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## Examining the Sex and Modality Differences in Divided Attention Tasks: A Case Study of Students in Bolgatanga Technical University

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### Keywords

*Divided Attention,  
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### ABSTRACT

This study looks at gender variations in performance among bolgatanga technical university students as well as the impact of divided attention and task mode on word recall. The study examines how single-task and dual-task situations affect recall across several modalities, drawing on theories of attention and memory. A control group (single-task condition) and two experimental groups (dual-task conditions including auditory and reading tasks) were randomly selected from a sample of 150 level 300 students. The correctly recalled words were counted and used to gauge the participants' performance on a word recall task. Recall ability under single-task settings was considerably higher than under dual-task conditions, according to one-way anova results, indicating the harmful impact of divided attention on memory encoding. Additionally, modality variations were noted, indicating different cognitive load across modalities, with the reading-based dual task resulting in a larger performance loss than the auditory test. The recall ratings of male participants were rather higher than those of female participants, although these differences were not always statistically significant. The results highlight how multitasking affects memory performance and support ideas of split attention and cognitive stress. The work offers implications for enhancing learning processes in academic contexts and advances our understanding of how gender and modality interact in attention-demanding tasks.

### INTRODUCTION

When people try to complete two or more things at once, they are engaging in multitasking, also known as divided attention. Students often participate in multitasking behaviours in educational environments, such as listening to audio content while reading or studying, and processing extra information. Therefore, increasing learning outcomes requires an understanding of how divided attention impacts cognitive function.

According to cognitive theories, dividing attention among tasks might hinder memory's encoding and retrieval processes since attention is a finite resource. Specifically, when activities compete for shared cognitive resources, particularly when they include similar processing modalities (e.g., auditory-auditory or visual-visual tasks), performance deteriorates, according to dual-task interference theory.

Furthermore, the results of earlier studies on gender differences in cognitive tasks have been inconsistent (Lui & Wong, 2012). While some research suggests that women do better on verbal memory tests, other studies find negligible or context-dependent differences. These discrepancies show that more empirical research is necessary.

Previous research has explored how college students manage distractions and media multitasking during extended independent study periods. For example, Calderwood *et al.* (2014) monitored participants in a 3-hour solitary homework session using three increasingly intrusive recording methods: remote surveillance cameras, a head-mounted point-of-view camera, and a

mobile eye-tracker. The researchers found no differences in multitasking behaviour across the three recording techniques. On average, students listened to music for 73 minutes, encountered 35 distractions lasting at least 6 seconds (totalling roughly 25 minutes), and showed clear links between psychological factors and multitasking: higher homework motivation and concentration self-efficacy predicted fewer and shorter interruptions, whereas elevated negative affect was associated with longer distraction episodes.

This study addresses these gaps by examining how divided attention and task modality (auditory versus reading-based tasks) influence word recall, and whether these effects differ by gender among university students.

### LITERATURE REVIEW

Source monitoring, the ability to remember the context in which information was acquired, requires active attentional resources (Troyer *et al.*, 1999). Consequently, controlled (conscious) memory processes are highly sensitive to attentional demands, whereas automatic processes are largely unaffected (Wallace, 2001). This distinction is critical because the proper focus of memory research is conscious experience (Davison & Neale, 2004). Divided attention during the encoding of information has consistently been shown to impair recall performance. Craik *et al.*'s (2000) research showed that divided attention during the encoding of information resulted in a greater effect on memory performance than divided attention during the retrieval of information. There are also conditions where the performance of the secondary

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task has been seen to facilitate memory, particularly in situations where the participants are given explicit instructions to perform the memory task (Murdock *et al.*, 1965). This has been explained as the effect of priming, where the participants are able to retrieve the information because of the related concepts (Tulving & Schacter, 1990).

Another prominent alternative approach is the levels of processing theory, proposed by Craik and Lockhart (1972). This theory suggests that the long-lasting nature of memory can be explained by the degree of processing: superficial, or sensory, processing results in transient information, which can be forgotten quickly, while deeper, or semantic, processing results in long-lasting information.

Gender differences have also been noted in episodic memory. Females have been observed to have better performance than males in recall and recognition of verbal information, episodic information, and even eyewitness memory (Yarmey, 1991). The female advantage has not been observed in working memory and semantic memory tasks, indicating that the female advantage may be attention-specific.

Despite extensive research on attention, modality, and gender in isolation, few studies have examined their combined effects on word recall in young adults under controlled single- versus dual-task conditions. The present study, therefore, addresses this gap by testing Level-300 undergraduates at Bolgatanga Technical University.

### General objectives

- To examine single and dual task effects within and across modality
- To examine gender differences in dual tasks

### Research questions

- What are the single and dual task effects within and across modality?
- What are the gender differences in dual tasks

### Statement of hypotheses

- Null: Recall of words under single task conditions will be significantly different from under dual task conditions
- Alternate: Recall of words under single task conditions will not be significantly different from under dual task conditions
- Null: There will be a significant difference between male and female (gender difference) in the recall of words
- Alternate: There will not be a significant difference between male and female (gender difference) in the recall of words

### Operational definitions of terms

- Divided attention is an intentional effort to be aware of two or more items simultaneously
- Encoding is the process of putting data into our memory
- Retrieval is how the data is accessed, by using associated clues

## MATERIALS AND METHODS

### Population

The population of Level 300 students pursuing various programmes was sampled systematically for the study.

### Sample

A systematic sampling technique was initially used to select participants for the study, and was finally randomly assigned to each of the three groups. Each group comprises 50 participants, making a total sample size of 150 participants, including both sexes.

### Equipment/materials/measures

Two sets of word lists, namely 50 study and 75 recall lists, were used for the study. Reading Equipment used included a projector, a laptop, a response sheet, pens and tape recorders. Fluency and listening comprehension exercises were also used as an extra task for the study.

### Design and Procedure

One hundred and fifty Level-300 undergraduates were systematically sampled and randomly assigned to one of three between-subjects conditions ( $n = 50$  per group): a single-task control group (CG) and two dual-task experimental groups (EG1 and EG2). All participants first studied a list of 50 concrete nouns (study list) presented auditorily at a rate of one word per second via audio recording. Immediately afterwards, a 75-word recognition list (containing the original 50 study words plus 25 new distractors) was played, and participants wrote down every word they recognised as having appeared in the study list.

In the single-task control condition (CG), participants performed only the study–recognition task. In the auditory dual-task condition (EG1), participants completed the same memory task while simultaneously listening to a recorded conversation and answering 10 multiple-choice comprehension questions about the conversation immediately after the recognition phase. In the reading dual-task condition (EG2), participants performed the memory task while simultaneously completing a reading-fluency task (silent reading of a 300-word passage with comprehension probes). All sessions were conducted individually in a quiet laboratory setting, and instructions emphasised equal attention to both tasks in the dual-task conditions.

### Scoring of data

The score for each participant was based on the number of correctly recalled words, with the maximum possible score of 25.

## RESULTS AND DISCUSSION

### Hypothesis 1

The means and standard deviations for the three groups were computed, and the values obtained are shown in Table 1.

The mean performance of the Control Group (CG) was 14.06 with a standard deviation (SD) of 4.05. The

**Table 1:** Means and Standard Deviations of the three groups in performance

Type of condition	N	Mean	Std. Deviation
CG	50	14.06	4.05
EG1	50	11.36	3.55
EG2	50	7.52	3.94
Total	150	32.88	11.54

Significant level:  $p < 0.05$

Source: Survey data, 2020

Experimental Group (EG1) had a mean performance of 11.36 (SD= 3.55), and the Experimental Group 2 (EG2) also had a mean performance of 7.52 (SD= 3.94). The CG under the single task condition had the highest recall

performance, and the lowest performance was EG2. According to Table 2, there is a significant difference among at least two of the three groups in terms of their recalled performance ( $F(3,147) = 36.337, p < 0.05$ ).

**Table 2:** One-way ANOVA of the three groups in performance

	DF	Sum of squares	Mean square	Variance	F probability
Between groups	2	1080.120	540.060	36.337	.000
Among groups	147	2184.820	14.863		
Total	149	3264.940			

Significant level:  $p < 0.05$

Source: Survey data, 2020

The significant difference is not due to chance alone. Therefore, the null hypothesis is rejected. The LSD (Least Significant Difference) value (1.52) is therefore used to

find out which of the three groups differ in performance, as shown in Table 3. The CG was statistically ( $p < 0.05$ ) higher than both EG1 and EG2 in recall performance.

**Table 3:** Comparison of the three groups and their performance using LSD (Least Significant Difference)

Group	CG	EG1	EG2
CG	-	2.7*	6.54*
EG1		-	3.84*
EG2			-

Significant level:  $p < 0.05$

Source: Survey data, 2020

Also the performance EG1 was significantly ( $p < 0.05$ ) different from the EG2

performance in recall of words.

CGM = CG Male, CGF = CG Female, EGM1 = EG1 Male, EGF1 = EG1 Female, EGM2 = EG2 Male, EGM2 = EG2 Male and EGF2 = EG2 Female. The highest

**Hypothesis 2**

The mean and standard deviation of the gender

**Table 4:** Mean and Standard deviation of gender performance in recall of words

Group	N	Mean	Std. Deviation
CGM	26	15.12	3.73
CGF	24	12.92	4.15
EGM1	33	11.00	3.61
EGF1	17	12.06	3.42
EGM2	25	7.92	4.17
EGF2	25	7.12	3.75
Total	150	66.14	22.83

Significant level:  $p < 0.05$

Source: Survey data, 2020

mean performance was CGM (15.12) with a standard deviation of 3.73, and the EGF2 recorded the least mean performance (7.12) with a standard deviation of 3.75.

Table 5 indicates that there is a significant difference among at least two of the groups in performance ( $F(5,144)$

**Table 5:** One-way ANOVA of gender difference groups in performance

	DF	Sum of squares	Mean square	Variance	F probability
Between groups	5	1161.03	232.21	15.89	.000
Among groups	144	2103.91	14.61		
Total	149	3264.94			

Significant level:  $p < 0.05$   
 Source: Survey data, 2020

=15.89,  $p < 0.05$ ).

Means of the same subscript letter = no significant difference, and means differ by 1 subscript letter =

**Table 6:** Multiple comparisons of the four groups and their performance using LSD (Least Significant Difference)

Groups	Means
CGM	15.12a
CGF	12.92bc
EGM1	11.00c
EGF1	12.06c
EGM2	7.92de
EGF2	7.12e

Significant level:  $p < 0.05$   
 Source: Survey data, 2020

significant difference.

The LSD value (2.17) is therefore used to find which of the groups differ in performance, as in Table 6. CGM is statistically higher than all the other groups in terms of recall performance. CGF, EGMI and EGFI are statistically the same, and also EGM2 and EGF2 are statistically the same.

**CONCLUSIONS**

This study demonstrates that split attention dramatically lowers word recall performance, with single-task settings producing better results than dual-task situations. Furthermore, tasks involving similar cognitive processes may result in higher interference and cognitive burden, according to modality differences. Although gender disparities were noted, they were not persistent enough to make firm judgments.

Overall, the results give empirical support for attention-based theories of memory and emphasise the significance of reducing multitasking in learning situations. Future research should improve task design and look more closely at how modality, cognitive load, and individual characteristics interact.

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