Immediate Effects of Alcoholic Drinks on Memory

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1. Abstract

This research investigates the immediate effects of different alcoholic drinks on memory performance, specifically focusing on three beverages: Beer Regular, Guinness, and Red Wine. Utilizing a Latin Square design, the study considers age and Body Mass Index (BMI) as blocking factors to mitigate variability. Ninety participants were randomly selected from three islands and divided into age groups ([21, 31), [31, 41), and [41, 51)) and BMI categories ([0, 19.5), [19.5, 22.5), [22.5, ∞)). Memory performance was measured before and after the consumption of 250 mL of the assigned alcoholic drink. Analysis of Variance (ANOVA) was used to assess the impact of the beverages on memory scores. The findings indicate no significant difference in memory performance across the different alcoholic drinks, suggesting that the type of alcoholic beverage consumed does not differentially affect immediate memory recall.

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2. Introduction

The cognitive effects of alcohol consumption have long been a subject of research interest, with numerous studies delineating its impact across various cognitive domains, including attention, problem-solving, and executive function (Evert & Oscar-Berman, 1995). Particularly, the immediate effects of alcohol on memory—a key area of concern for public health and neuroscience—merit rigorous investigation due to their implications for daily and social functioning. This study is motivated by a desire to investigate whether the immediate cognitive effects of alcohol vary among three widely consumed types: Beer Regular, Guinness, and Red Wine. As distinctions in the immediate effects attributed to different alcoholic compositions are less understood, our research aims to fill this gap.

The choice of age and BMI as blocking factors is supported by literature indicating their influence on alcohol's cognitive effects. Studies have shown that older adults tend to be more sensitive to cognitive impairments caused by alcohol (White et al., 2023). Also, there exists an inverse correlation between BMI and consumption of alcoholic beverages (Kleiner et al., 2004), which implies that individuals with lower BMI levels might have more experience in performing tasks after consuming alcohol. This nuanced approach allows us to control for potential confounding variables effectively and to focus on the specific effects of the type of alcoholic beverage consumed.

We expect this study to clarify whether different types of alcoholic beverages—specifically Beer Regular, Guinness, and Red Wine—affect memory performance immediately after consumption in distinct ways. By doing so, we hope to inform personal consumption choices, providing clearer insights into how different alcoholic beverages might affect cognitive performance in various contexts.

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3. Design of the Experiment

Building on these insights, our study employs a 3 by 3 Latin Square design, which works with two blocking factors and one treatment factor, each divided into 3 levels. This design helps us to control for variability and focus on the treatment effects of the beverages. The two blocking factors in our study are age and BMI, categorized into three groups each. The age groups are set between [21, 31), [31, 41), and [41, 51), and the BMI groups are divided into [0, 19.5), [19.5, 22.5), and [22.5, ∞). For the BMI calculation, we use the formula weight / height^2, where weight is measured in kilograms and height is measured in meters (Weir & Jan, 2024).

To conduct the study, we selected participants from three islands, ensuring randomization by generating random numbers in R to select islands, villages, and participants. Each participant's memory performance was measured before and after consuming the assigned alcoholic drink. The memory test involved recording the time taken to memorize 30 cards, with the primary response variable being the change in memory game scores.

By utilizing Analysis of Variance (ANOVA) for our Latin Square design, we aimed to discern whether different types of alcoholic drinks significantly affect memory performance. Despite the rigorous design of the study, several limitations were encountered, including a relatively small sample size and potential non-random sampling issues.

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     Balanced one-way analysis of variance power calculation

              k = 3
              n = 10
              f = 0.1000685
      sig.level = 0.05
          power = 0.07081814

NOTE: n is number in each group


     Balanced one-way analysis of variance power calculation

              k = 3
              n = 422.2206
              f = 0.1000685
      sig.level = 0.05
          power = 0.9

NOTE: n is number in each group
```

Table 1: Power Analysis

After we collected data, we found out that the differences between groups are small, which made the power inevitably small. To obtain a power of 0.9, we need at least 423 replicates, which is impossible given the fact that the population in the three islands is limited. Instead, we only have 10 replicates in each group and our power is approximately 0.071, which would be considered as one of the limitations of our experimental design.

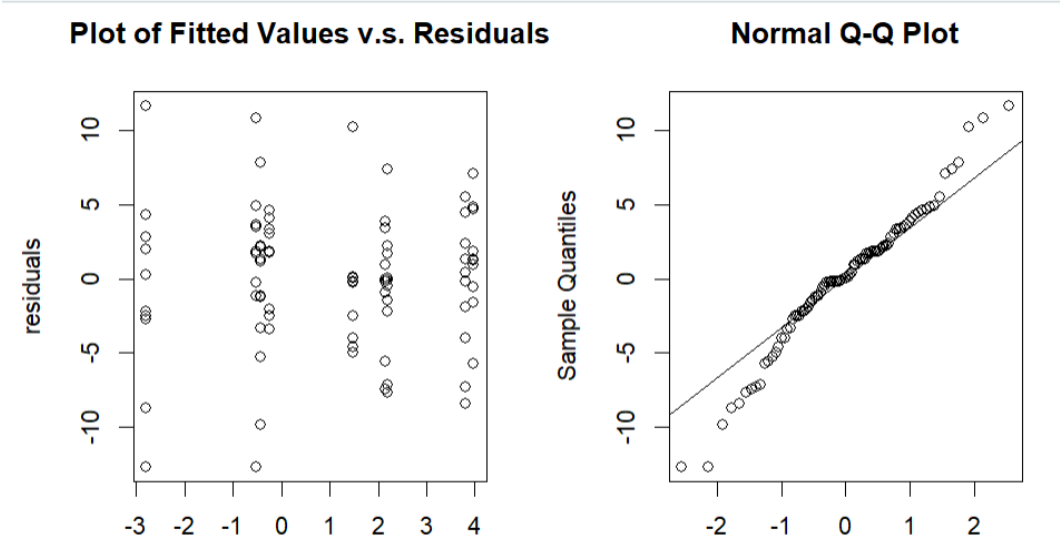
However, choosing a Latin Square design is still a good option for us because it helps us to manage variations from age and BMI, making the best use of the available resources. While the design is not perfect, it helps us to make a rough conclusion on our research question. The limitations show the need for further research with larger sample sizes and extended observation periods.

4. Results and Interpretation

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Alcohol	2	4	2	0.088	0.91577
Age	2	300.2	150.09	6.614	0.00216 **
BMI	2	95.6	47.79	2.106	0.1282
Residuals	83	1883.5	22.69		
Significance code: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1					

Table 2: ANOVA table

Since the p-value of the treatment factor (alcohol) is greater than 0.05, we fail to reject the null hypothesis. There is no sufficient evidence to conclude that there exists any significant difference between the effect of different alcoholic beverages on memory.



Plot 1: Residual Plot and Normal Q-Q Plot

As illustrated by the residual plot, the residuals scatter randomly around 0 and their variances are approximately constant. Further, since the sample quantiles are close to the theoretical quantiles, the assumption of normality is satisfied. Therefore, there is no evidence against the validity of our model.

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  Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = score ~ factor(alcohol) + factor(age) + factor(BMI))

$`factor(alcohol)`
           diff       lwr      upr     p adj
B-A  0.47666667 -2.458658 3.411991 0.9206338
C-A  0.06666667 -2.868658 3.001991 0.9983817
C-B -0.41000000 -3.345324 2.525324 0.9406346
```
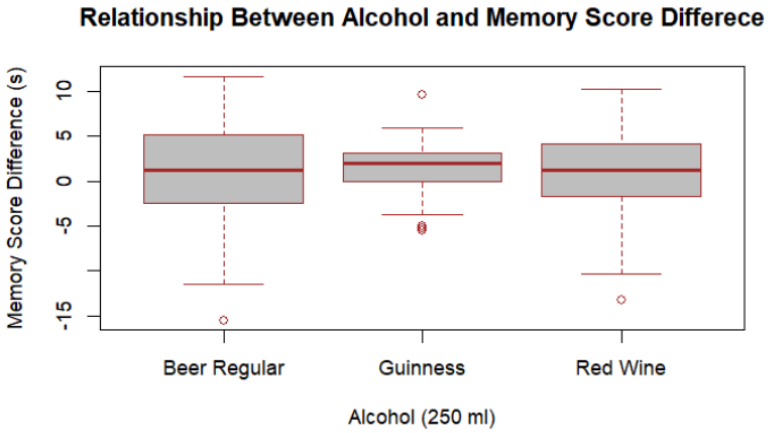

Table 3: Tukey Test



Plot 2: Boxplot

The Tukey comparisons and boxplot validate the conclusion we made by the ANOVA analysis. In this Tukey test, we use A to represent Beer Regular, B to represent Guinness, and C to represent Red Wine with 250ml each. The differences in memory score changes are not statistically significant across different alcohol types.

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5. Discussion

5.1 Limitations

Our study, while insightful, has several limitations that should be acknowledged. One primary limitation is the potential for non-random sampling. Although we attempted to ensure randomness in our sampling, practical constraints may have led to some bias, potentially affecting the generalizability of our results. Another limitation is the minimal differences between groups in terms of age and BMI, despite our efforts to control for these variables using a Latin Square design. The actual differences between these groups might be small, influencing the outcomes.

Additionally, our sample size of 90 participants may be insufficient to detect small but meaningful differences between the effects of different alcoholic beverages. Future studies should aim to include more participants to increase the statistical power of the findings. Furthermore, when more than 10 participants were available for a group, we had to randomly exclude some individuals to maintain uniform group sizes. This exclusion could introduce additional variability and affect the results.

Our study's focus on the immediate effects of alcohol consumption is another limitation. This short duration post-consumption may not capture the longer-term cognitive impacts that different alcoholic beverages might have. Moreover, factors such as individual drinking habits and tolerance to alcohol were not controlled for in our study. These variables could significantly influence memory performance and should be considered in future research.

5.2 Real World Applicability

Despite these limitations, our results have practical implications. The finding of no significant difference in the immediate effects of Beer Regular, Guinness, and Red Wine on memory performance. This result indicates that, at least in the short term, the type of alcoholic beverage may not matter as much

as we thought it would. These results make sense in the real world situation, as we found little literature arguing that there exist any differences between the immediate memory impairments caused by different alcoholic beverages. And these results could also guide public health organizations to perhaps focus less on the type of alcohol consumed and more on other factors that might influence memorization.

5.3 Summary of the Project

This study explored the immediate effects of different alcoholic beverages—Beer Regular, Guinness, and Red Wine—on memory performance. Employing a Latin Square design to account for variability due to age and Body Mass Index (BMI), we sampled 90 participants from three islands. Our analysis, using Analysis of Variance (ANOVA), revealed no significant differences in memory scores between the different types of alcoholic drinks, suggesting that the immediate cognitive effects of these beverages are comparable.

A number of limitations were identified, including a relatively small sample size and the potential for non-randomness in the sampling process. Additionally, the study's focus on short-term effects post-consumption may not fully capture the long-term cognitive impacts of alcohol. Despite these constraints, our research provides a foundation for understanding the immediate effects of different alcoholic drinks on memory.

The findings of this study suggest that further research with larger sample sizes and extended observation periods may be beneficial in comprehensively understanding the cognitive impacts of alcohol. Future studies may also consider additional factors such as drinking habits and long-term consumption patterns to provide more nuanced insights. While our results indicate no significant difference among the beverages tested, it is important to note that the broader implications of alcohol consumption on cognitive health warrant continuous investigation to inform public health policies and recommendations.

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6. Acknowledgment

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7. References

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