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Working Memory and Reading Comprehension in Typical Children Speaking Kannada

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Abstract

Working memory plays a crucial role in reading comprehension by enabling the retention and integration of information during reading. The present study aimed to examine the relationship between working memory and reading comprehension in typical Kannada-speaking children aged 8–12 years. A total of 30 typically developing children proficient in Kannada language were assessed using working memory tasks (Digit Span Forward and Backward, Word Span Task, and Sentence Repetition Task) and reading comprehension tasks (word reading list, passage reading, and comprehension questions). Data was analyzed using descriptive statistics. Mean performance on working memory tasks was 68.0% while reading comprehension performance was 63.3%. The highest scores were observed for Word Span Task (74.8%) and Digit Span Forward (73.8%), whereas Passage Reading was the lowest (56.0%). For Working Memory Task, 50.0% of participants scored in the medium range and 50.0% in the high range, with none in the low range. For Reading Comprehension task participants scored 10% in the low range, 40.0% in the medium range and 50.0% in the high range. The findings indicate a positive association between working memory and reading comprehension, with stronger working memory capacity linked to better comprehension performance. The study highlights the need for further research with larger samples and across diverse linguistic and clinical populations.

Keywords: Working memory; Reading comprehension; Kannada-speaking children

1. Introduction

Working memory is a cognitive system that enables individuals to temporarily store and actively manipulate information required for complex mental activities and serves as a mental workspace that supports higher-order functions such as reasoning, language processing and learning. This function acts as a flexible mental hub allowing for the storage of significant data during complex cognitive operation (Gathercole & Alloway, 2008).

Reading comprehension is a dynamic and multifactorial process that involves constructing meaning from written text. It requires the coordination of several linguistic and cognitive processes including word

recognition, vocabulary access, syntactic parsing and the generation of inferences. Working memory is characterized as the cognitive capacity for simultaneous information retention, processing and it serves as a primary predictor of reading comprehension (Seigneuric, Ehrlich, Oakhill, & Yuill, 2000).

Daneman and Carpenter (1980) demonstrated the association between working memory and reading comprehension and found that individuals with higher working memory span performed better on reading comprehension tasks revealing the role of working memory in maintaining and integrating text information.

Swanson and Berninger (1995) showed that working memory substantially predicts reading performance among school-age children. They found that students with limited working memory capacity frequently struggle with comprehension even when their fundamental word-decoding skills remain strong and it indicated that working memory contributes to reading beyond simple word identification, especially when it comes to synthesizing and making sense of written information.

Nation and Snowling (1997) suggested that comprehension difficulties are more closely linked to limitations in higher-level complex thinking skills than to basic reading ability.

Swanson (1999) reported that working memory capacity significantly predicts reading comprehension performance in children particularly in tasks requiring simultaneous storage and processing of verbal information. Wolf and Bowers (1999) highlighted that reading development depends on multiple cognitive components including working memory, phonological processing, and rapid naming.

Baddeley and Hitch (1974) proposed a multicomponent framework for working memory and subsequently revised by Baddeley (2000) characterized working memory as comprising four key elements the phonological loop, the visuospatial sketchpad, the central executive and the episodic buffer. In this structure the phonological loop handles the temporary storage of verbal content whereas the central executive manages attentional regulation and the coordination of information. This model has served as a cornerstone for understanding how working memory supports language-based activities including reading comprehension.

Oakhill, Cain and Elbro (2003) demonstrated that children with poor reading comprehension often show limitations in working memory and inference-making abilities and findings emphasized that successful comprehension depends not only on decoding skills but also on the efficient use of cognitive resources to integrate and interpret textual information.

Karanth (2003) reported that difficulties in reading comprehension are often associated with limitations in cognitive processing abilities including working memory and emphasized that even when basic reading skills are acquired, deficits in memory and processing can hinder deeper understanding.

Cain, Oakhill and Bryant (2004) found that individual differences in working memory capacity are closely associated with children's ability to understand and retain information from text and suggested that children with better working memory skills are more capable of constructing coherent mental representations of written material thereby achieving higher levels of reading comprehension.

Cowan (2005) proposed that working memory capacity reflects the ability to maintain attention on information which is crucial for integrating textual content during reading.

Nation (2005) denotes that reading comprehension difficulties may arise from broader cognitive processing limitations including restricted working memory capacity rather than solely from deficits in vocabulary or linguistic knowledge.

Das and Mishra (2010) reported the importance of working memory in academic learning among school-aged children. and indicated that working memory capacity significantly contributes to tasks involving comprehension, reasoning and information integration in classroom.

Singh and Karanth (2012) suggested that children with stronger working memory capacity demonstrate better performance in language comprehension tasks across different linguistic contexts.

Melby-Lervåg and Hulme (2013) provided a meta-analytic perspective indicating a strong and consistent relationship between verbal working memory and reading comprehension across different age groups and found that working memory is not only associated with reading performance but also plays a causal role in comprehension development.

Vaid and Mishra (2020) investigated cognitive processes underlying reading in Indian children and found that working memory is a crucial predictor of reading comprehension performance.

NEED OF THE STUDY

Working memory plays an important role in reading comprehension where children must retain, process and interpret information while reading. According to 2011 census, Kannada language is spoken by approximately 43.7 million people predominately in Karnataka and neighbouring regions. Kannada language with its alpha syllabic script and morphologically rich structure imposes additional cognitive demands during reading particularly on working memory.

Limited research investigated the relationship between working memory and reading comprehension in typical children speaking Kannada language. Thus, examining this relationship within the Kannada language is essential to better understand language-specific cognitive processes and to contribute to the development of appropriate assessment and intervention strategies.

The present study aims to fill this gap by exploring the relation between working memory and reading comprehension in typical children speaking Kannada language.

METHODOLOGY

Aim: The aim of the study was to examine the relationship between working memory and reading comprehension in typical children speaking Kannada.

Subjects: A total of 30 children aged 8 -12 years proficient in Kannada language with adequate reading comprehension.

Inclusion criteria:

- Children aged 8-12 years.
- Typical children attending Kannada medium school.

- Children with no history of neurological, developmental or language related disorders.

Exclusion criteria:

- Children with hearing and visual impairment.
- Children with speech and language delay.

Stimulus: Working memory tasks (Digit span test - Forward and Backward, Word Span Test and Sentence Repetition tasks) and Reading comprehension tasks (Short story passage in Kannada) were used and permission was obtained from the school and informed consent was taken from parents before data collection.

Procedure:

The tasks were administered in the following sequence:

1. Working memory tasks
2. Reading comprehension tasks

Each subject was given clear instructions about the tasks and administered individually in a quiet room within the school.

Scoring

- Working memory was scored based on maximum span length.
- Total correct responses across tasks were calculated.
- Reading comprehension was scored based on correct answers.
- An overall working memory score was derived by combining all task scores.

Statistical analysis

The data was analyzed using descriptive statistics (mean, SD, percentage). Categorical variables were summarized using frequencies and percentages while numerical quantitative data were expressed as mean ± standard deviation (SD). A p-value of less than 0.05 was considered statistically significant. All statistical analyses were conducted using SPSS version 23.0.

RESULT AND DISCUSSION

The aim of the present study was to examine the relationship between working memory and reading comprehension in typical children speaking Kannada and the results are discussed below.

Table 1

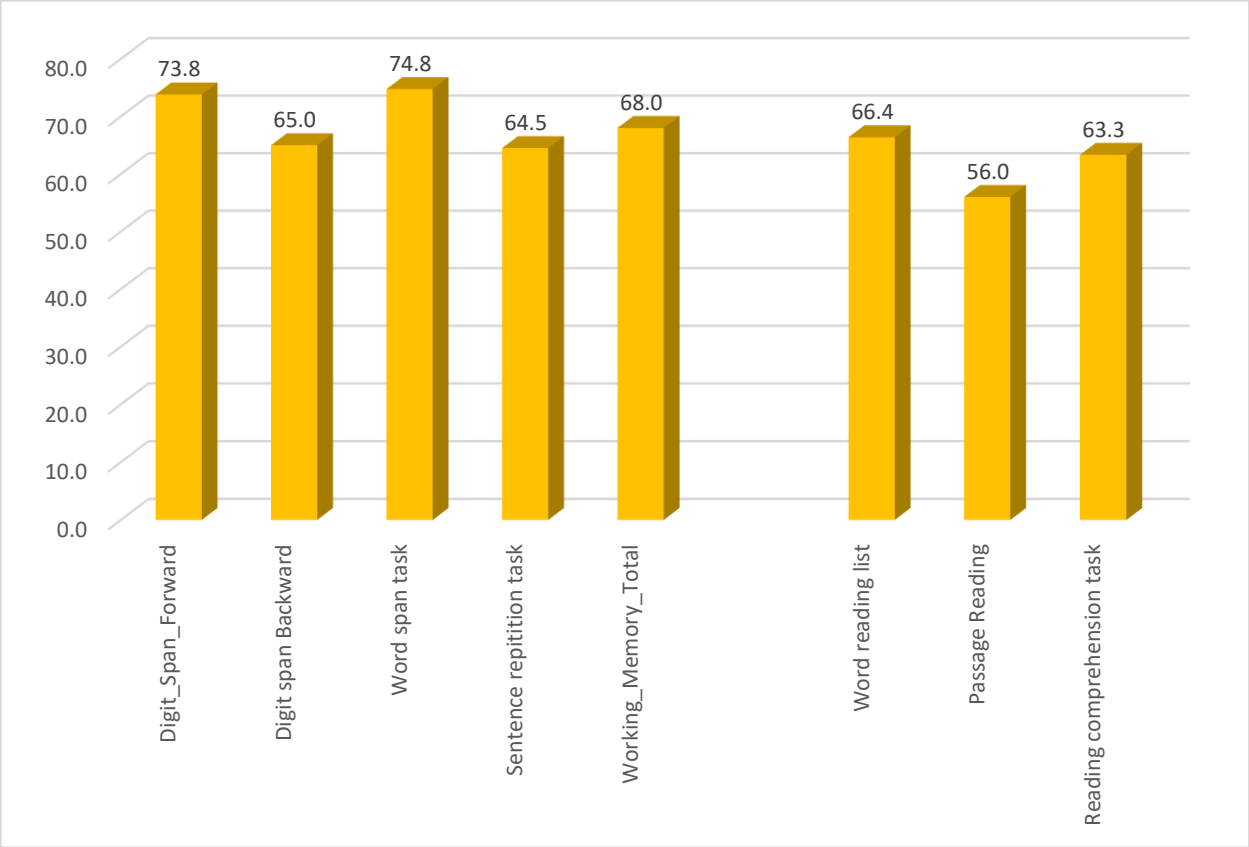
Shows the descriptive Statistics of Working Memory and Reading Comprehension Performance in Kannada-Speaking Children (N = 30)

						Performance (%)
	N	Minimum	Maximum	Mean	Std. Deviation	Mean (%)
Digit Span Forward (7)	30	3	7	5.17	1.39	73.8
Digit span Backward (6)	30	2	6	3.90	0.96	65.0
Word span task (7)	30	2	7	5.23	1.55	74.8
Sentence repetition task (20)	30	6	20	12.90	4.36	64.5
Working Memory Total (40)	30	17	37	27.20	7.48	68.0
Word reading list (12)	30	0	12	7.97	3.63	66.4
Passage Reading (5)	30	1	5	2.80	1.32	56.0
Reading comprehension task (17)	30	1	16	10.77	4.41	63.3

From the above table it can be inferred that the following mean performance percentages are as follows: Digit Span Forward attained 73.8% of the maximum score, Digit Span Backward attained 65.0%, Word Span Task attained 74.8%, Sentence Repetition Task attained 64.5% and the Working Memory Total score attained 68.0%. In reading tasks, Word Reading List performance was 66.4%, Passage Reading was 56.0%, and Reading Comprehension Task was 63.3% of the maximum possible score.

FIGURE 1

Shows the descriptive Statistics of Working Memory and Reading Comprehension Performance in Kannada-Speaking Children (N = 30)



The figure shows that the mean performance percentages were highest for Word Span Task at 74.8% and Digit Span Forward at 73.8% and Word Reading List at 66.4%. Digit Span Backward and Sentence Repetition Task were 65.0% and 64.5%, respectively, while Reading Comprehension Task was 63.3% and Passage Reading was the lowest at 56.0%. The overall working memory total showed a mean score of 27.20 (SD = 7.48), corresponding to 68.0%.

Table 2

Shows the classification of Working Memory and Reading Comprehension Performance Levels among Kannada speaking Children.

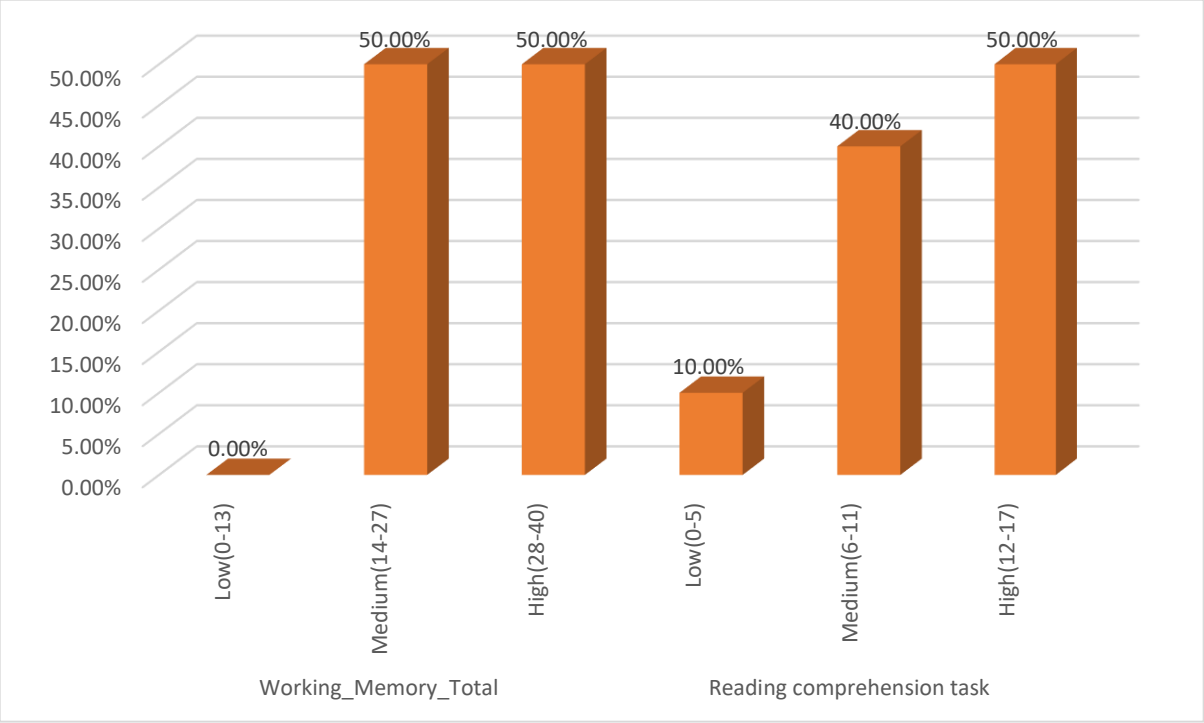
TOTAL SCORE		Count	Column N %
Working Memory Total (40)	Low (0-13)	0	0.0%
	Medium (14-27)	15	50.0%
	High (28-40)	15	50.0%

	Total	30	100.0%
Reading comprehension task (17)	Low (0-5)	3	10.0%
	Medium (6-11)	12	40.0%
	High (12-17)	15	50.0%
	Total	30	100.0%

Based on the results from the table for the Working Memory Total (scored out of 40) half of the 30 participants (N= 15, 50.0%) scored in the medium range, the other half (N=15, 50.0%) scored in the high range and none scored in the low range. For the Reading Comprehension Task (scored out of 17), 3 participants (10.0%) scored in the low range, 12 (40.0%) scored in the medium range and 15 (50.0%) scored in the high range.

FIGURE 2

Shows the classification of Working Memory and Reading Comprehension Performance Levels among Kannada speaking Children.



Based on the figure for working memory none of the participants fell in the low category (0-13) while 50.0% of the participants were in the medium range (14-27) and 50.0% were in the high range (28-40). In contrast, the Reading Comprehension Task (scored out of 17), 10.0% of participants scored in the low range (0-5), 40.0% scored in the medium range 6-11) and the largest proportion, 50.0%, scored in the high range (12-17).

DISCUSSION

The present study aimed to assess the performance of working memory and reading comprehension skills among typical children speaking Kannada and results showed relatively better performance on basic verbal working-memory tasks than on more complex reading-related tasks. The highest mean scores were observed for Word Span Task and Digit Span Forward indicating stronger short-term storage while Digit Span Backward and Sentence Repetition showed comparatively lower performance because these tasks require greater mental manipulation and processing demands. Daneman and Carpenter (1980) reported that individuals with higher working memory capacity perform better in comprehension tasks due to efficient maintenance and integration of textual information which is in accordance to the present study. Overall the findings of the present study align with previous research by demonstrating that working memory plays a crucial role in reading comprehension. The observed pattern where stronger working memory performance corresponds with relatively better comprehension outcomes supports the view that working memory is essential for efficient processing and integration of textual information.

SUMMARY & CONCLUSION

Working memory capacity contributes significantly to reading comprehension because readers must maintain and integrate information across text. The present study aimed to examined the relationship between working memory and reading comprehension by using working memory task and reading comprehension tasks in typical children speaking Kannada aged 8-12 years. The findings revealed that children demonstrated relatively higher performance in working memory (68.0%) compared to reading comprehension (63.3%) indicating that while cognitive capacity is generally adequate, comprehension abilities show greater variability. This pattern was further supported by task-level performance where Word Span and Digit Span Forward showed stronger outcomes whereas Sentence Repetition and Digit Span Backward reflected comparatively lower performance suggesting differences in cognitive processing demands across tasks.

The findings suggest a clear association between working memory and reading comprehension where stronger working memory capacity is linked to better comprehension performance.

LIMITATIONS OF THE STUDY

- Limited sample size.
- Administered only in Kannada language.

FUTURE DIRECTIONS

- Use a larger sample size.
- Conduct the study in different Indian languages.
- Extend the study to different clinical populations.

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