

Assessment of Working Memory in Monolingual Broca's Aphasia

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Introduction

An intact working memory (WM) effects have been found across a range of complex cognitive processes and language processing (Caplan & Waters, 1999; Engle, 2002; Wright & Shisler, 2005). The predominant view of WM was first proposed by Baddeley and Hitch (1974). Working memory (WM) is “a multicomponent system responsible for active maintenance of information in the face of ongoing processing and/or distraction” (Conway et al., 2005) which facilitates goal directed behavior.

Researchers have reported that the language problems seen in aphasia go beyond an impaired linguistic system and involve a complex cognitive deficit (Helm-Estabrooks, Bayles, Ramage, & Bryant, 1995; Chapey, 2001). A number of researchers have explored the integrity of working memory in adults with aphasia. Miyake et al., (1994) proposed that comprehension deficits in aphasia were the product of reduced WM capacity for language. Caspari et al., (1998) administered a simplified version of the reading span task to 23 individuals spanning a wide range of aphasia types and severity levels. The authors concluded that “the ability of aphasic individuals to comprehend language is predictable from their working memory capacities”. Friedmann and Gvion (2003) studied the relationship between verbal working memory and sentence comprehension in adults with conduction aphasia and agrammatic aphasia, and an NL group. Measures of working memory included several span measures: digit, word, nonword, a listening span task, and a 2-back task. The results of the study indicated that both aphasia groups presented with limited working memory abilities and performed poorly on sentence comprehension task.

Need

Results of the previous investigations indicate that individuals with aphasia have impaired working memory systems. Further, the working memory capacity deficit may contribute to the language processing difficulties of adults with aphasia. Evidence of improved language performance in individuals with aphasia given WM support is reported (Francis et al., 2003; Linebarger, McCall, Virata, & Berndt, 2007). Importantly, early identification of such deficits could play a crucial role in treatment for adults with aphasia.

Aim

The purposes of this study include:

1. To measure working memory ability in Kannada speaking individuals with Broca's Aphasia.
2. To compare the performance of individuals with Broca's Aphasia with healthy elderly individuals on working memory.
3. To find gender differences if any.

Method

Participants

Group-1 (G1) Reference group: 20 Kannada speaking healthy elderly individuals (10 Males; 10 Females) in the age range of 45 – 60 years (M-52.5) participated in this study. Participants were screened for speech, language, hearing, cognition, medical / neurological problem and vision by qualified professionals in the respective field. All participants completed 10th standard education.

Group-2 (G2) Clinical group: 10 Kannada speaking adults with Broca's aphasia (5 Males; 5 Females) in the age range of 45 – 60 (M-54.2) at the time of testing participated in this study. Years of education completed was 10th standard. All participants presented with one stroke unilateral left hemisphere damage subsequent to cerebrovascular accident (CVA); 6 months post onset; pre-morbid right-handed; and no history of dementia or other neurological illness; hearing acuity within normal limits; normal visual acuity. Type of aphasia was determined by performance on the WAB test.

Research Design

A Standard group comparison design was used.

Materials

Working memory was assessed for five tasks: 1. Word span (bisyllable words, each stimulus consisted of three words); 2. Non word span test (tri-syllable words); 3. Listening span (5 word sentence each); 4. Digit span test (2 digit numbers, each stimulus consisted of five numbers); 5. digit-ordering task (3 & 4 digit numbers, each stimulus consisted of five numbers). Each task consisted of 10 items. The stimulus was audio recorded.

Procedure

During the assessment phase, informed consent was obtained, the WAB was administered. Each participant was tested individually in a noise free room. Stimulus was presented through headphone at the comfortable level. Instructions were given to participants at each level of presentation. A score of '1' was assigned for each correct response, score of '0' for each incorrect and no response.

Results and Discussion

The data obtained were subjected to statistical analysis using SPSS-17 software. Statistical test used were Mann-Whitney U test and Independent sample t test.

I. In order to check for the presence of gender effect on various working memory task, Mann-Whitney U test was carried out. These analyses revealed that no significant differences at .05

level of significance were present among the genders in both the group. Hence, in the final analysis, data was combined.

II. Performance of adult with Broca's aphasia on various working memory task: 1. Word span: M=1.1; SD=.99; 2. Non word span: M=1.3; SD=.82; 3. Listening span: M=3.4; SD=.96; 4. Digit span: M=2.4; SD=.51; 5. Digit ordering span: M=1.7; SD=.67. Mean value for listening span and digit span task were slightly higher than for other three tasks.

III. Performance of healthy elderly individuals on various working memory task: 1. Word span: M=6.5; SD=.75; 2. Non word span: M=6.7; SD=.73; 3. Listening span: M=6.9; SD=.75; 4. Digit span: M=8.0; SD=.82; 5. Digit ordering span: M=8.2; SD=.85. Mean value for digit span and digit ordering span task were slightly higher than for other three tasks

IV. Performance between the group (adult with Broca's aphasia and healthy elderly individuals) on various working memory task: Healthy elderly individuals performance indicated (Mean=36.5; SD=2.1). Adults with Aphasia performance indicated (Mean=9.9; SD=1.9). The results between the two groups indicated significant differences at 0.05 level of significance.

The results of the present study indicated that, adults with Broca's aphasia performed poorly on all five tasks of working memory in comparison with healthy elderly individuals. These results are in support with the literature indicating that adults with aphasia present with a working memory deficit (Miyake et al., 1995; Caspari et al., 1998; Friedmann and Gvion, 2003). Results also indicated that, there was no significant difference in performance among the genders in both the group. Thus, highlighting the importance of measurement of working memory and incorporating these parameters in clinical rehabilitation strategies for adults with aphasia.

Conclusion

Theories of working memory are evolving in response to empirical findings of working memory ability in adults with and without aphasia. Different type of processing can be differently be affected by WM, and that the type of processing plays a crucial role in determining the effect the WM has on comprehension (Friedmann & Gvion, 2003). The present study adds on to the existing research on limitation of working memory in adults with aphasia. Future investigations of measurement and treatment of working memory are warranted to determine the role of working memory in language processing.

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