2011 International Conference on Languages, Literature and Linguistics
IPEDR vol.26 (2011) © (2011) IACSIT Press, Singapore

An Investigation into Bilingual Cognitive Processing

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Abstract: Bilingualism has been an area of extensive research for a long period of time. Measuring information process, the mental process of cognition, has relied heavily on time and accuracy measures. Differences in reaction time can yield interpretations about the speed or difficulty of mental process, leading to inferences about cognitive process and events. Method: Participants for the study were 20 bilingual young adults (10 males, M=19.3years, SD=1.2, range= 18-22; 10 females, M = 19.8 years, SD = 1.7, range= 18-22) and 20 bilingual old adults (10 males, M = 74.4 years, SD = 5.1, range = 69-80). The results of the present study revealed significant main effect of the groups ($f= 166.66$, $p< 0.05$) indicating that bilingual old adults were slower in processing both verbs and nouns in comparison to the bilingual young adults. In terms of gender, among both the groups, the female participants processed faster for both the categories compared to males. The study revealed significant difference statistically ($F= 22.196$, $p< 0.05$).No significant main effect for verb and noun categories ($F=0.462$, $p>0.05$) was observed although nouns were processed faster than verbs in young adults and verbs were processed faster than nouns in the older group. It was also observed that the group gender interaction ($F=30.9$, $p<0.05$) was statistically significant. But there was no significant differences group and category interaction and gender and category interaction.

Keywords: Bilinguals, Cognition, Retrieval time

1. Introduction

The Human cognitive processes are heavily dependent on linguistic abilities. Lexical access is one part of the speech processing architecture which has received much attention in recent years in relation to bilingual linguistic ability. Lexical access reaction time studies have been used over the years as a determinant of the cognitive abilities of individuals and serve their purpose in various domains. Cognitively, words can provide important information regarding perception, comprehension and memory [1] Comprehension and retrieval of lexical units involve a variety of cognitive activities such as processing of structural information, meaning information and so on. The study of lexical retrieval especially pertaining to nouns and verbs through confrontation naming has taken on increased importance in the last few years, as naming is a fundamental aspect of human language use The reaction time in the retrieval of words using picture naming tasks provides a great deal of information on the functioning of retrieval abilities in the individual. Reaction time is defined as the elapsed time between the presentation of a sensory stimulus and the subsequent behavioral response (which can be any kind of observable behavior like eye movement, vocal response or motor response). Lexical items are alienated into different word classes, such as nouns and verbs, as they play different semantic and syntactic roles in language. They are responded to differentially by language users in behavioural tasks. Nouns and verbs are retrieved by different neural networks thereby honouring an organizational principle [2] Though there are conflicting evidences on the anatomical locus of verb retrieval skills in the brain, but in general, it is evident that either nouns or verbs could be differentially impaired following brain damage, reflecting the possible differences either in the organization and or processing of these two grammatical classes of words. The study of lexical access will provide an insight into the cognitive abilities of the individual. Hence the present study is in this direction.

2. Method

2.1. Research Participants

Participants were 20 young (10 males, M=19.3years, SD=1.2, range= 18-22; 10 females, M = 19.8 years, SD = 1.7, range= 18-22) and 20 older (10 males, M = 74.4 years, SD = 5.1, range = 69-80) who were native Kannada speakers but

not exposed not less than five languages and were fluent not less than two languages. All the participants were right-handed and had no existing speech, language, hearing and neurological or psychiatric illness. All the participants were having normal or corrected-to-normal vision. Participants were given an informal consent before the commencement of study.

2.2. Experimental Procedure

Experimental set consisted of ten nouns and ten verbs in Kannada. All the words [nouns (cat, elephant, hen, eye , ear, apple, chair, broom, key, book) and verbs (writing, sleeping, standing, sitting, crying, dancing, bathing, running, sweeping, laughing)] were selected only after obtaining familiarity rating by native Kannada Speaker. These stimuli images were set in black outline on a white background and were presented through the laptop. A specially programmed DMDX software is used. All the stimuli were inserted in a single list, and were randomly presented to the participants. The software was programmed so that all the ten written word stimuli were automatically displayed on the screen one by one for 3500 msec. RT (the time interval between application of a stimulus and detection of a response**)** for each stimulus was measured. Only the vocal responses from the subjects were recorded through Check Vocal software. The software automatically re-triggered to calculate the RT on the basis of an adjustable threshold. Participants were instructed to name the pictures immediately after it appears on the laptop screen as best and short as they could. If the participant demonstrated trouble perceiving the picture, then the latency time was calculated as 3500 msec. They were also told to avoid making a mistake, and also to avoid false starts, hesitation, articles or any other additional words.

3. Results

The current study was carried out to assess the word retrieval for nouns and verbs in bilingual young adults and geriatric population.

Group	Gender	Category	Mean	Standard Deviation
Younger Group	Male	Noun	8.46	154.77
Younger Group	Male	Verbs	1.03	403.00
Younger Group	Female	Noun	9.40	99.13
Younger Group	Female	Verbs	1.04	111.35
Geriatric Group	Male	Noun	2.45	397.75
Geriatric Group	Male	Verbs	1.94	418.92
Geriatric Group	Female	Noun	1.48	381.14
Geriatric Group	Female	Verbs	1.51	227.18

Table 1 showing average latency time for the retrieval of nouns and verbs

As shown in Table 1, the younger bilingual male participants exhibited a mean reaction time of 8.46ms for nouns and 1.03ms for verbs and the younger bilingual female participants exhibited a mean reaction time of 9.4ms for nouns and 99.13ms for verbs whereas the bilingual old male participants exhibited a mean reaction time of 2.45ms for nouns and 1.94ms for verbs where as the bilingual geriatric female participants exhibited a mean reaction time of 1.48ms for nouns and 1.51ms for verbs. The results of the present study revealed significant main effect of the groups ($f= 166.66$, $p< 0.05$) indicating that bilingual old participants were slower in processing both verbs and nouns in comparison to the bilingual young adults. In terms of gender, among both the groups, the bilingual female participants processed faster for both the categories compared to males. The study revealed significant difference statistically ($F= 22.196$, $p< 0.05$) .No significant main effect for verb and noun categories ($F=0.462$, $p>0.05$) was observed although nouns were processed faster than verbs in bilingual young adults and verbs were processed faster than nouns in the bilingual geriatric group. Also it was observed if there was any effect of their language on their responses. Few of the subjects had given their response in the language commonly used by them. However they have been considered as false starts and not included in the response.

4. Discussion

Bilingualism has been an area of extensive research for a long period of time. It is a very complex area of study due to its innumerable classifications based on various parameters like their characterizations, language acquisition patterns, proficiency, cognitive and linguistic abilities and so on. India being a grass-root level multilingual country, the importance of research related to bilingualism is warranted. In the present study there were differences observed in the retrieval speed for the nouns and verbs. Differences in naming latencies reflect differences in cognitive processing during action and object naming. Longer reaction times in one of two similar tasks are believed to result from an additional cognitive step or demand needed for the slower task .Differences in naming latencies reflect differences in cognitive processing during action and object naming. Longer reaction times in one of two similar tasks are believed to result from an additional cognitive step or demand needed for the slower task. This study indicated that older individuals were slower to process both the nouns and verbs than the young adults. This could be attributed to regions in the brain showing differential recruitment for young adults and old adults when the requirements for selection of semantic information are high. Reference [3] have also opined that decreased processing speed during high selection verb generation is associated with increases in left inferior frontal gyrus activation in young participants but it decreases in older participants. The nouns were processed faster than verbs in younger adult group in the current study which is in line with [4] observation that the production of nouns is less impaired than the understanding and production of verbs. On the other hand, verbs were processed faster than nouns in older group. Similar observations have been reported by [5]. However, some researchers have reported the opposite trend, with a selective deficit in noun processing. Positive correlations between reaction time and cortical activity in young adults and negative correlations between reaction time and cortical activity in senior adults in dorsolateral pre frontal cortex is reported [6]. Older adults often experience more difficulties than younger adults on memory tasks with high demands on control processes. The findings would suggest that senior adults may compensate for declining performance by the use of additional right homologous brain regions. The idea of compensation is supported by several neuroimaging studies in which right prefrontal recruitment in senior adults is associated with faster response times and higher memory performance [7].It was also observed in the current study that the female participants processed faster for both the grammatical categories compared to males. Various independent research studies have yielded controversial results as regards the effect of gender on reaction time. The males showed a shorter reaction time than females in every age group except 10 – 14 years and the oldest age group. In general, research seems to suggest that females have a higher regional cerebral blood flow than males [8] In females, it is up to 20% larger than in males, giving females better decision making and sensory processing skills. Females have demonstrated more frontal activation, compared to more parietal activation in males, during a mental rotation task and males have demonstrated a greater bias towards right hemisphere activation (and females to left hemisphere activation) during a task requiring a judgement of a whole object from its parts [9]

5. Conclusion

The current study demonstrates that processing for nouns and verbs declines with age. The neural underpinnings of this behavior remain largely unknown. This study would advance our understanding of cognitive impairments among the healthy aging and the pathology with implications for the clinical practice. The findings can be strengthened by expanding on different lexical categories.

6. Acknowledgment

We thank the Dean, Kasturba Medical College, Mangalore (A Unit of Manipal University) for supporting us to conduct such a study. We are also grateful to Mr Radhish and Mr Livingston for their cooperation.

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