Do you Recall? An Experimental Study on Memory Recall Differences in Males and Females

ABSTRACT

Short-term memory recall is a crucial component of cognitive performance, influencing various aspects of information processing. This study delves into exploring short-term memory recall within the context of gender differences in cognitive performance. Existing research has identified differences in free memory recall between males and females, suggesting our hypothesis that women has better performance in free memory recall than men in terms of non-gender specific stimuli. To investigate this, we recruited a sample of 18 college students (9 males, 9 females). Using independent-sample t-test for analysis, we noticed a subtle difference for females and males in free memory recall. However, despite this marginal difference, statistical analysis indicated no significant disparity between male and female participants. This study contributes valuable insights to our understanding of gender-related patterns in short-term memory recall.

INTRODUCTION

Information and environmental events are transmitted to the brain as electrochemical signals and sent as input to the sensory neurons. Retrieving this encoded information is called memory recall. During memory recall, there is a replaying of neural activity that was originally generated in the brain during a specific event [3]. It is not simply a process of pulling out things from memory storage, but a creative method where scattered and unorganized information is gathered [3]. An important part of the memory system, short-term memory, is involved in this process. It serves as a system of temporary storage, storing little data for a short while. Prior to being either forgotten or moved to long-term storage, incoming information must first be processed and manipulated in short-term memory. Memory recall is known to be of three main types, free recall, cued recall, and serial recall. Free recall is the process of retrieving information without specific cues; cued recall is the process of utilizing cues or hints to help with retrieval; and serial recall is the process of remembering items in a particular order.

The effect of gender differences on memory recall has been a debatable topic. Certain research findings state that there is no significant difference in memory recall between genders. While the gender schema theory suggests that gender stereotypes have a large impact on memory. According to this theory males and females should recall the same amount of information overall but females should recall feminine stimuli, such as grocery lists, and events associated with communal and caring themes, better than masculine stimuli, such as sheets of directions, events associated with competitive and power-oriented themes, and males should recall masculine stimuli better than feminine stimuli [1]. Another paper determines that women were more likely to score high in performance on a free recall test compared to men. It has also been shown that men have a higher level of visual episodic memory compared to women [2].

Taking inspiration from these papers, we came up with the hypothesis that 'Females perform better than males on a free recall test, particularly when exposed to non-gender specific stimuli'. Keeping our hypothesis in mind we designed our experimental study. Our experimental study consisted of a memory recall quiz that incorporated both grouped and ungrouped data from a diverse range of non-gender-specific stimuli, such as numbers, shapes, colors, audio, visuals, and letters.

METHODOLOGY

Preliminary Questionnaire

It is known that daily activities have an effect on memory recall. Other factors affecting recall are their educational background and experience with mental strategic games (Puzzles, Chess, Sudoku, etc.). To understand its influence on memory recall, we designed a survey using Google Forms to collect this information. The survey included demographic questions, including age and gender (our emphasis is on memory recall differences between males and females), activity-related questions such as playing strategy-based games, reading books, and their daily levels of physical activity. Additionally, we included factors such as color blindness, as well as physical and cognitive impairments in this survey. This questionnaire aimed to ensure consistency among the chosen participants so as to align with the study's objectives.

Participants

We recruited a group of 18 participants, evenly distributed between 9 females and 9 males as we wanted to overcome the limitation observed in [1] where participant distribution between genders showed considerable discrepancies. This was done during the questionnaire process to fit the participants in the predetermined gender groups as well as the age range of 18 to 30. The youngest participant in our experiment was 20 years old, while the oldest was 27 years old. Our objective was to maintain a targeted age group so as to eliminate the potential impact of age-related differences on memory recall [1].

Experimental Design

Our hypothesis and its subsequent null hypothesis are as follows:

H_1: The accuracy for recall in females [μ_2] is higher than the accuracy for recall in males [μ_1].

$$\mu_2 - \mu_1 \neq 0 \tag{1}$$

H_0: The mean accuracy for recall in females and males is the same.

$$\mu_2 - \mu_1 = 0 \tag{2}$$

μ_1: The mean accuracy for recall in females

μ_2: The mean accuracy for recall in males

From the hypothesis, we figured our Independent Variable (IV) to be Gender (Male and Female) and Dependent Variable (DV) to be Accuracy and Time. As we wanted to find a difference in memory recall between males and females, we used a between-subjects experimental design.

Our experiment was created as a video quiz consisting of 14 questions that had varying formats which included visual, audio, and audiovisual formats. Every question was divided into two parts, one part was a 5-second view of a grouped or ungrouped set of numbers, letters, colors, shapes, or images. Ungrouped data is where unrelated images, one of the types of questions, were evenly spaced out. While grouped images were in pairs and had a relation between them (for example, an image of the sky was placed next to that of a bird). Similarly, we added these variations for colors (cool, warm, and neutrals), letters (consecutive letters like ABC), and numbers (consecutive numbers like 13, 14, 15). The reason behind chunking the data was to follow 'Miller's Law' which explains how people can only hold seven plus or minus two items, in their short-term memory at any one time [4]. This was an additional step of our experimental study. To avoid any influence of prior knowledge, we introduced a counterbalance where the grouped and ungrouped questions for each type were spaced throughout the quiz. As the information was displayed for 5 seconds, the next screen was a question asking the participant to recall what they saw. This format was followed for each question type. We also had questions that were based on an audio and a video that was played. The audio consisted of 10 spoken words while the video where a character narrated his morning routine. The created quiz was a non gender specific stimulus for both males and females. Each participant was tested for its correctness and time taken per question.

Measures and Materials

The video quiz was 4 minutes 30 seconds long and totaled to an average of 10 minutes for the whole experiment. Two researchers were present during the experiment. The quiz was shown to the participants on a laptop which was controlled by one researcher and the timing was recorded on a mobile phone by the other. The participants were made to write down the answers on a sheet of paper.

Procedure

The participants were given access to the video quiz in their own residence in the presence of the researchers. Before beginning, the participants were asked for consent and were briefed on how to answer the questions. We then gave them access to the demographic questionnaire which they filled out and the experiment began. This study focuses on the accuracy of the recall so we asked them to make sure to answer to the best of their ability and to let us know when they were done so we could time them accurately. After the question was asked, one researcher paused the video while the second researcher started the stopwatch as the participants answered the question on their sheets of paper. Once the participants voiced their completion, the stopwatch time was recorded. After the experiment, we recorded everything that the participants did during the day before the experiment.

Data Analysis

The data was initially on paper as the participants answered the questions there. We calculated the accuracy of each answer and made entries of accuracy and time in an Excel sheet. Mean accuracy and meantime were calculated using formulas and the final sheet had 3 columns: Gender, Mean Accuracy, and Mean Time.

We imported our finalized data sheet into a data analytics tool called SPSS (Statistical Package for Social Sciences) for a detailed analysis. We used an independent two-sample t-test because we wanted to compare the means of two independent groups, i.e. Males and Females to determine if there is a statistically significant difference between them, with test variables being mean accuracy and mean time, while gender acting as the grouping variable. Another reason for using t-tests was because our data set was small and normally distributed and t-tests are useful for handling smaller data sets. This statistical approach allowed us to investigate any gender disparities in accuracy and time measures, offering a full comprehension of our data.

RESULTS

The aim of this study is to learn about the mean accuracy in males and females. Our alternate hypothesis states that females have higher recall accuracy than males. We tested our data for normality using the Quantile-Quantile (Q-Q) plot. It is a graphical tool used in statistics to assess whether a dataset follows a particular theoretical distribution, such as the normal distribution. It compares the quantiles of the observed data to the quantiles of the expected distribution. Using visual inspection, it can be seen that since the data forms a straight line, it is normally distributed.

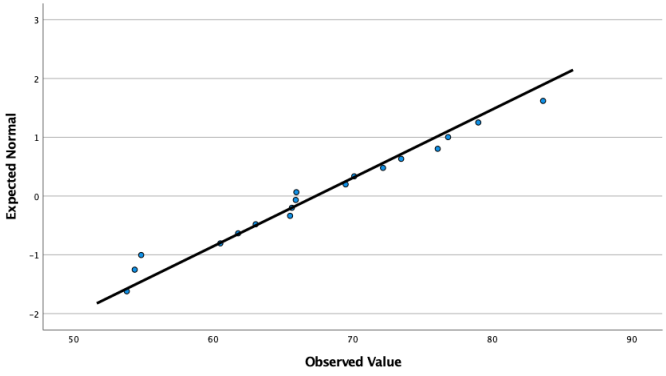

Figure 1. Normal Q-Q Plot of Accuracy Mean

	Gender	N	Mean	Std. Deviation	Std. Error Mean
AccuracyMean	Male	9	66.7969	9.83942	3.27981
	Female	9	67.8738	7.73001	2.57667
TimeMean	Male	9	13.0790	2.78965	.92988
	Female	9	13.4116	2.81058	.93686

Table 1. Mean, Standard Deviation and Standard Error for Male and Female accuracy and time

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
AccuracyMean	Equal variances assumed	.565	.463	-.258	16	.400	.800	-1.07690	4.17089	-9.91881	7.76500
	Equal variances not assumed			-.258	15.151	.400	.800	-1.07690	4.17089	-9.95924	7.80543
TimeMean	Equal variances assumed	.051	.825	-.252	16	.402	.804	-.33259	1.32000	-3.13085	2.46568
	Equal variances not assumed			-.252	15.999	.402	.804	-.33259	1.32000	-3.13087	2.46569

Table 2. Independent-Samples T-test

Interpretation

In the Independent-Samples T-test, Levene's Test was conducted to check for the assumption of equal variances for the accuracy and time mean scores among the participants. Considering the non-significant difference for both Accuracy Mean and Time Mean, the assumption seemed appropriate. The results are described below.

Accuracy Mean

As shown in Table 2, The two-tailed p-value of 0.4 and the t-value of -0.26 with a degree of freedom (df) of 15.15 indicate that there is no statistically significant difference in the mean accuracy of the male and female participants. The average difference of 0.8 shows that women outperform men in terms of accuracy on average. However, the difference is negligible and, most importantly, not statistically significant. The mean difference's 95% confidence interval contains zero and spans from -9.96 to 7.81. This suggests that there isn't a substantial difference in the two gender groups, at least not with confidence.

Time Mean

The two-sided p-value of .402 and the t-value of -.25 with a df of 16 show that there is no statistically significant difference in the mean time taken by male and female participants as displayed in Table 2. Males appear to have a little numerical margin in time, as indicated by the mean difference of -.33, although this difference is not statistically significant. The mean difference's 95% confidence interval is between -3.13 and 2.47, including zero. This suggests that there is not enough data to conclude that there is a significant gender difference in the amount of time needed to complete the job. The findings imply that gender does not significantly affect how long it takes to complete the activity in the test.

Data Specific

We calculated the mean accuracy for each question type to learn about how different types of data (visuals, numbers, shapes, letters, audio) are perceived by the participants and how easily they are recalled. A summary of the mean accuracy for these questions and a comparison between males and females is shown in Table 3.

Question type	Male Accuracy (%)	Female Accuracy (%)
Images(Ungrouped)	59.9	62.5
Images(Grouped)	63.1	57.5
Numbers(Ungrouped)	49	45.34
Number(Grouped)	77.2	79.16
Colors(Ungrouped)	67.23	70.5
Colors(Grouped)	77.8	83
Letters(Ungrouped)	87.7	87.76
Letters(Grouped)	82.8	77.5
Shapes	83.4	87.13
Audio	65.7	65
Audio-Visual 1	89.94	100
Audio-Visual 2	94.7	100
Visual 1	26.3	30
Visual 2	21	10

Table 3. Accuracy Mean for Male and Female wrt each question

DISCUSSION

Apart from the accuracy and the time taken, we have collected some qualitative data demonstrating the difference in recall between participants. Although the stimulus was non-gender specific, we noticed varying degrees of recall and behaviors between the males and females.

Learning

Some participants did not understand the concept at first but after the first question, they started memorizing the answers as they understood what the next questions would be like. By

doing this, they started doing better with the answers and their accuracy improved. In our study, one male participant's accuracy for Q1(ungrouped images) was 25% and his accuracy for Q6 (ungrouped numbers) was 82.8%.

Pattern Recognition

The participants who had a background in IT recognized the patterns of the data presented and found a way to remember less and fill up the answers according to the patterns. The participants voiced that it started becoming easier when they found the patterns of the grouped questions. One of our grouped questions was "IJK TUV ABC FGH". One of our participants who was studying computer science recognized the pattern and just remembered the first letter of each group. Their accuracy for this question was 100%.

Visualization

After analyzing the answer sheets, it was noticed that the female participants answered the questions in the format that was presented on screen. If the images were two rows of four, the participant named the images in two rows of four, even though the question did not state that it was necessary to do it in order. We had a question that presented seven shapes, one participant answered the question by drawing the shapes instead of writing the names of the shapes.

Behaviors

Another observation was the difference in the behavior of males and females while writing the answers. The females seemed more adamant in getting all the answers and hence took more time while the males did not worry much about getting all the answers, they just wrote down what they remembered and they were done.

Time of the Day

Before taking the experiment, we asked the participant about their day and mental state at that time. We observed that the participants who had assignments and academics to focus on did not recall as good as others who were more stress-free. One participant who took the quiz at 10:17 AM had a mean accuracy of 65.6% whereas another participant who took the quiz at 9:22 PM had a mean accuracy of 53.7%.

Audio and Visuals

We had one audiovisual question which was a video of a morning routine with narration. There were four questions based on this video. Some were based on the narration and some were based on the visual components of the video. For the questions based on narration, 88.8% of the participants got the answer right. For the questions based on visual components only 27.8% of the participants got the answer right.

LIMITATIONS AND FUTURE WORK

In this experimental study, the limitation was the small sample size, a larger sample size would give us a wider and varying demographics when it comes to the participants' habits of physical and mental activity and how it affects recall. We also did not consider people with visual or auditory disabilities which might significantly affect the results we found in this study. Another limitation was the concentrated group of students. Conducting a study with different age groups might give us more accurate results between males and females. The stimulus we used in this study was limited to visual and auditory stimuli, while the future work could include a study that includes various other stimuli such as olfactory (smell), tactile (touch), emotional (emotions and feelings), temporal (time-related cues) etc as memory recall can be influenced by any kind of stimulus.

CONCLUSION

According to Frenando [4], women were more likely to score high in performance in a free recall test compared to men. Our study concluded that this is not the case. The result of the experiment and the results of our independent t-tests failed to reject the null hypothesis and did not support our alternate hypotheses test suggesting that there is no significant difference between males and females in a non-gender-specific recall. Although there were behavioral differences and different approaches followed by our participants as individuals the outcome of accuracy and time taken on an average between males and females balanced out. While some females cared about accuracy a lot, others took a lot of time to recall even the shortest answers. A similar case applied to some of the males as well.

Our participants were able to use their long-term memory to recognize patterns and their experiences as students to recall the necessary information to complete the experiment to the best of their ability. Experience is a crucial factor when it comes to cognitive memory because it is easier to remember information that already has meaning. This information is recalled based on previous experiences and facilitates the use of constructive strategies and repetition in real-life scenarios.

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