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RESEARCH ARTICLE

EXPLORING GENDER DISPARITIES IN VISUAL MEMORY: INSIGHTS FOR COGNITIVE INTERVENTIONS

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ABSTRACT

Background: The human brain's cognitive processes vary across genders, intriguing neuroscientists for decades. Visual memory, crucial for daily tasks, involves recalling visually presented information. While known factors like age and education influence memory, gender differences in visual memory remain less explored. **Aim:** This study aimed to investigate gender-specific variations in visual recall performance to enhance understanding of cognitive disparities between males and females. **Material and Methods:** Eighty healthy participants (40 males and 40 females), aged 18 to 24 years, were recruited for this observational study at the Research Lab, Department of Physiology, NIMS&R, Jaipur. The study used the Auditory Word Memory (AWM) test as the primary assessment tool. Participants viewed slides with word stimuli and recalled them after a delay. Data were analyzed using an independent samples unpaired t-test. **Result:** Significant gender differences were found in visual memory ($p = 0.0128$), with males averaging 5.6 and females 4.95 recalled items. This indicates males outperformed females in visual memory tasks. **Conclusion:** Our study reveals significant gender disparities in visual memory recall, suggesting males have advantages over females in such tasks. These findings contribute to understanding cognitive differences between genders in visual memory performance.

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INTRODUCTION

The study of cognitive processes, particularly how they vary across genders, has long intrigued researchers in neuroscience. Among these processes, visual memory plays a crucial role in daily functioning, influencing tasks ranging from basic visual recognition to complex spatial navigation and learning¹. Visual memory involves the ability to encode, store, and retrieve visual information, which is fundamental to activities such as reading, driving, and interpreting facial expressions^{2,3}. Research into the neurocognitive aspects of visual memory has uncovered various factors that influence memory performance, including age, education level, and cognitive strategies^{4,5}. However, gender differences in visual memory remain a topic of ongoing investigation and debate. Previous studies have suggested that biological and hormonal factors, along with differences in brain structure and function, may contribute to variations in how men and women process and retain visual information^{6,7}. For instance, it has been documented that women tend to outperform men on certain visual memory tasks, potentially due to differences in hippocampal and

Moreover, hormonal influences such as estrogen have been implicated in enhancing neural plasticity and memory consolidation processes, which may contribute to superior visual memory abilities observed in females^{10,11}. Despite these findings, the literature presents inconsistencies regarding the extent and nature of gender differences in visual memory. While some studies report female advantages, others suggest negligible differences or even male advantages in specific visual memory tasks^{12,13}. These discrepancies underscore the need for comprehensive and methodologically rigorous investigations to elucidate the underlying mechanisms and implications of gender differences in visual memory. This study aims to address this gap by examining gender differences in visual memory performance using standardized visual memory tests among young adults with similar educational backgrounds. By comparing the visual memory abilities of male and female participants within this specific age group and controlling for cognitive variables, this research seeks to provide a clearer understanding of how gender influences visual memory processes. Such insights not only contribute to advancing scientific knowledge but also hold

implications for educational practices, cognitive therapies, and the development of gender-sensitive approaches in various domains.

MATERIALS AND METHODS

Ethical Statement: Ethical clearance for this study was obtained from the Institute Ethical Committee, NIMS Medical College, NIMS University, Jaipur. **Participants:** The participants in this observational study were 80 healthy, first-year MBBS students, aged 18 to 24 years, with an equal distribution of 40 male and 40 female subjects. The study was conducted at the Research Lab, Department of Physiology, National Institute of Medical Sciences and Research (NIMS&R), Jaipur. Written informed consent was obtained from all participants. Purposive sampling ensured an equal representation of both males and females. Inclusion criteria required participants to be cooperative, willing to provide consent, and aged between 18 and 25 years. Exclusion criteria included conditions that could potentially impact cognitive function, such as neurological disorders, history of head injury, chronic systemic diseases, chronic pain, smoking, alcoholism, upper limb musculoskeletal disabilities¹⁴, and visual impairments affecting cognitive functions. This approach aimed to gather data from a diverse group of young adults without underlying health conditions that might confound the study's investigation into gender differences in visual memory recall. **Materials:** The study materials consisted of a memory test battery focused specifically on visual memory assessment. The visual memory subtest used in the evaluation was the Visual Word Memory Recall Test (VWM). Memory stimuli comprised 10 PowerPoint slides containing written words¹⁵.

Procedure: The 'Memory Test' employed in this study was designed to ensure neutrality and equal suitability for both male and female participants. Before commencing the tests, participants underwent thorough familiarization with the testing protocols. Each participant underwent individual testing sessions in a controlled, visually isolated research laboratory at the Department of Physiology, NIMS&R. During the visual memory test, participants were sequentially presented with visual stimuli from the subtest, each slide displayed for 3 seconds with a 3-second interval between slides. The entire presentation lasted approximately 30 seconds. Following this presentation phase, a two-minute delay ensued, during which participants engaged in light conversation unrelated to the memory task. After the delay period, participants were prompted to recall as many words as possible from the earlier presentation within a 30-second timeframe. They recorded their responses in any order on a preprinted sheet containing 10 squares. Participants then waited for 60 seconds before transitioning to the subsequent subtest.

Scoring: Each trial of the Visual Word Memory Recall Test (VWM) subtest was scored based on the number of correct responses. The correct responses in each trial were recorded to provide data for statistical analysis. The data obtained from these scores were used to compare the visual memory recall abilities between male and female participants. By following this rigorous methodology, the study aimed to ensure accurate and reliable results in examining gender differences in visual memory recall.

RESULTS

The statistical analysis aimed to compare the mean scores of two groups using an independent samples t-test for the Visual Word Recall Test. Group 1, consisting of males, had 40 participants with a mean score of 5.6. Group 2, consisting of females, had 40 participants with a mean score of 4.95 as shown in Table 1 and Pie diagram 1. The calculated t-value was 2.55, and the p-value was 0.0128. This result is significant at $p < 0.05$, indicating a statistically significant difference between the two groups shown in Table 2.

Table 1. Descriptive Statistics for Visual Word Recall Scores

Group	N	Mean Value	Sum of Squares (SS)	Variance (s^2)
1(Males)	40	5.6	47.6	1.22
2(Females)	40	4.95	53.9	1.38

Table 2. t-Test Results for Visual Word Recall Scores

Statistics	Value
t-value	2.55
p-value	0.0128
significance	Yes ($p < 0.05$)



Bar Diagram 1. Mean Scores of Visual Word Recall by Gender

DISCUSSION

The results of this study reveal significant gender differences in visual word memory recall among young adults, with males demonstrating superior performance compared to females. The independent samples t-test revealed a statistically significant difference ($t(78) = 2.55$, $p = 0.0128$), where males ($M = 5.6$) outperformed females ($M = 4.95$) on the Visual Word Recall Test. These findings are consistent with existing literature indicating a male advantage in specific visual memory tasks, particularly those involving the retrieval of visually presented information (Goldstein et al., 1999; Lewin, Wolgers, & Herlitz, 2001; McGivern et al., 1997)^{16,20,21}. Physiologically, these differences may be attributed to variations in brain structure and function between males and females. Studies using magnetic resonance imaging (MRI) have shown that males tend to have larger volumes in brain regions associated with spatial processing, such as the hippocampus and parietal cortex, which are crucial for visual memory tasks (Goldstein et al., 1999)¹⁶.

These structural differences may facilitate enhanced spatial navigation and memory retrieval processes, giving males a cognitive advantage in tasks requiring the recall of spatially organized visual stimuli, such as words presented visually. Hormonal influences, particularly testosterone, have also been implicated in shaping cognitive abilities related to visual memory. Testosterone levels have been associated with improved spatial abilities and the use of spatial strategies during memory tasks (Kimura & Hampson, 1994)¹⁸. This hormonal influence may explain why males often exhibit stronger performance in visual memory tasks that require spatial organization and recall. Cognitive strategies and processing styles further contribute to gender differences in visual memory recall. Males tend to employ more spatial and object-oriented strategies, whereas females often utilize verbal and detail-oriented approaches (Kimura & Clarke, 2002)¹⁹. These cognitive differences may stem from evolutionary adaptations where males historically engaged in activities requiring spatial navigation and hunting skills, while females focused on gathering and social interaction, emphasizing verbal and social memory skills (Silverman & Eals, 1992)²². Additional studies support the notion of a male advantage in visual memory tasks. For example, research by Voyer et al. (2007)²³ in a meta-analysis found consistent evidence that men perform better than women in specific types of visual memory tasks, including those involving object location and spatial memory. Similarly, a study by Hausmann et al. (2000)¹⁷ reported that males outperformed females in tasks requiring the mental rotation of objects, which also involves spatial visualization skills crucial for visual memory recall. In general, this study underscores the physiological and cognitive factors contributing to gender differences in visual word memory recall. By elucidating the mechanisms behind male advantages in visual memory tasks, particularly in the recall of visually presented words, this research emphasizes the importance of considering biological and cognitive diversity in educational and cognitive intervention strategies.

CONCLUSION

In conclusion, this study highlights significant gender differences in visual word memory, emphasizing the importance of recognizing these cognitive variations. These findings underscore the need for tailored approaches in educational and cognitive interventions to accommodate diverse gender-specific cognitive profiles

Limitations

Limitation of this study is the relatively small and homogenous sample size, which consisted solely of first-year MBBS students from a single institution, potentially limiting the generalizability of the findings to broader populations. Additionally, the use of a single assessment tool for visual memory may not fully capture the complexity and variability of visual memory processes across different contexts and tasks

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All authors contributed significantly to the study. Abid Manzoor conceptualized and designed the study, oversaw data collection, and drafted the manuscript. Adil Abbass and Sadaf Iqbal assisted with data analysis and interpretation, and critically revised the manuscript for important intellectual

content. Tarun Raikwar and B. Jahnavi contributed to the methodology, conducted the literature review, and helped in manuscript preparation. Heera Lal Kumawat did the final formatting. All authors reviewed and approved the final manuscript

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