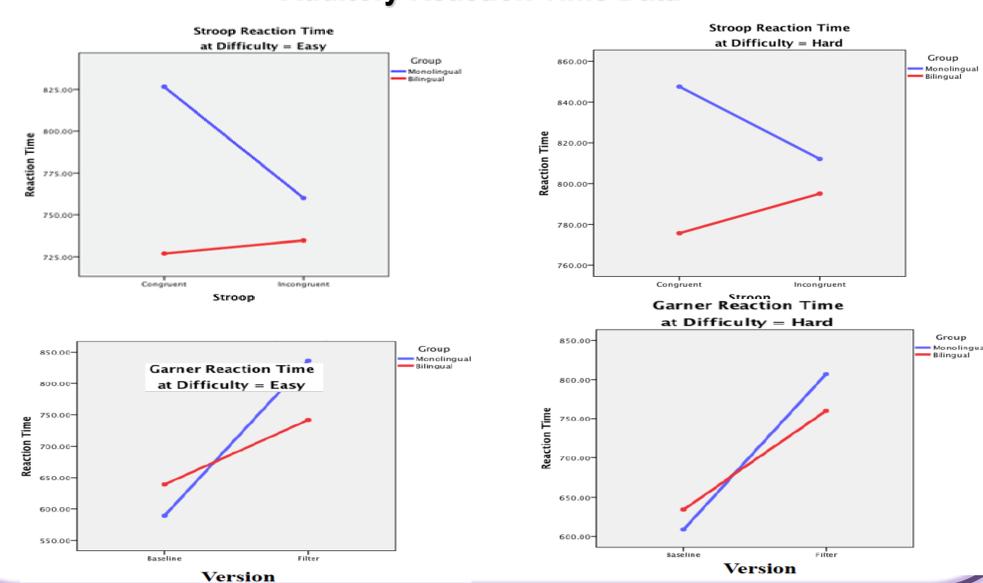
Auditory Simon Data



Auditory Accuracy Data



Auditory Reaction Time Data



Results

Data from the auditory tasks, the accuracy and the reaction time for the Stroop Effect (difference between the congruent and incongruent trials), Garner Effect (difference between the neutral trials in the Baseline and Filter versions) and the Simon Effect were analyzed.

1. Although the results are not significant because of a small sample size, the results in the Simon Tasks show a bilingual Advantage.
2. Results in QuickSIN and Auditory Flanker Task show a trend toward a monolingual advantage.
3. The Auditory Flanker Tasks have internal Validity. The Hard condition is harder than the easy Condition, the incongruent trials are harder than the congruent trials, and filter version is harder than the baseline version.
4. There is significant interaction between version (baseline and filter) and group (monolingual and bilingual) ($p=.01$). Also, between congruency (congruent and incongruent) and group ($p=.049$). There was a significant three-way interaction between difficulty (easy and hard), Stroop (difference between congruent and incongruent) and group ($p=.004$)

Discussion

Different from previous studies, the results of this study have found a trend toward a monolingual advantage in auditory tasks. Although the Auditory Simon task produced the desired results of a bilingual advantage, the Auditory Flanker Task showed that bilinguals were slower on both the baseline and filter tasks. Although bilinguals are more accurate (Garner Accuracy) they tend to be slower (Garner Reaction Time). These results can suggest that there is a trade off between reaction time and accuracy where for both bilinguals and monolinguals, where the participants do better because they are going slower at a particular trial.

The occurrence of a bilingual advantage within executive control functions such as inhibitory control and selective attention is still unclear. Although there have been studies to show a bilingual advantage in behavioral studies (Bialystok 2012), there are still other studies, including this one that have not been able to replicate them nor find an advantage within the young adult population.

The present study supports the idea that since bilinguals show greater difficulty in these tasks it can suggest that bilingualism is more complex than originally thought. The effects of bilingualism might extend farther than the visual and auditory domains. Auditory tasks, specifically the Flanker task, presents more of a generalizable approach to real-life scenarios people will be presented with and therefore more studies using the Auditory Flanker will be done to look more into this ecological validity. More studies looking at auditory processing differences between bilinguals and monolinguals within the central and peripheral auditory system should be further examined as well as electroencephalogram and fMRI studies to look at brain mapping of the auditory cortex differences.

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