

# Exploring the Role of Dm ERP Effect: Memory Encoding Amidst Stress, Sleep Disturbances, Anxiety, and Impulsiveness

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## Introduction

**Working memory (WM)** is a critical part of memory because it controls both the intentional encoding and retrieval of information (Baddeley, 1992). Working memory is also sensitive to changes in arousal, daily hassles and fatigue that we encounter throughout the day.

In a prior experiment (Kaseya & Lawson, 2022a), we examined whether **stress**, **drug use**, and **sleep disturbances** affected their word recall. Students (N = 54) studied 30 words for 5 minutes, and after a 2-minute distractor task (i.e., basic math problems), recalled as many words as possible within 5 minutes. Our results showed a **negative correlation between sleep disturbances and memory recall**. However, we did not find a correlation between drug usage, stress, and memory recall.

In a second experiment (Kaseya & Lawson, 2022b), we added **anxiety** in an online administered memory task. Our results indicated that participants with anxiety (negative) did have a higher chance of stress. Contrary to expectations, however, we did not find any association between stress, anxiety, or sleep disturbances and memory performance.

The current study continues to examine factors associated with memory recall by including measures of **stress**, **anxiety**, **impulsiveness**, and **sleep disturbances**. We also collected EEG data during the study of words since ERPs are sen. Research by Paller and colleagues (Paller et al., 1988) have shown that the late positive component of event-related potentials are sensitive to differences in items later recalled.

Event-related potentials (ERPs), such as the **Difference due to memory (Dm) effect**, offer insights into memory processes by distinguishing between correctly recalled and not recalled items. ERPs that occur within the 400-800ms latency range after the onset of a word are reliable indicators of memory performance, according to Paller et al. (1988). ERPs serve as a tool to detect how effectively participants encode words into long-term memory, allowing researchers to correlate ERP components with subsequent recall performance, thus providing insight into memory processes.

## Hypotheses

- Stress & Sleep Disturbances will be positively associated with memory.
- Anxiety & Impulsiveness will be negatively associated with memory.
- Dm ERP effect will differentiate recalled from not recalled words.
- Dm ERP effect will be related to factors that affect college students (i.e., **stress**, **sleep disturbances**, **anxiety**, and **impulsiveness**)

## Method

### Participants

College students (N = 15) enrolled at Eastern Kentucky University participated in the study. All participants gave informed consent and received course credit for their participation.

### Surveys

- Perceived Stress Scale Survey**: A 10-item questionnaire was used from Cohen & Williamson (1988) to measure the participant's **stress** depending on their thoughts and feelings during the past month.
- State-Trait Inventory for Adults** (Y-1): A 20-item questionnaire was used from Spielberg (1977) to measure the participant's **anxiety** by asking the participants about how they are feeling now.
- Pittsburgh Sleep Quality Index survey** (Watson et al., 1988): Nine questions from this survey was used from to measure **quality of sleep** over the past week.
- Urgency-Premeditation-Perseverance-Sensation Seeking-Positive Urgency** (UPPS-P): A 59-item questionnaire was used from Cyders et al. (2007) to measure the participant's factors that could lead to **impulsive behaviors**.

## Memory Task

STUDY 30  
WORDS  
(3 sec stimulus duration,  
repeated once)

2 MINUTE  
DISTRACTOR  
TASK  
(MATH PROBLEMS)

5 MINUTES TO  
RECALL

30 Words

Ready	Clear	Allow	Apple	Round	Pupil
Adapt	Pause	Offer	Light	Brick	Juice
Fault	Moral	Basis	Screw	Hotel	Paper
Occur	Lower	Labor	River	Cable	Party
Dream	Doubt	Habit	Table	Waste	Cloud

## Procedure

After agreeing to participate, participants were hooked up to the EEG system. Participant completed the surveys during the EEG hookup.

Participants were then asked to study 30 words presented on a computer screen one at a time. EEG was recorded during the study phase. After completing the study phase, participants completed a computerized distractor task involving simple math (addition/subtraction) problems.

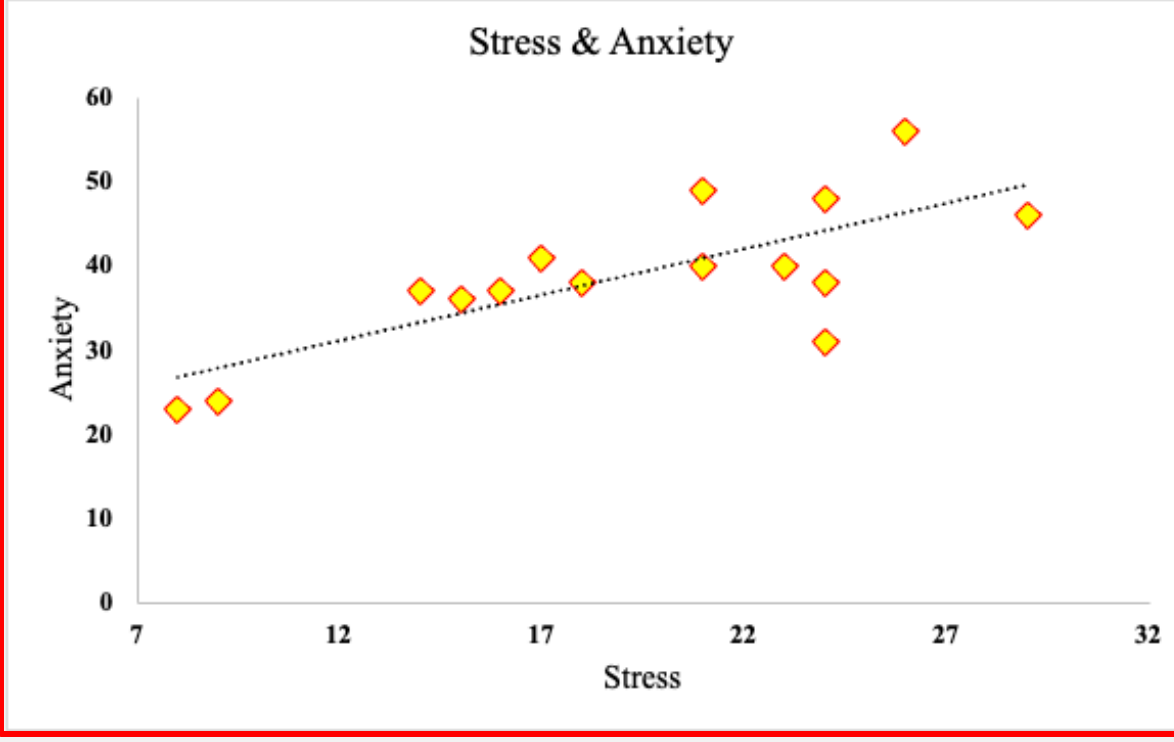
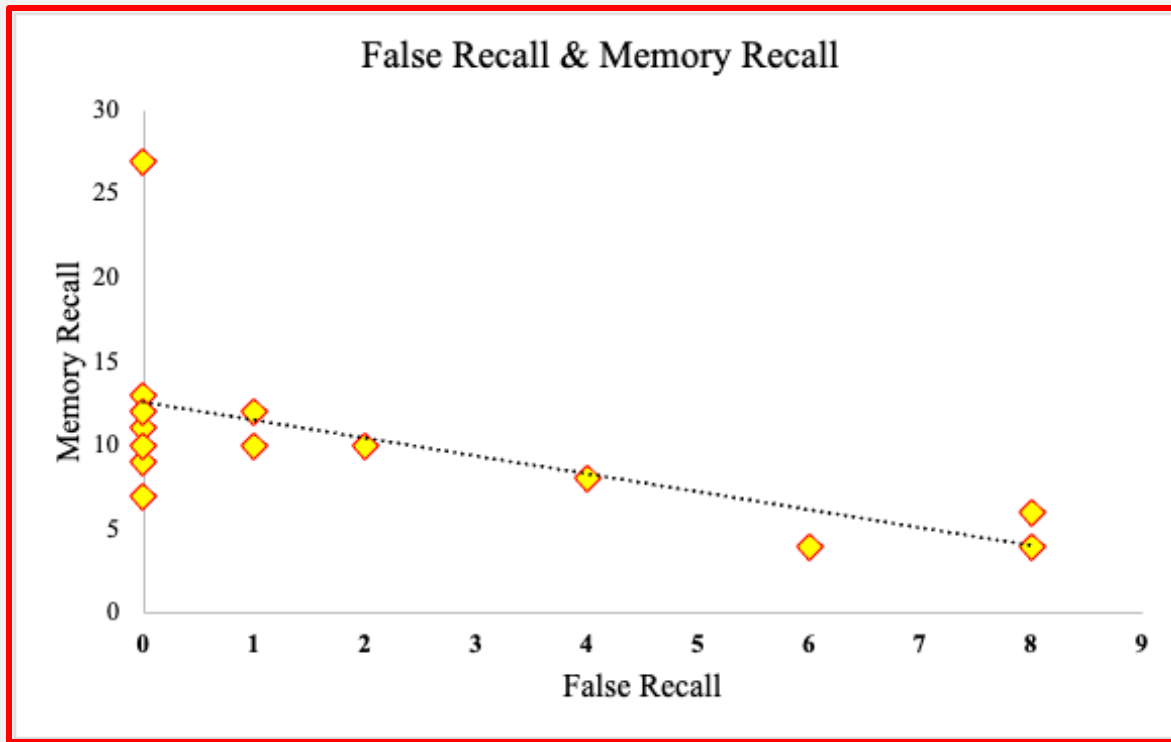
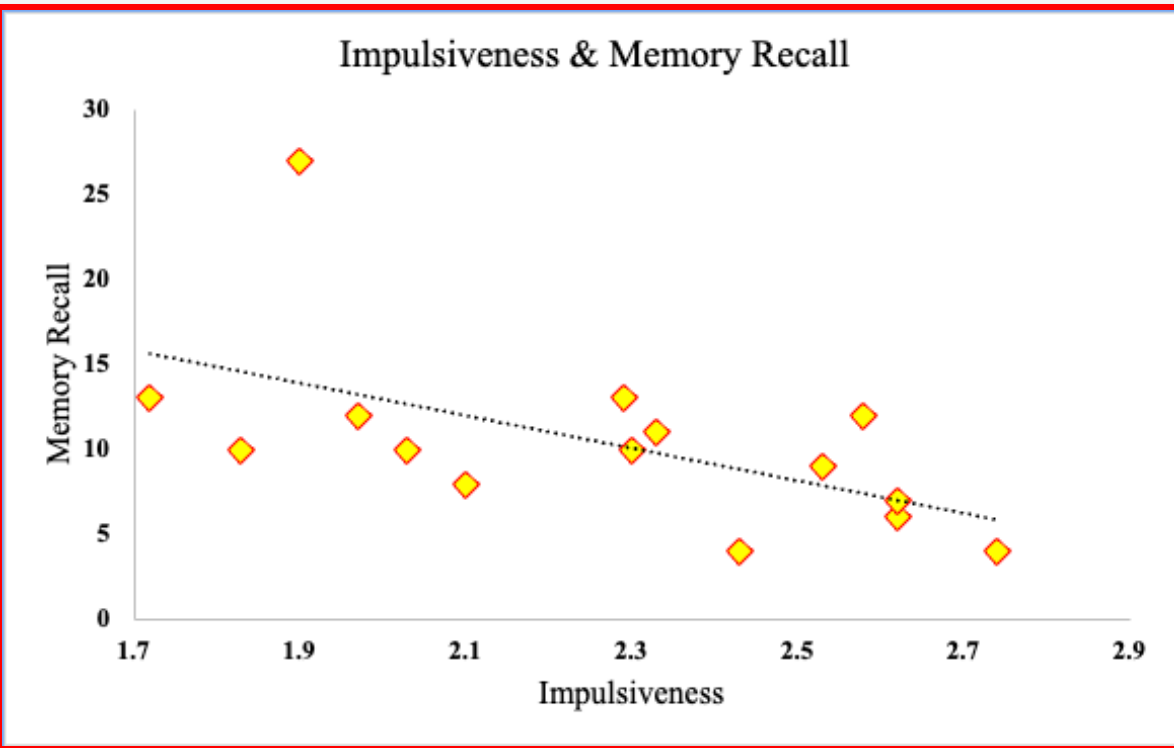
Participants were then given blank sheet of paper and asked to write down as many words from the study phase as possible. Then they were given 5 minutes to recall as many words as possible in any order.

### Data Analysis

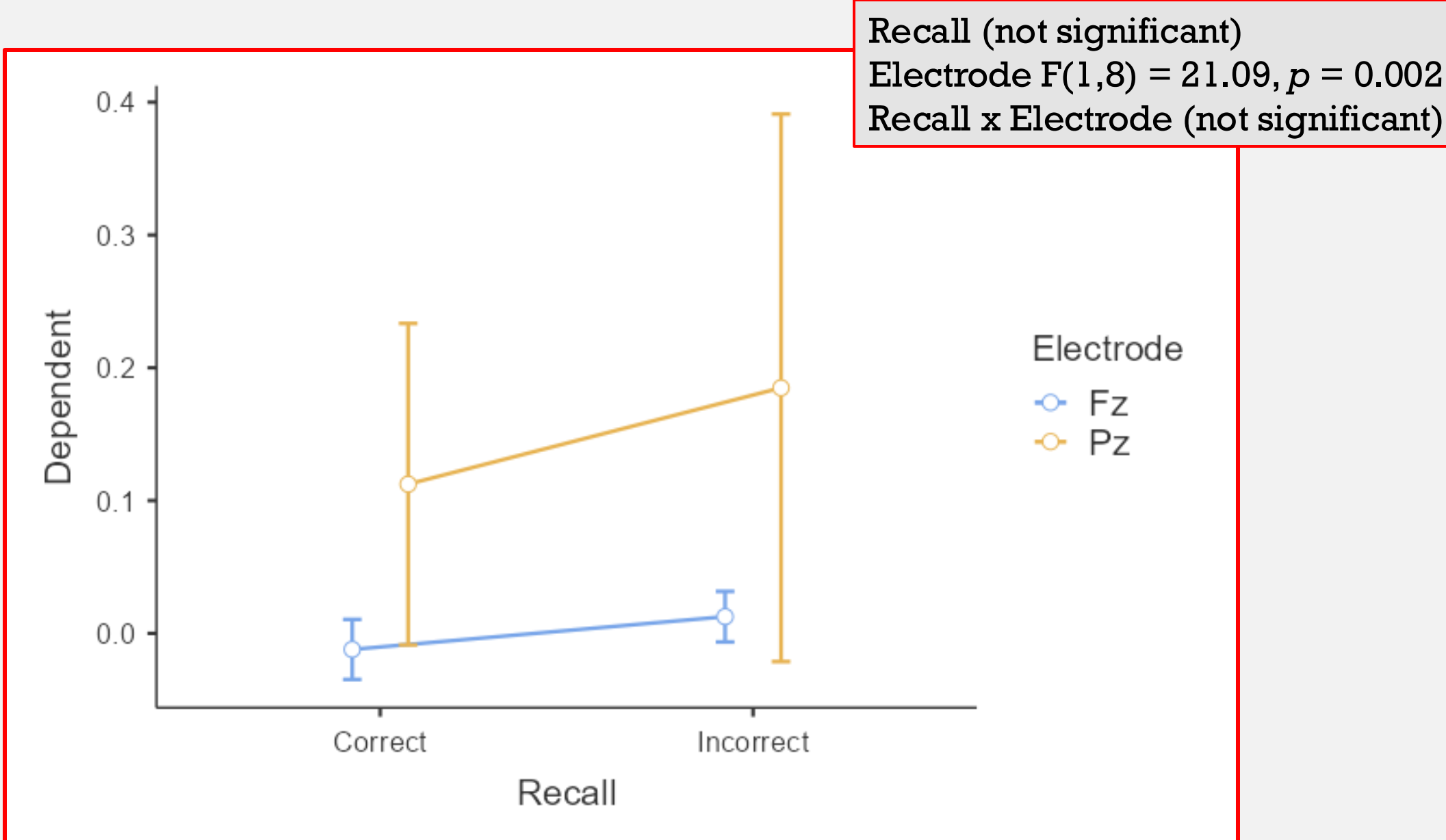
- Behavioral data consisted of survey total scores, number of words recalled and number of false words recalled.
- EEG data was collected using the BIOPAC M160 system and Acknowledge software. EEG data was analyzed using EEGLab within MATLAB (Delorme & Makeig, 2004).

## Correlational Results (n = 15)

	Stress	Sleep Disturbances	Anxiety	Impulsiveness (UPPS-P)	Memory Recall
Stress					
Sleep Disturbances	0.308				
Anxiety	0.157	-0.147			
Impulsiveness (UPPS-P)	0.335	0.081	0.045		
Memory Recall	-0.246	0.032	-0.231	-0.564	
False Recall	-0.148	0.042	-0.256	0.431	0.149



## Preliminary ERP Results (n = 10)



## Discussion

This study examined the relationship between several factors (Stress, Sleep Disturbances, Anxiety, Impulsivity) and memory recall performance. The behavioral results showed that only impulsivity significantly affected recall. As Figure 1 shows, impulsiveness was found to negatively predict recall performance ( $r = -0.564$ ,  $p = 0.029$ ), which was consistent with our hypothesis. However, the correlation between recall and anxiety did not reach conventional significance levels, which challenged our initial expectations.

It's important to note that the sample size was limited to 15 participants, and individual differences in studying techniques could affect the generalizability of the findings. Also, the use of self-reported measures and a cross-sectional design may introduce bias and limit causal inference.

Despite these limitations, this study highlights the complex interplay between psychological factors and memory processes among college students, underscoring the need for more research with larger and more diverse samples and longitudinal designs to provide more comprehensive validation of these relationships.

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