Effects of Different Pain Relievers and Dosages on Cognitive Retention

Exploratory Data Analysis (EDA)

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1 Introduction

1.1 Relevant Background

Pain can affect how well we perform everyday tasks in situations where focus and mental clarity are crucial. Aspirin, Paracetamol, and Tramadol are pain relievers used commonly to reduce physical discomfort, but we don't know much about their impacts on cognitive functions. Tasks requiring mental effort, such as recalling information, are harder to perform while in pain. This study is interested in how different types of common pain relievers at standard dosages (Aspirin, Paracetamol, and Tramadol) may affect outcomes of tasks involving memory tests. We also analyze the effects of different dosages of each drug on memory function. The concept of recalling information is used in various settings, so understanding how pain relief can impact performance can be valuable to help with pain management without an impact on productivity.

1.2 Research Questions

1. *How does the type of pain reliever (Aspirin 500 mg, Paracetamol 500 mg, Tramadol 50 mg, and Placebo) affect cognitive task performance?*
2. *How does the dosage (low vs. high) of each drug affect cognitive retention, while accounting for confounding factors like age?*

1.3 Study Design

This study involves *7 treatment groups*, with **30 participants** assigned to each. The groups are as follows:

1. Aspirin 500 mg
2. Aspirin 1000 mg
3. Paracetamol 500 mg
4. Paracetamol 1000 mg
5. Tramadol 50 mg
6. Tramadol 100 mg
7. Placebo

This results in **210 total observations** ($7 \times 30 = 210$).

1.4 Confounding Variable: Age

To reduce variability, we consider **age** as a **confounding variable**. Participants will be categorized into three groups:

1. 18–34 years
2. 35–50 years
3. 50+ years

1.5 Data Analysis Method

We will use **one-way ANOVA** to analyze the effects of pain reliever type on memory performance. and dosage levels on cognitive retention.

2 Summary Statistics

2.1 Summary of quantitative variables

Table 1 shows the summary statistics of memory game scores before and after the treatment. The mean is similar across all groups, however, the standard deviation (SD) is relatively high. The median game scores remain close to the mean, and the IQR (Interquartile Range) is smaller than the SD. The cards memory task shows little change before and after treatment, suggesting that pain relievers may not have a major effect on this specific task.

Table 1: Summary Statistics for Quantitative Variables

Statistic	Game_Before	Game_After	Cards_Before	Cards_After
Mean	62.37095	62.13476	8.128571	8.042857
Median	60.50000	61.10000	9.000000	9.000000
SD	15.73766	15.48217	1.918842	1.917702
IQR	23.07500	23.22500	3.000000	2.750000

Table 2: Summary of Drug Types

Drug	Count	Percentage
Aspirin	60	28.57
Paracetamol	60	28.57
Placebo	30	14.29
Tramadol	60	28.57

2.2 Summary of counts and percentage for qualitative variables

Table 2 shows the distribution of participants across drug types. Aspirin, Paracetamol, and Tramadol each have 60 participants (28.57%), ensuring balance. However, the Placebo group is smaller (30 participants, 14.29%).

Table 3 shows the dosage levels assigned to participants. There is an equal split between high-dose (90 participants, 50%) and low-dose (90 participants, 50%) conditions.

Table 4 provides an overview of participant locations. The distribution is relatively even across six different locations, with each site having either 30 (14.29%) or 60 (28.57%) participants.

2.3 Confounding Variable

Table 5 shows the breakdown of age groups, which is a confounding variable in this study. The three age groups: 18–34, 35–50, and 50+ each have 70 participants (33.33%).

Table 3: Summary of Dosage Levels

Dosage	Count	Percentage
High	90	50
Low	90	50

Table 4: Summary of Locations

Location	Count	Percentage
Arcadia	60	28.57
Hayarano	30	14.29
Nelson	30	14.29
Reading	30	14.29
Shinobi	30	14.29
Talu	30	14.29

Table 5: Summary of Age Groups

Age_Group	Count	Percentage
18-34	70	33.33
35-50	70	33.33
50+	70	33.33

Table 6: Mean Improvement in Game Scores by Drug

drug	Mean_Improvement	SD_Improvement	Median_Improvement
Aspirin	-1.581667	5.278723	-1.55
Paracetamol	1.713333	5.249551	1.30
Placebo	-1.086667	5.754263	-0.95
Tramadol	-0.415000	6.014836	-1.25

3 Plots

3.1 Game Score Distribution Before and After Treatment

Figure 1 shows the distribution of memory game scores before and after treatment across different drug types using box plots.

1. The median scores for all drugs appear similar before treatment.
2. **Tramadol has a higher median** than other drugs both before and after treatment.
3. The **Placebo group has a slightly lower median score** compared to other drugs.
4. There is **one outlier in the Tramadol group before treatment**.
5. The (IQR) is **similar across all drug types**.

These boxplots provide an initial comparison of cognitive performance changes before and after drug administration.

3.2 Memory Card Score Distribution Before and After Treatment

Figure 2 shows the distribution of **memory card scores before and after treatment** across drug types.

1. Before treatment, the scores are relatively high across all groups, with Paracetamol and Placebo showing slightly higher medians than the others.
2. After treatment, the distributions remain similar, though there is a slight increase in spread for Aspirin and Paracetamol.
3. Outliers are present in all groups, indicating some variability in memory card performance across individuals.

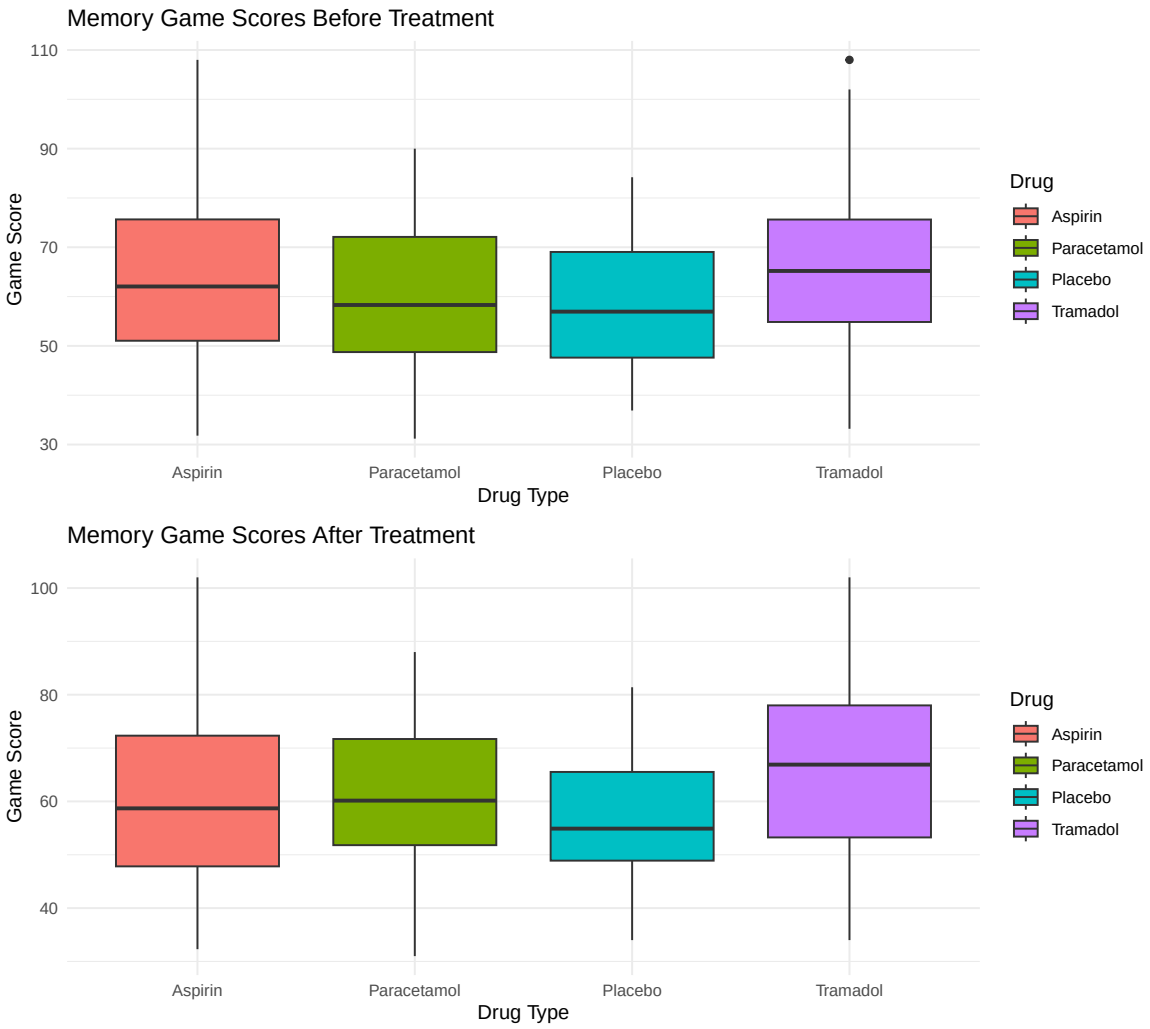

Figure 1: Boxplot of Memory Game Scores Before and After Treatment by Drug Type

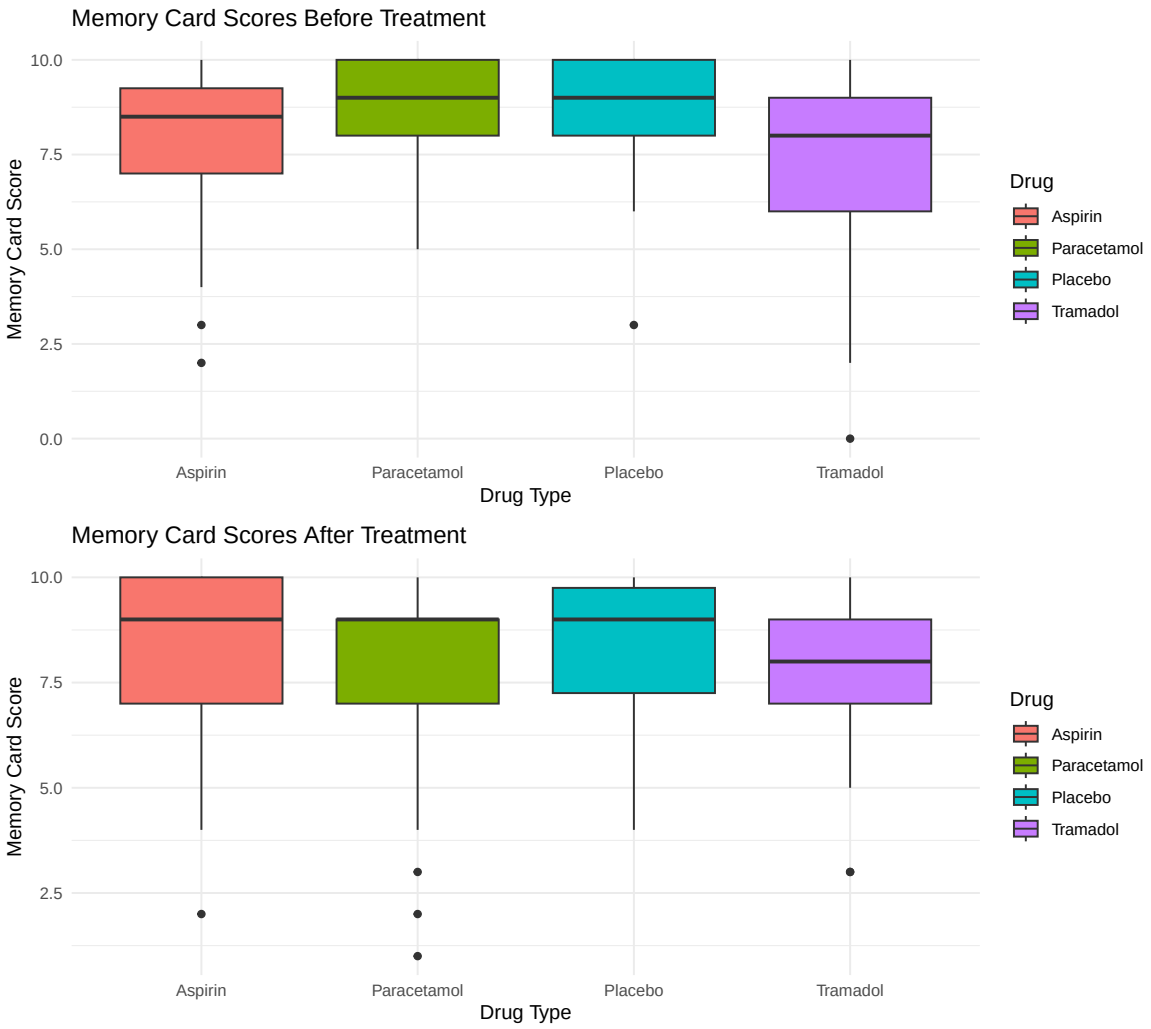

Figure 2: Boxplot of Memory Card Scores Before and After by Drug

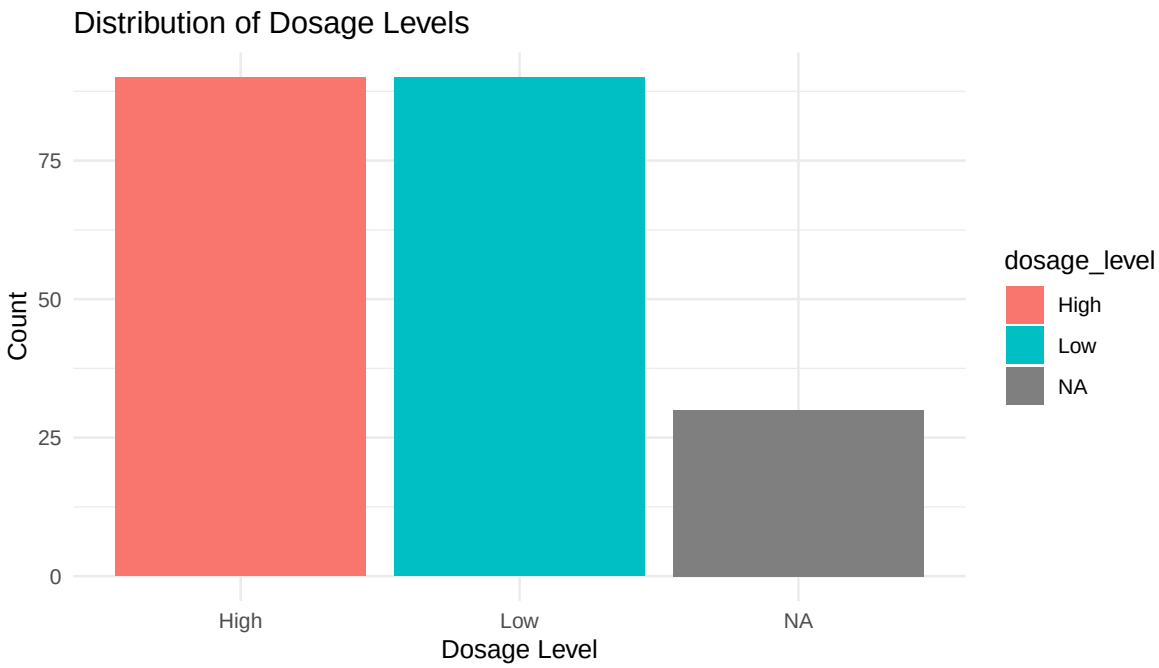

Figure 3: Distribution of Dosage Levels

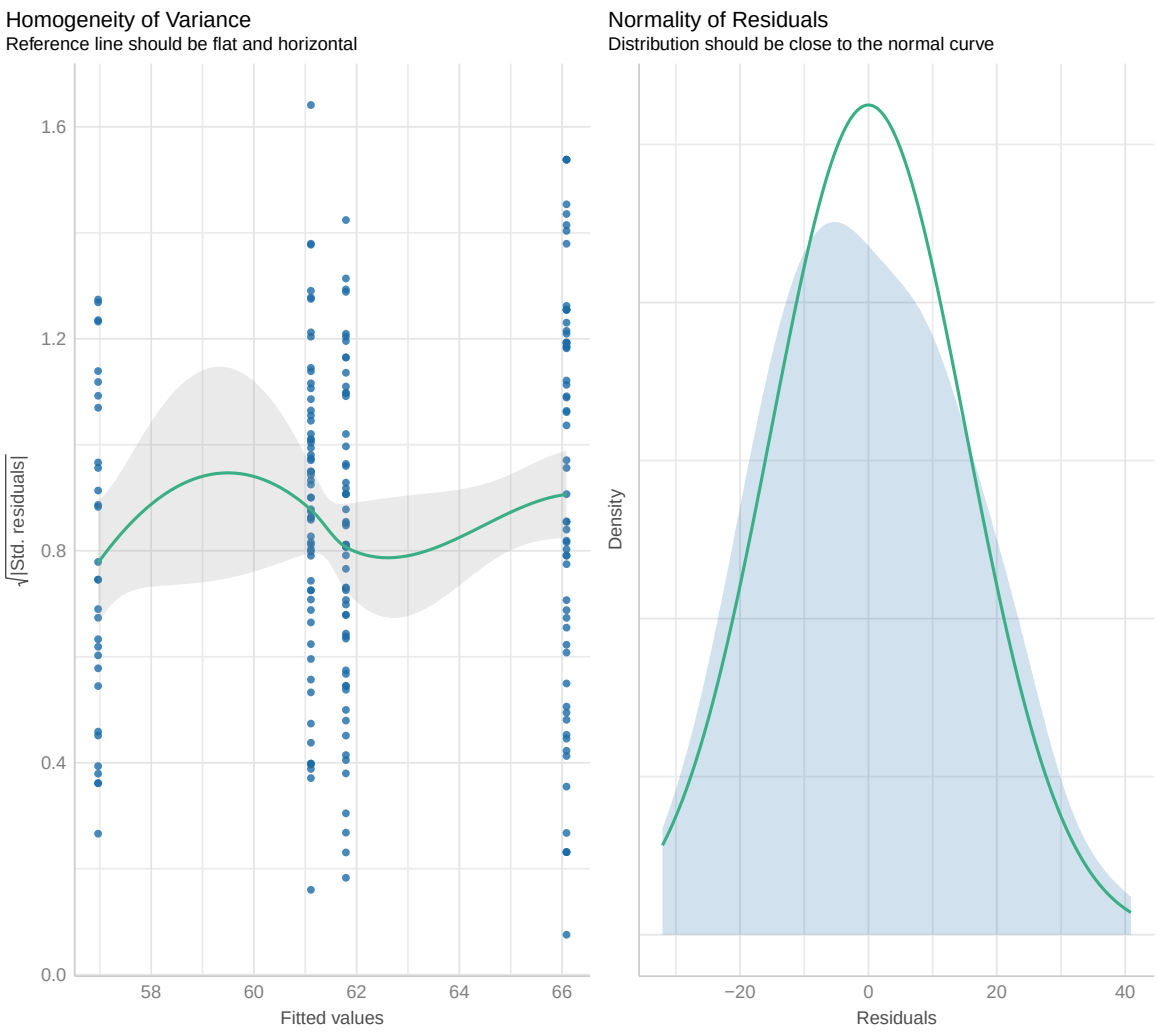

Figure 4: Assumption Check for Time taken after taking the Drug

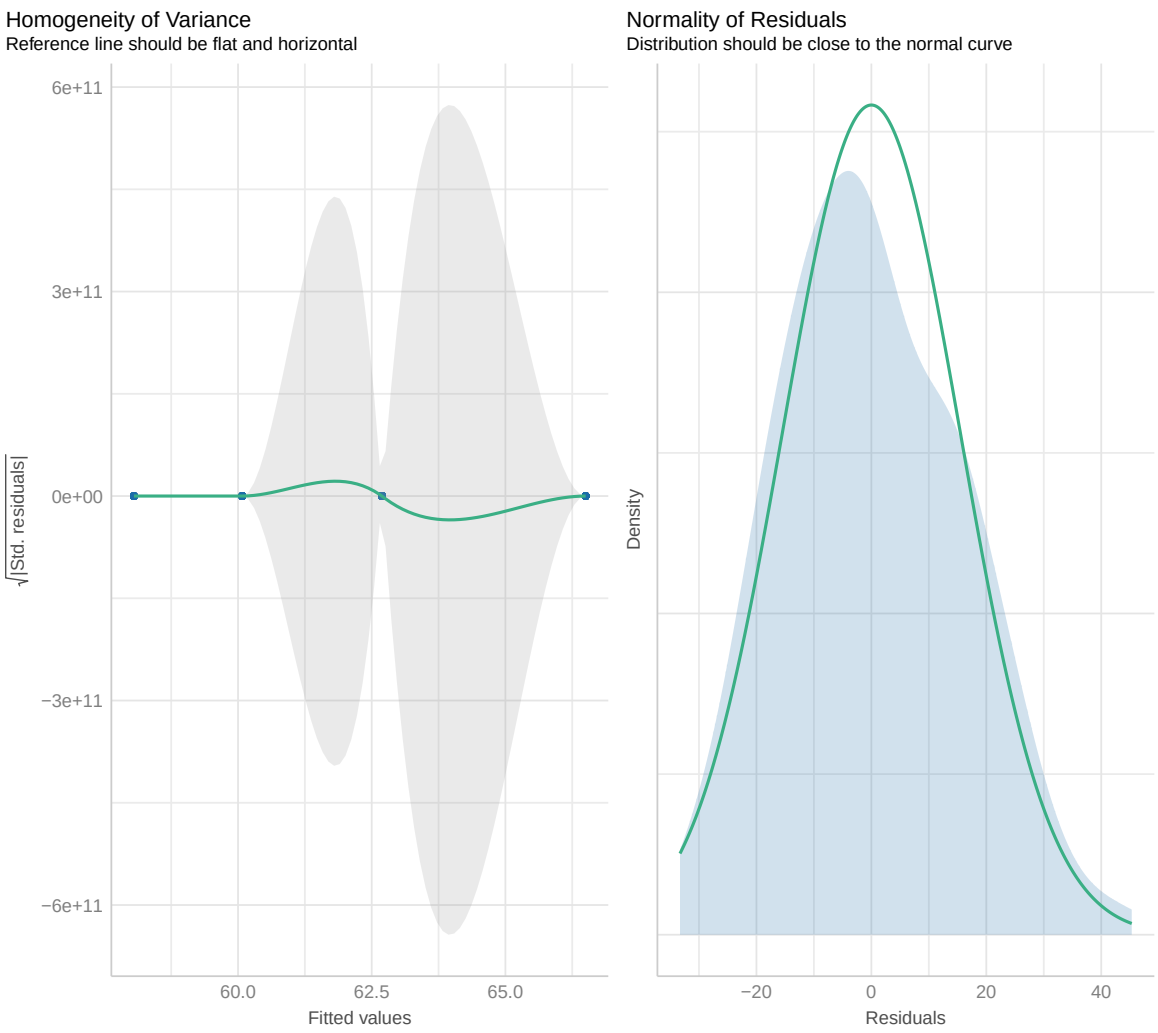

Figure 5: Assumption Check for Time taken before taking the Drug

4 References