Relationship between Working Memory and Language Skills among Children with Mild Intellectual Disability

Harish Kumar ¹, Prerna Singh² & Dr. Premlata Sharma³

¹ Harish Kumar, Special Educator, All India Institute of Speech and Hearing, Mysore-570006 and Research Scholar, RIE (NCERT), Mysore.
² Prerna Singh, Research Scholar, University of Mysore, Mysore, Karnataka
³ Dr. Premlata Sharma, Rtd Prof. & Principal of Regional Institute of Education, Mysore, Karnataka.

Abstract: The aim of the study is to find out the relationship between working memory components and language skills. Sample: There were 36 participants with mild intellectual disability (MID) of mental age 7-10 years and chronological age 12 to 15. Design: This study was conducted in descriptive survey method in special and inclusive schools of Delhi. Tools: A battery of working memory and language assessment tool was administered. Results: Executive loaded working memory (ELWM) accounted for language skills. Conclusion: Remedial programs based ELWM will benefit these children in enhancement of language skills.

Introduction

According to the census 2011, there are 15.5 million persons with intellectual disabilities (5.6 percent of total population of disability) in India (Census of India, 2011). Intellectual disability is characterized by significant limitations in intellectual functioning and adaptive behavior, which covers a range of everyday social and practical skills. This disability originates before the age of 18 (Schalock & Luckasson, 2015). Children with MID falls under the IQ range of 50 – 69 (Weiner, 2003). Many studies have found that children with intellectual disabilities (ID) have working memory (WM) deficits (Van der Molen, Van Luit, Jongmans, & Van der Molen, 2007). Working memory model comprises four components: a phonological loop responsible for the temporary storage of verbal/speech based information which is known as Phonological Short Term Memory (PSTM); a visuo-spatial sketchpad to temporary hold and maintain visuo-spatial information which known as Visual Spatial Short term Memory(VSSTM); a central executive to provide overall attention control of the working memory system which is known as executive loaded working memory(ELWM) and an episodic buffer, which contributes modality free storage as well as link to long term semantic and long term knowledge(A. Baddeley, 2007; A. D. Baddeley, 2000; A. Baddeley & Hitch, 1974). There are very few researches on relationship between working memory components and language skills among children with MID. L. A. Henry, (2001) found out that the poor performance on phonological short term memory (PSTM) and central executive loaded working memory (CELWM) in children with low IQ. Rosenquist et al. (2003) also investigated that there is a problem in automatic rehearsal in children with MID. WM Skills are highly associated with children’s abilities to learn language skills, academic domains such as reading, mathematics and science (Holmes & Adams, 2006). Present study included the three original components of working memory (PSTM, VSSTM, CELWM) with language skills in order to determine which component of working memory were most predictor of language skills.

Objective of the Study

The present study is to find the relationship between working memory and language skills and to determine which working memory component were the best predictor of Language skills.

Method

Participants

Total numbers of participant were 36 with MID of mental age 7 to 10 (mean age 9.1, S.D. = ± .84) and chronological age 12 to 15 (Mean age 14.10, S.D. = ± .79). They were identified as MID with certified clinical psychologist and there IQ was taken from the school records. All the children were taken from the 8 special and inclusive schools of NCR, Delhi and were tested individually in their school premises. Prior permission was taken from the schools at which study was carried out and written consent was obtained from parents for the participation of their child in this study.

Tools

A working memory battery was compiled from standardized tests based on the previous research studies. A study was also conducted to check reliability and internal consistency of the battery (Cronbach’s Alpha= .88). Construct validity was ranging from .63 “” to 90 “”. (Kumar et al., 2016). Detailed explanation of all these memory tasks is given below.
Phonological Short Term Memory (PSTM) – Two tests were used to assess the phonological short term memory: a digit span (DS) and syllable span (SP) test (Bhatia Battery, 1955). The digit and the syllable span tasks varied at 8 levels of difficulties. In both the tasks, the participant had to immediately repeat digits or Hindi syllables verbally in exactly the same order as presented at the rate of one per second. Span score were calculated based on the longest list recalled correctly. There were three tests trails at each list length. As long as the participants passed two trials, they were taken in to the next level of digit or Hindi syllable list.

Visual-Spatial Short Term Memory (VSSTM) – Two tests were used to assess the visual-spatial short term memory:

Abstract Figure Short Term Memory Span (AFSTMS) – This task was taken from the Indian Child Intelligence Test, 2005. In this task abstract pictures were shown in a specific order. The number of pictures showed increased gradually from two to seven at the last trial. Each picture was presented to the child for five seconds and then he/she was asked to rearrange in same array. In this task, level of difficulty increased with increase in number of pictures presented. Span score was calculated based on the longest list recalled correctly.

Spatial Short Term Memory Span (SSTMS) – This task was taken from the corsi-block Tapping test. In this task, the experimenter pointed to a series of line drawing cubes arranged randomly in different spatial locations on A4-sized paper. Here, participant must point to the same cubes in the same order. Test start with pointing to two cubes and maximum series of pointing cube was up to 8. There were two trials at each level. To move to the next level participant must complete one trial out of two. Span was measured as the longest sequence pointed.

Central Executive (CELWM) – Three tests were administered to assess this component of working memory.

Listening Span (Henry, L.A 2011): This test was translated and retranslated in Hindi with help of four experts in the field of Psychology, Special Education, Educational Psychology and Linguistic. This test was translated with prior permission of the main Author. It contains different short sentence that would either be true or false (e.g. “Log Chal Sakte hai” or “ Fool gaa sakte hai”). This will vary four levels of difficulties each of which were tested by two different trials. Sentence-first words must be recalled in any order on this task. Listening span score was the longest list length at which two trials were passed.

Odd One out Span Task (Henry, L.A 2013): Here, participants were shown three visual items that cannot be readily named. They were asked to point the items that were slightly different from the other two. This was the processing part of the task, i.e choosing the ‘odd one out’. The storage part is to remember the spatial location of the odd one out (to the left, middle or right in the grid). The task varied at five levels of difficulties. Each task had two trials. Initially, children were given practice trial. The participant was moved to next trial only after completion of two trials. Threshold span reflects the longest set of lists can be successfully recalled in order.

Reverse digit span task (RDS): This task is similar to the digit span task but way of the response on this task is reverse. Span score was the longest list length correctly recalled.

Language Skill : BASIC-MR, Behavioral assessment Scales for Indian Children with Mental Retardation (Peshwaria, R; Venkatesan, 1992) was used to assess the language skills of children with intellectual disabilities. This scale is suitable for children with intellectual disabilities between 3 to 16 years. Inter Rater Reliability – r = 0.835. Construct Validity – Pre-Test – r (0.726), Post Test – r (0.804)

Results

The purpose of the study was to find the relationship between working memory measures and language skills among children with mild intellectual disability. The following three components were taken as a measure of working memory: Phonological loop (PSTM), Visuo-spatial sketch pad (VSSTM) and central executive (CELWM). The summated scores of DS and SP were taken for PSTM. The scores of AFSTMS and SSTMS were summed to measure VSSTM. Likewise, score of listening span, odd-one-out span and RDS were summed to measure central executive loaded memory. Investigator took the scores of Language Assessment Tool (Peshwaria, R; Venkatesan, 1992) as a measure of language skills. Inclusion criteria of the participants included: (i) Children with MID of mental age 7 to 10. (ii) Mother tongue was Hindi and (iii) children of MID with no organic cause. The data was normally distributed which was tested on Shapiro-Wilk test and was checked for all the assumptions of pearson’s product moment correlations and multiple regression. Table 1 –shows the correlation between working memory measures, receptive, expressive and total scores on language skills.

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<thead>
<tr>
<th>Task</th>
<th>Language Skills</th>
<th>P</th>
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<tbody>
<tr>
<td>PSTM r</td>
<td></td>
<td>.15</td>
<td>.38</td>
<td></td>
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<tr>
<td>PSTM p</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VSSTM r</td>
<td></td>
<td>.36</td>
<td>.031</td>
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<tr>
<td>VSSTM p</td>
<td></td>
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<tr>
<td>CELWM r</td>
<td></td>
<td>.39</td>
<td>.017</td>
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<tr>
<td>CELWM p</td>
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* - significant at .05 level, ** - Significant at .01 level
Phonological Short Term Memory
PSTM did not show any significant correlation with language skills.

Visuo-Spatial Short Term Memory
VSSTM was significantly correlated with language skills (r=.36, n=36, p<.05). There was a positive correlation.

Central Executive Loaded Working Memory
CELWM was significantly correlated with language skills (r=.39, n=36, p<.05). There was a positive correlation.

Regression Analysis
To see which working memory measures were the best predictor of Language skills. Investigator computed stepwise regression for variables independently. The measures of working memory were taken as independent variables, whereas, language skills were taken as dependent variables.

Language Skills
ELWM predicted 15% of variance significantly in language skills (F (1,34) = 5.910, p < .05, R²=.15), whereas central executive loaded memory and phonological memory did not contributed significantly.

Discussion
The results of this study indicate that ELWM act as significant predictor of language skills. There are evidences that ELWM plays vital role in language comprehension in typically developed children (Daneman & Carpenter, 1980.; Davidson, Kaushanskaya, & Weismer, 2015). In case of children with MID, most of the studies are related to phonological memory and naming speed, syntax etc (Barker, Sevcik, Morris, & Romski, 2013; Pierpont, Richmond, Abbeduto, Kover, & Brown, 2011; van der Schuit, Segers, van Balkom, & Verhoeven, 2011). To our knowledge, at present except L. Henry & MacLean, 2003 who worked on working memory and expressive vocabulary, none other study is done on WM as predictors of language skills in children with MID. This study explains that ELWM contributes 15% in case of children with MID for language skills. Hence, by making remedial programs with ELWM will benefit these children to develop their language skills.

References


