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Auditory Working Memory in Monolinguals and Bilinguals – A Comparison Using Auditory "N" Back Test

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Abstract

Introduction: Auditory working memory is the ability to process information presented orally, analyze it mentally and store it to be recalled later. There are various methods to measure auditory memory skills. **Auditory n-back** is one of the frequently used methods to measure auditory working memory. Studies on the impact of bilingualism on cognitive development point out that bilingualism in children is associated with increased metacognitive skills and superior divergent thinking ability and with better performance on some perceptual tasks and classification tasks. The present study was taken up to investigate the auditory working memory in bilingual children using auditory 2 back task and to compare with that of monolingual children.

Method: A total of 60 subjects, which consisted of both monolingual and bilingual children, participated in the study. Stimuli for the study was prepared by using 7 common bi-syllabic words in Malayalam, out of which 5 words were repeated twice to make a string of 12 words. Children were instructed to say "yes" if the stimulus was repeated 2 steps back and say "no" if the stimulus was not repeated.

Results: The result indicated that bilingual children performed significantly better than monolingual children in auditory 2 back task ($p<0.05$) suggesting that the processing capacity for bilingual children is better than that of monolingual children.

Conclusion: Results of the present study indicated a better performance in auditory working memory for bilingual children than that of monolinguals. There may be a positive effect on the formation of cognitive processes in early bilinguals.

Key words:

Introduction

"Working memory" (WM) refers to the ability to hold on to pieces of information until the pieces blend into a full thought or concept, i.e., it refers to the limited capacity system that allows simultaneous storage and processing of temporary information (Baddeley, 1974). Based on the type of stimuli, working memory can be classified as visual working memory and auditory working memory. Auditory working memory is the ability to process information presented orally, analyze it mentally and store it to be recalled later. Visual memory and auditory memory are different categories of the broader concept of memory. Visual memory refers to the recollection of visual information whereas auditory memory is the recollection of things that were heard.

Based on linguality, a person can be classified as monolingual, bilingual or multilingual. A person who speaks and comprehends only one language is called monolingual; a person who speaks and comprehends two languages is a bilingual, and person who can speak and comprehend more than two languages is called a multilingual. Bloomfield (1933) argues that a bilingual should possess "native-like control of two or more languages. Types of bilingualism in relation to language acquisition are as follows: successive bilingualism, also known as consecutive bilingualism, which includes anyone that started to acquire a second language after knowing another language already. Simultaneous bilingualism is considered to occur when two languages are acquired from birth or prior to one year of age (De Houwer , 2005) .

Studies on the impact of bilingualism on cognitive development point out that bilingualism in children is associated with increased metacognitive skills and superior divergent thinking ability and with better performance on some perceptual tasks and classification tasks (Bialystok, 2001). According to Julia Morales (2013), bilingual children develop a better working memory which holds processes and updates information over short periods of time than monolingual children. The working memory plays a major role in the execution of wide range of activities, such as mental calculation or reading comprehension. This may be due to enhanced frontal executive processes in the brain.

There are various methods to measure auditory memory skills. Auditory n-back is one of the frequently used methods to measure auditory working memory. This test requires codification, temporary storage and response, as it is necessary for the individual to update and maintain information continuously in the WM to readily access it. In this test, a series of stimuli are presented, and the subject must signal whenever the current stimulus matches the one that was presented n-steps back in the list. Variation in the 'n' can be used to assess individual's levels of processing capacity.

Need for the Study

The review of literature indicated that bilingual children are better than monolingual children in various aspects. There are various studies done in bilinguals on verbal working memory (Bialystok, 2001). However, these are limited studies on auditory working memory and bilingualism. Hence, there is a need to determine the performance of auditory working memory in bilinguals. Auditory n-back is one of the frequently used methods to measure auditory working memory. Hence the present study was taken up to investigate the auditory working memory in bilingual children using auditory 2 back task and to compare with that of monolingual children.

Aim of the Study

To compare the auditory working memory in bilingual children and monolingual children using auditory 2 back task.

Method

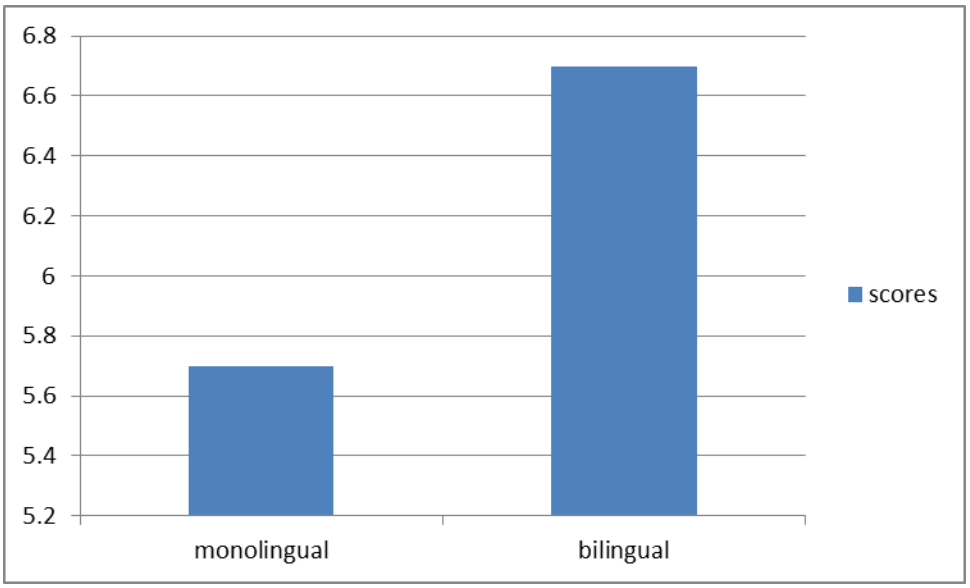
Participants: A total of 60 subjects participated in the study. Based on their linguality, the children were divided into two groups. Group 1 consisted of 30 monolingual children (15-M, 15-F) with Malayalam as Language 1 (L1) and Group 2 consisted of 30 sequential bilingual children with Malayalam as Language 1 (L1) and English as Language 2 (L2). The subjects in Group 2 were selected based on the responses obtained for International Second Language Proficiency Rating Scale (E. Wylie 2006). All the children had normal hearing sensitivity, intelligence, and no history of speech and language problems. All the subjects were having average and above average academic performance.

Stimuli used: Stimuli for the study was prepared by using 7 common bi-syllabic words in Malayalam, out of which 5 words were repeated twice to make a string of 12 words. A native female Malayalam speaker read these sequences of words with an inter-stimulus sequence interval of 2 seconds and they were recorded using a digital voice recorder. The recorded stimuli were presented to each of the subject at their most comfortable level through loudspeaker, which was connected to Dell laptop.

Procedure: The subjects were presented with a sequence of stimuli and the task consisted of indicating when the current stimulus matches the one from 2 steps earlier in the sequence. After presentation of 3rd word, the child had to start responding for each word. The child had to remember the position of the word, two turns back and so on. Children were instructed to say "yes" if the stimulus was repeated 2 steps back and say "no" if the stimulus was not repeated. A score of "1" was awarded for each correct response and "0" score for incorrect or no response.

Results and Discussion

The scores obtained on auditory 2 back task by monolingual children and bilingual children were subjected to statistical analysis using SPSS version 17 software. Descriptive statistics were obtained for both groups. The mean score obtained for monolingual children was 5.7 with a standard deviation of 1.2 and for bilingual children it was 6.7 with a standard deviation of 0.9. Gender comparison was done on performance of auditory 2 back task for both monolingual and bilingual children using paired sample t-test. The result revealed that there were no statistically significant differences between males and females in both the groups ($p > 0.05$). Hence the data obtained for males and females were clubbed in both the groups for further analysis. The scores obtained by monolingual children and bilingual children were compared using independent sample t-test. The result indicated that bilingual children performed significantly better than monolingual children in auditory 2 back task ($p < 0.05$) suggesting that the processing capacity of bilingual children is better than that of monolingual children. Empirical evidence suggests that bilingualism in children is associated with increased meta-cognitive skills and superior divergent thinking ability (Bialystok,2001). A bilingual advantage is found in WM, suggesting that bilinguals have an advantage in set maintenance) and in the related abilities of monitoring (Costa, et al., 2009).



Conclusion

Results of the present study indicated a better performance in auditory working memory for bilingual children than that of monolinguals. There may be a positive effect on the formation of cognitive processes in early bilinguals. Variations in language experience may also alter brain organization. Thus, bilingualism provides a fertile testing ground for questions about neural flexibility or brain plasticity.

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