Alcohol Usage Not Significantly Correlated with Memory Task Performance in Adults on The Islands

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Author Contributions

BH, AJ, JY, BL, and MA - Conceptualization and planning of research
JY, AJ, BH - Design of methodologies
MA, AJ, JY, BL, and BH - Data collection and recording
JY - Annotation, management, and processing of data
JY - Statistical analysis
JY - Visualization and data presentation
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- Review and revision of final report

Introduction

Alcohol is a socially accepted and frequently consumed drug by many people around the world, despite its harmful health effects[1]. Alcohol is a known causal factor for more than 200 diseases and is implicated in 5.3% of yearly global deaths (~3 million individuals yearly). It has also been attributed to ~132 million disability-adjusted life years (DALYs), due to the burden of disease and injury caused by its overconsumption[2]. In addition to the physical damage alcohol can cause, there are also many prominent effects on brain function[1]. The adverse effects of maternal alcohol use during pregnancy on brain development in children have been extensively studied in the context of fetal alcohol syndrome[1]. Changes in brain structure and cognition in adults with alcoholism have also been widely observed in CT and MRI scans[1].

Despite scientific interest in the neurological effects of alcohol, its effects on memory is a newly emerging topic with little to no conclusive study results[3–5]. Many conflicting results have been observed, and meta-analyses of the current data demonstrate a need for more evidence[6,7]. Some studies show a positive impact of moderate alcohol consumption on cognitive function[6]. However, other studies suggest that even light drinking can lead to accelerated cognitive decline[7].

This cross-sectional observational study aims to address the question, "Is there a correlation between different levels of regular alcohol consumption and performance in memory and recall tasks?" By analyzing data from individuals with a wide range of alcohol consumption frequencies, we hope to determine whether there is an overall positive or negative correlation between alcohol consumption and memory ability. We hypothesize that alcohol consumption levels will correlate with a change in performance on memory tasks. By analyzing the relationship between alcohol consumption and memory, we aim to uncover valuable insights in various fields such as psychology, neuroscience, public health, and public policy[4,5].

Materials and Methods

Participants were sampled from the village of Arcadia on the island of Providence. Arcadia was chosen for its population size of 4339, which is larger than other villages. Sampling from a larger population allows the study to represent a greater range of individuals, improving generalizability. Since there was no feasible method of obtaining a list of all individuals to take a simple random sample, a multistage sampling strategy was employed. Random houses were selected from all houses in Arcadia, a random participant was selected from each house. Only adults at least 19 years of age were included, to ensure participants were old enough to drink.

Each house in Arcadia has a number, so Excel `=RANDBETWEEN(1, 1571)` was used to generate a list of 200 house numbers out of the 1571 total houses in Arcadia. From each selected house, the adults were numbered in order of appearance. R `sample(number of adults, 1)` was used to generate a random number out of the number of potential participants. The corresponding individual was then enrolled into the study if consent was given. Selected individuals who did not give consent were excluded from the study. Numbers corresponding to an empty house or to a duplicate individual were also removed. This resulted in a final sample size of n = 163 participants. Using a probability sampling method with random number generation allows for the minimization of potential researcher-driven selection biases which could have arose if non-probability (e.g. convenience) sampling strategies were used.

An issue with this usage of Excel random number generation is reproducibility. A new random sequence of numbers would be generated if the study was repeated, and it would be difficult to replicate and validate the results. A potential solution would be to use only R with a specific seed for random number generation. Setting a seed allows the same sequence of numbers to be generated each time. For example, 200 numbers between 1 to 1571 could be generated as house numbers using `sample(1571, 200, replace = TRUE)`. Then, since there is a variable number of adults in each household, a different range of numbers would have to be generated each time. Because there is a seed set, a single `sample()` such as `sample(3, 1)` would always return the same number. So, a list of 200 numbers between 1 and 2, 1 and 3, 1 and 4, etc. could all be generated beforehand. These lists of numbers would then be merged into a dataframe and exported as a csv for use during data collection. For each house number, the randomly generated participant number from the corresponding column would be used based on the number of adults which happen to be in that house. An example of how this may be implemented is shown below.

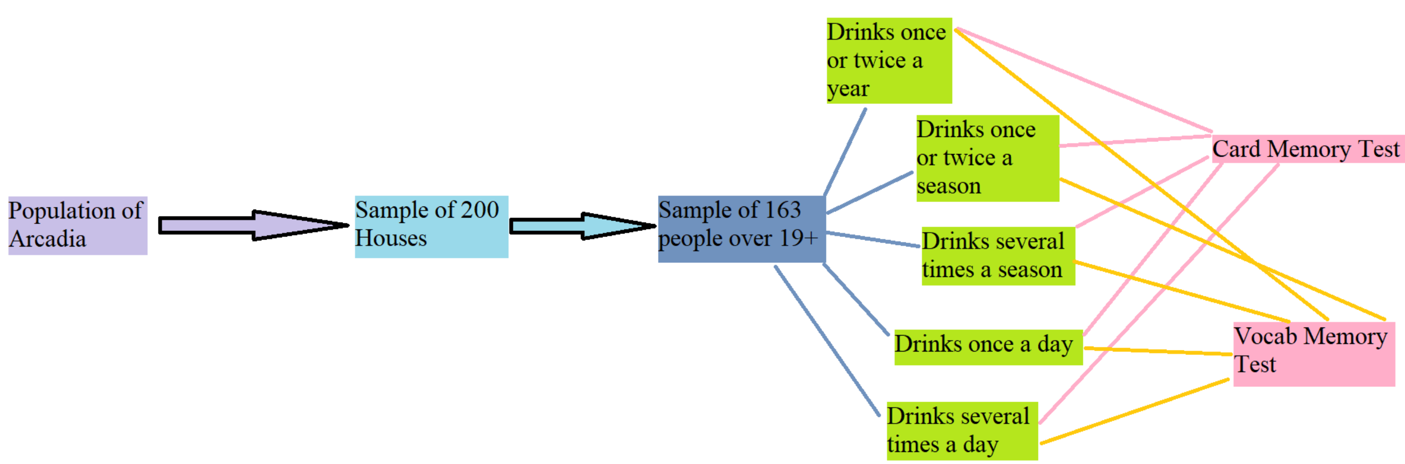
```r
# set seed for reproducibility
set.seed(2024)

# randomly sample with replacement to generate random integers in a range
houses <- sample(1571, 200, replace = T)
two <- sample(2, 200, replace = T)
three <- sample(3, 200, replace = T)
four <- sample(4, 200, replace = T)

# combine into dataframe
randoms <- data.frame(houses = houses, two = two, three = three, four = four)

# export as csv for use in Excel during data collection
write.csv(randoms, "datarand.csv")
```

After sampling was completed, all participants were first asked the question of “How often do you drink alcohol?”. The responses of each participant could consistently be grouped within one of the ordinal categories “Rarely/Once or twice a year”, “Once or twice each season”, “Several times each season”, “Once each day”, or “Couple of times each day”. Participants who did not provide consent, empty houses, or duplicates were marked with the corresponding entry of “NO CONSENT”, “EMPTY”, “DUPLICATE”, or “NONE” for alcohol consumption. The participants were then asked to take two types of memory tests: a cards test and a vocabulary test. Each participant’s results were scored out of 10 and 20 respectively. Participants were also asked “How forgetful do you feel right now?” to categorize the subjective forgetfulness of each participant. Responses fell into the ordinal categories “Not at all”, “A little”, and “Moderately”.



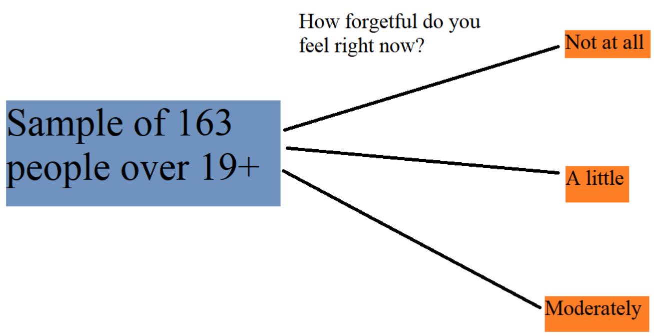


Figure 1: Sampling and measurement processes of the study.

Graphical and numerical summaries of cards test scores, vocabulary test scores, and forgetfulness by alcohol consumption were first generated to look for any overall trends and potential associations. To verify if any alcohol consumption groups significantly differed from one another, one way-ANOVA F tests and Kruskal-Wallis tests were used to detect potential differences in mean memory test scores. If a significant difference was detected in these analyses, pairwise t-tests were then used to determine which groups had significantly different means. A 5% significance level was used since there was no clear need to set a different alpha to minimize a specific type of error. To check for association between the categorical groups of alcohol consumption and self-reported forgetfulness, chi-squared tests and Monte Carlo simulation chi-squared tests were used.

Results

To make comparisons between the quantitative cards memory test scores of different alcohol consumption categories, side-by-side boxplots were used (Figure 2). Means were also added to the plots as an additional factor for comparison. This graphical summary allows for the preliminary visualization of potential associations between alcohol consumption frequency and cards memory test scores. Numerical summaries were then calculated to more precisely examine the centers and sample sizes of the groups (Table 1).

```
data %>%
  # create boxplots
  ggplot(aes(x = Alcohol_consumption, y = Cards)) +
  geom_boxplot() +
  # add means
  stat_summary(fun.y = mean, geom = "point", shape = 18, size=3, color="red", fill="red") +
  theme_light() +
  theme(axis.text.x = element_text(angle = 10, vjust = 0.5)) +
  labs(x = "Alcohol consumption frequency", y = "Cards Memory Test Score (/10)")
```

```
df <- data %>%
  group_by(Alcohol_consumption) %>%

  # calculate medians and means
  summarise("Number of participants" = n(),
            "Median Cards Score (/10)" = median(Cards),
            "Mean Cards Score (/10)" = mean(Cards)
  )

kable(df,
      caption = "Numerical summaries for Card Memory Test Score by Alcohol Consumption Frequency") %>%
  kable_styling()
```

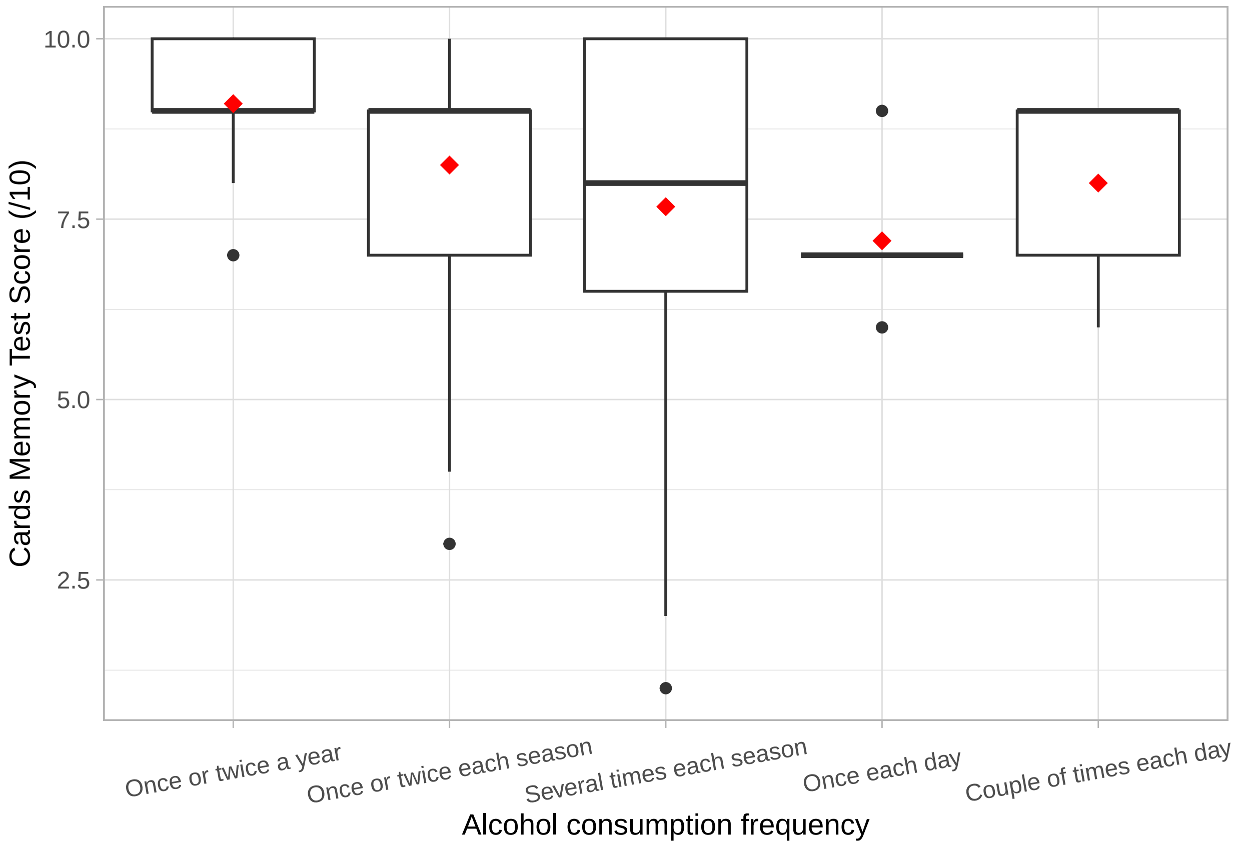


Figure 2: Side-by-side boxplots of Cards Memory Test Score by Alcohol Consumption Frequency. Means shown in red.

Table 1: Numerical summaries for Card Memory Test Score by Alcohol Consumption Frequency

Alcohol_consumption	Number of participants	Median Cards Score (/10)	Mean Cards Score (/10)
Once or twice a year	10	9	9.100000
Once or twice each season	84	9	8.250000
Several times each season	55	8	7.672727
Once each day	5	7	7.200000
Couple of times each day	9	9	8.000000

From Figure 2, there appears to be a moderate negative correlation between alcohol consumption frequency and performance on cards memory tests. The median scores appear to generally trend downwards with increasing consumption frequency, but the differences are small, ranging only between 7 and 9. The means behave similarly, with a slightly more clear trend. The *Couple of times each day* group does not appear to follow the trend, since it has both a higher median and mean compared to groups of less frequent alcohol consumption. The spread of data varies significantly between groups, potentially due to differences in sample sizes. The boxplot for the *Once each day* group appears especially unusual due to the very small sample size ($n = 5$) and presence of outliers. The numerical summary in Table 1 supports the presence of a negative association, as both the median and mean cards scores generally appear to decrease with greater consumption. However, it can also be seen from Table 1 that a large majority of participants are in the *Once or twice each season* or *Several times each season* categories. Very few participants were in any of the other categories ($n \leq 10$), making these results less reliable.

Side-by-side boxplots (Figure 3) and numerical summaries (Table 2) were also used in a similar manner for the vocabulary memory tests.

```
data %>%
  # create boxplots
  ggplot(aes(x = Alcohol_consumption, y = Vocab)) +
  geom_boxplot() +
  # add means
  stat_summary(fun.y = mean, geom = "point", shape = 18, size=3, color="red", fill="red") +
```

```r
  theme_light() +
  theme(axis.text.x = element_text(angle = 10, vjust = 0.5)) +
  labs(x = "Alcohol consumption frequency", y = "Vocabulary Memory Test Score (/20)")
```

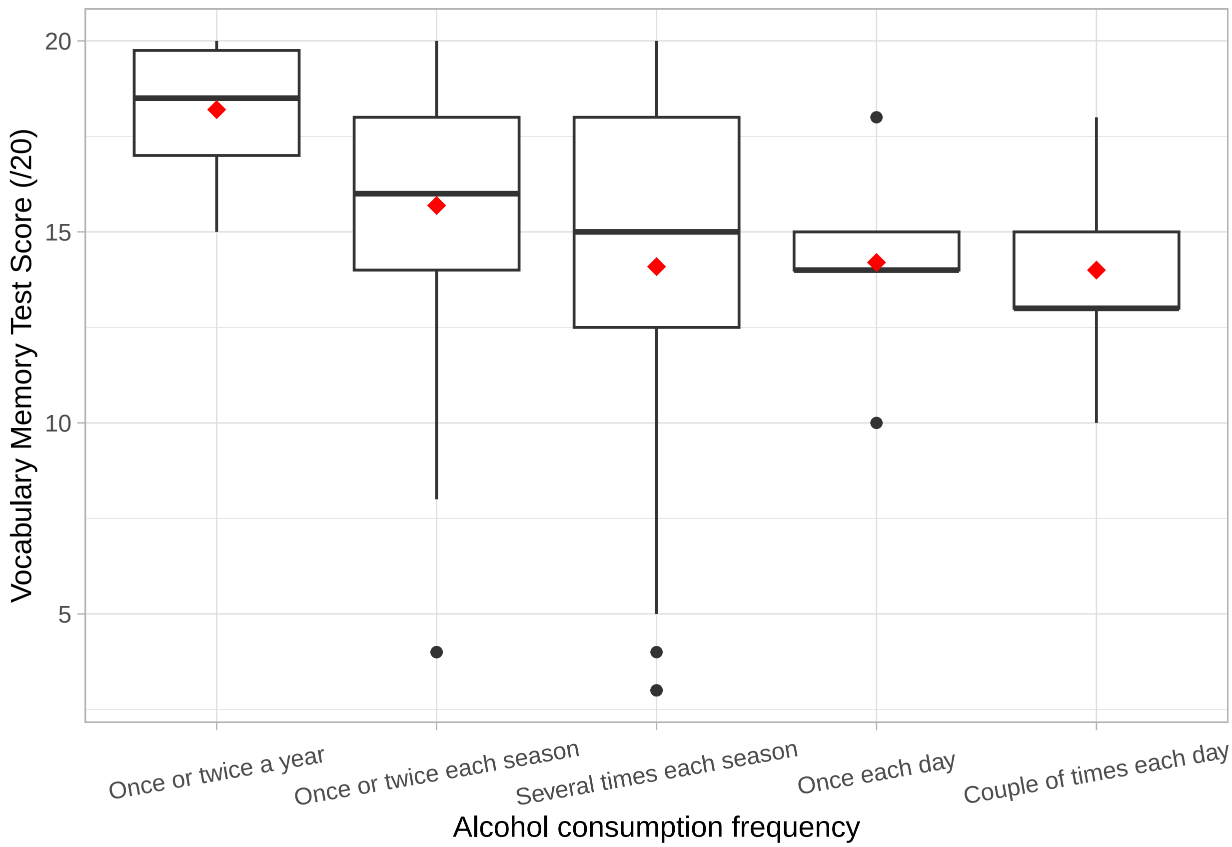


Figure 3: Side-by-side boxplots of Vocabulary Memory Test Score by Alcohol Consumption Frequency. Means shown in red.

```r
df <- data %>%
  group_by(Alcohol_consumption) %>%

  # calculate medians and means
  summarise("Number of participants" = n(),
            "Median Vocab Score (/10)" = median(Vocab),
            "Mean Vocab Score (/10)" = mean(Vocab)
  )

kable(df,
caption = "Numerical summaries for Vocabulary Memory Test Score by Alcohol Consumption Frequency") %>%
  kable_styling()
```

Table 2: Numerical summaries for Vocabulary Memory Test Score by Alcohol Consumption Frequency

Alcohol_consumption	Number of participants	Median Vocab Score (/10)	Mean Vocab Score (/10)
Once or twice a year	10	18.5	18.20000
Once or twice each season	84	16.0	15.69048
Several times each season	55	15.0	14.09091
Once each day	5	14.0	14.20000
Couple of times each day	9	13.0	14.00000

Similarly to the cards memory tests, the boxplots for the vocabulary memory test scores in Figure 3 seem to show a negative correlation with increasing alcohol consumption. It looks like there may be a stronger trend in this test, as the medians are more significantly different from each other, ranging from 13 to 18.5. The scoring scheme of this test is out of 20 rather than 10, which may contribute to better sensitivity. The means follow a similar trend as the medians, but the means for the higher consumption groups are very close to each other. Interestingly, the *Couple of times each day* group does follow the trend for these scores, having the lowest median and mean. Once again, differences in the spread of data are observed between groups, possibly because of varying sample sizes. Table 2 supports the presence of a negative association between alcohol consumption frequency and vocabulary memory scores as well, with the medians and means generally lower for greater consumption.

Self-reported forgetfulness and alcohol consumption frequency are both categorical variables. A two-way table was first produced to examine the data (Table 3). Due to the varying sample sizes, many categories, and presence of cells with no observations, a mosaic plot would not be suitable for this data. So, in order to see whether forgetfulness varies with alcohol consumption, a stacked bar chart of the conditional distributions of forgetfulness by alcohol consumption was created (Figure 4).

```r
# reorder forgetful levels
forgetfuldat <- data %>%
  mutate(Forgetful = factor(Forgetful, levels = c("Not at all", "A little", "Moderately")))

# create two-way table
forgetfultab <- table(forgetfuldat$Alcohol_consumption, forgetfuldat$Forgetful)

kable(forgetfultab,
      caption = "Two-way table of Forgetfulness by Alcohol Consumption Frequency") %>%
  kable_styling() %>%
  # add labels
  add_header_above(c("Alcohol Consumption" = 1, "Forgetfulness" = 3))
```

Table 3: Two-way table of Forgetfulness by Alcohol Consumption Frequency

Alcohol Consumption	Forgetfulness		
	Not at all	A little	Moderately
Once or twice a year	3	7	0
Once or twice each season	18	53	13
Several times each season	14	33	8
Once each day	0	2	3
Couple of times each day	1	7	1

```r
data %>%
  # order levels
  mutate(Forgetful = factor(Forgetful, levels = c("Moderately", "A little", "Not at all"))) %>%
  ggplot(aes(x = Alcohol_consumption, fill = Forgetful)) +
  # use position = "fill" for conditional distributions
  geom_bar(position = "fill") +
  theme_light() +
  labs(x = "Alcohol consumption frequency", y = "Proportion") +
  theme(axis.text.x = element_text(angle = 10, vjust = 0.5))
```

There does not appear to be a substantial association from the conditional distribution bar chart in Figure 4. The *Once each day* group has a much greater proportion of moderate forgetfulness, but this may be due to chance or sampling error. Table 3 shows that there were only 5 total responses which reported drinking *Once each day*, and of those, only 3 reported *Moderate* forgetfulness. From Figure 4, the proportion of *Moderate* responses actually decreases with increasing alcohol consumption over several other groups. However, the lowest alcohol consumption group, *Once or twice a year*, does have the highest proportion of *Not at all* forgetful responses and no *Moderate* forgetfulness responses. Additionally, the two highest consumption groups have the lowest proportions of *Not at all* forgetfulness responses.

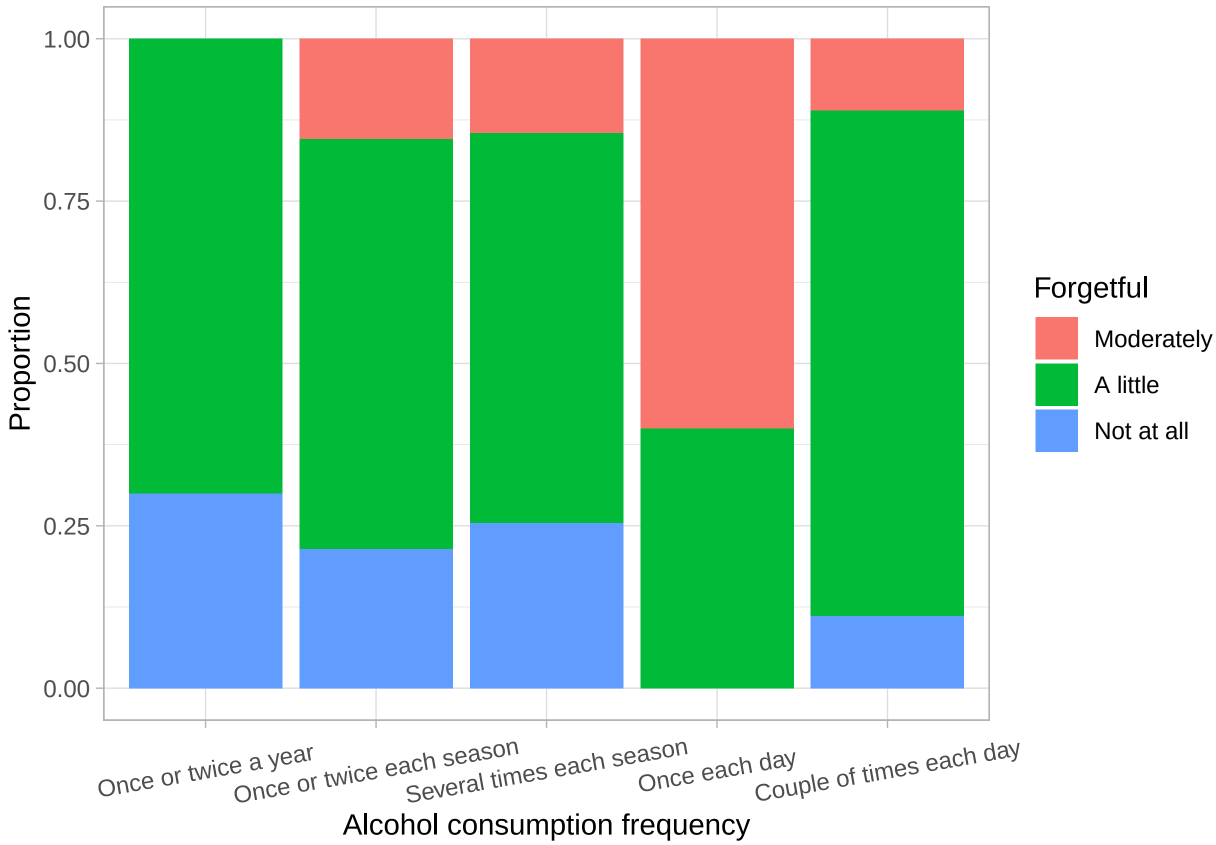


Figure 4: Conditional distributions of Forgetfulness by Alcohol Consumption Frequency

Although an association between memory game scores and alcohol consumption frequency appears possible from the graphical and numerical summaries, these results might be caused by chance, and this correlation may not truly be present in the population. To determine the extent to which these data actually provide evidence of an association, one-way ANOVAs were used to test for significant differences between mean cards and vocabulary memory test scores across alcohol consumption groups. A 5% significance level was used. If no significant differences are detected, the data does not provide evidence that there is a real correlation between alcohol consumption and memory scores. If a significant difference is detected between one or more alcohol consumption groups, the data does provide evidence to support a correlation between alcohol consumption and memory scores. Further tests could then be used to determine which groups are significantly different from each other.

Due to the multistage sampling method employed, there may not be an equal chance of each individual being selected due to differences in the number of residents in each house. However, there should be no dependency between individuals since the sample randomly selected both houses and residents. Since this was an observational study and participants were not assigned to groups beforehand, the groups should be independent from each other. To check if the population σs might be the same for the groups, the sample standard deviations (Tables 4-5) and strip plots of residuals (Figures 5-6) were examined for both memory tests.

```r
# calculate n and stdev for vocab
sd_cards <- data %>%
  group_by(Alcohol_consumption) %>%
  summarise(n = n(), sd = sd(Cards))

kable(sd_cards,
      caption = "Standard deviations of Cards Memory Scores by Alcohol Consumption Frequency") %>%
  kable_styling()
```

Table 4: Standard deviations of Cards Memory Scores by Alcohol Consumption Frequency

Alcohol_consumption	n	sd
Once or twice a year	10	0.9944289
Once or twice each season	84	1.6122647
Several times each season	55	2.4271195
Once each day	5	1.0954451
Couple of times each day	9	1.3228757

```r
# calculate n and stdev for vocab
sd_vocab <- data %>%
  group_by(Alcohol_consumption) %>%
  summarise(n = n(), sd = sd(Vocab))

# display via kable
kable(sd_vocab,
      caption = "Standard deviations of Vocab Memory Scores by Alcohol Consumption Frequency") %>%
  kable_styling()
```

Table 5: Standard deviations of Vocab Memory Scores by Alcohol Consumption Frequency

Alcohol_consumption	n	sd
Once or twice a year	10	1.686548
Once or twice each season	84	3.400837
Several times each season	55	4.819992
Once each day	5	2.863564
Couple of times each day	9	2.500000

```r
# run ANOVA first to get residuals
anova_cards <- aov(data$Cards ~ data$Alcohol_consumption)

# create dataframe for strip plot
strip <- data.frame(Alcohol_consumption = data$Alcohol_consumption, Residuals = anova_cards$residuals)

# create strip plot
strip %>%
  # color code
  ggplot(aes(Alcohol_consumption, Residuals, colour = Alcohol_consumption)) +
  # hide color legend, ensure 0 vertical jitter, reduce horizontal jitter
  geom_jitter(show.legend = F, height = 0, width = 0.2) +
  theme_light() +
  # rotate labels
  theme(axis.text.x = element_text(angle = 10, vjust = 0.5)) +
  labs(x = "Alcohol consumption frequency")
```

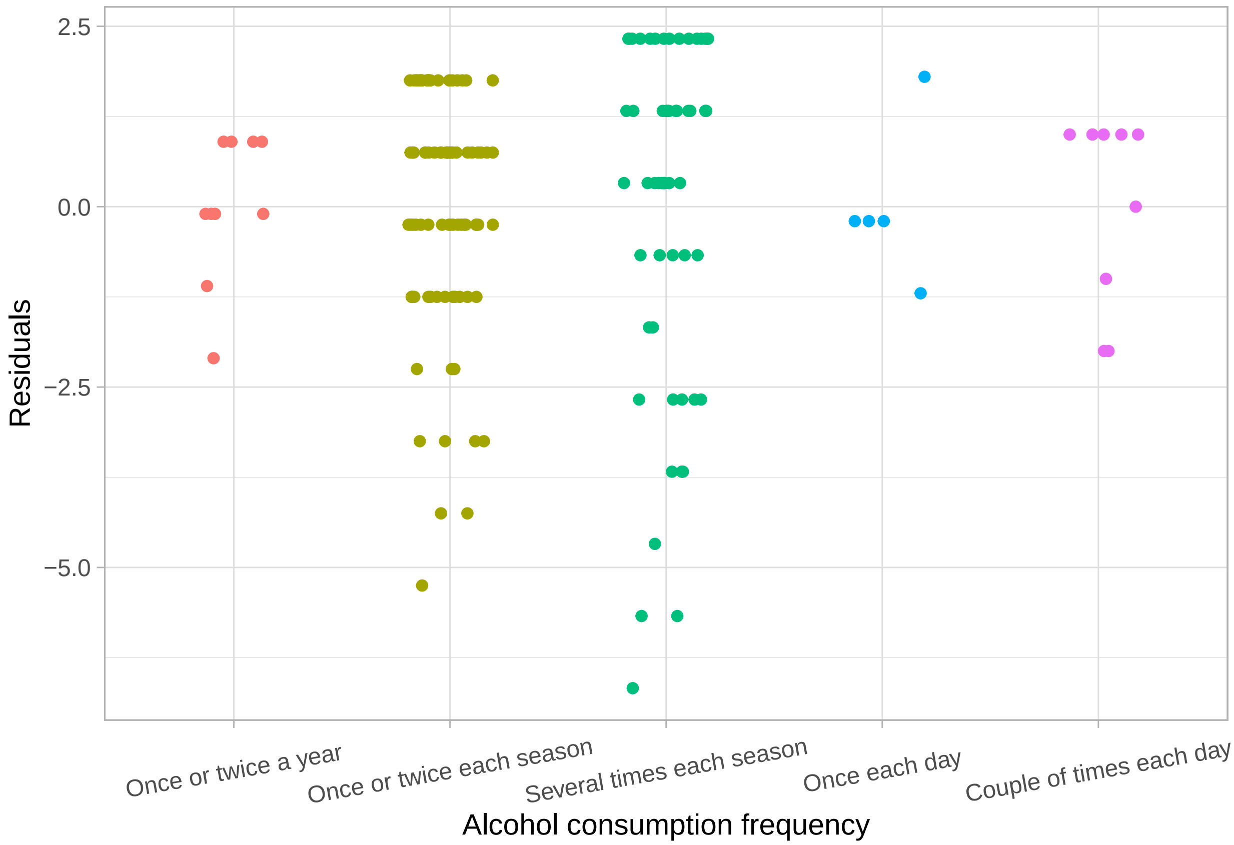


Figure 5: Strip plot of residuals for Cards memory test.

```
# run ANOVA first to get residuals
anova_vocab <- aov(data$Vocab ~ data$Alcohol_consumption)

# create dataframe for strip plot
strip <- data.frame(Alcohol_consumption = data$Alcohol_consumption, Residuals = anova_vocab$residuals)

# create strip plot
strip %>%
  # color code
  ggplot(aes(Alcohol_consumption, Residuals, colour = Alcohol_consumption)) +
  # hide color legend, ensure 0 vertical jitter, reduce horizontal jitter
  geom_jitter(show.legend = F, height = 0, width = 0.2) +
  theme_light() +
  # rotate labels
  theme(axis.text.x = element_text(angle = 10, vjust = 0.5)) +
  labs(x = "Alcohol consumption frequency")
```

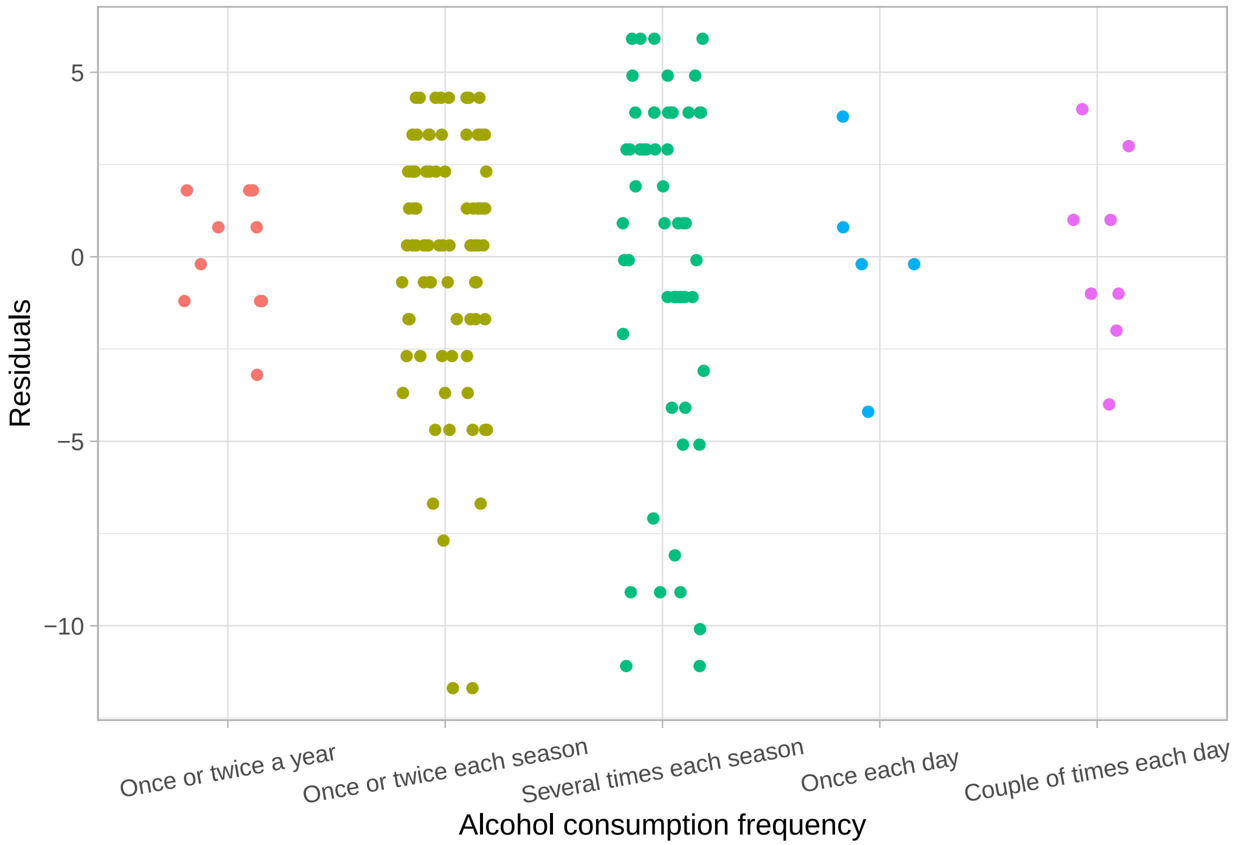


Figure 6: Strip plot of residuals for Vocabulary memory test.

From Tables 4-5 and Figures 5-6, the groups look like they may belong to populations with different standard deviations. As a result, it may not be appropriate to assume the observed ANOVA F statistic will follow an F distribution, and the ANOVA p-value may not be reliable.

To check for normality in the data, normal Q-Q plots and histograms of the residuals for each memory test were used (Figure 7-10).

```
qqnorm(anova_cards$residuals, main = NULL)
qqline(anova_cards$residuals)
```

```
hist(anova_cards$residuals, breaks = 10, main = NULL, xlab = "Residuals")
```

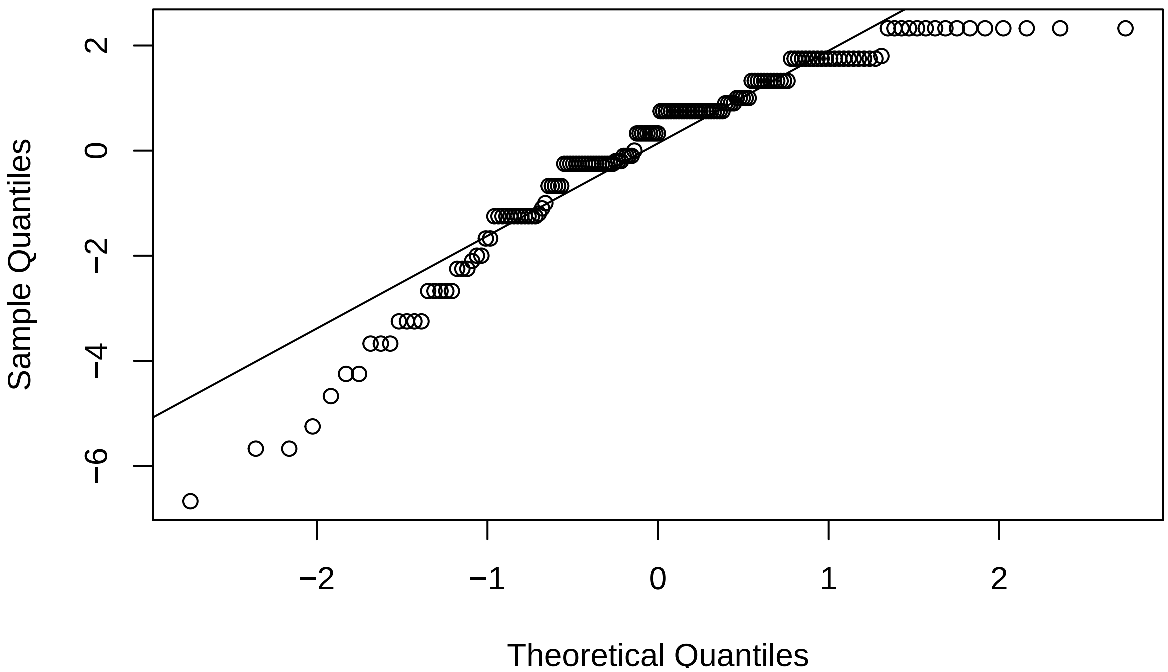


Figure 7: Normal Q-Q Plot of residuals for Cards memory test.

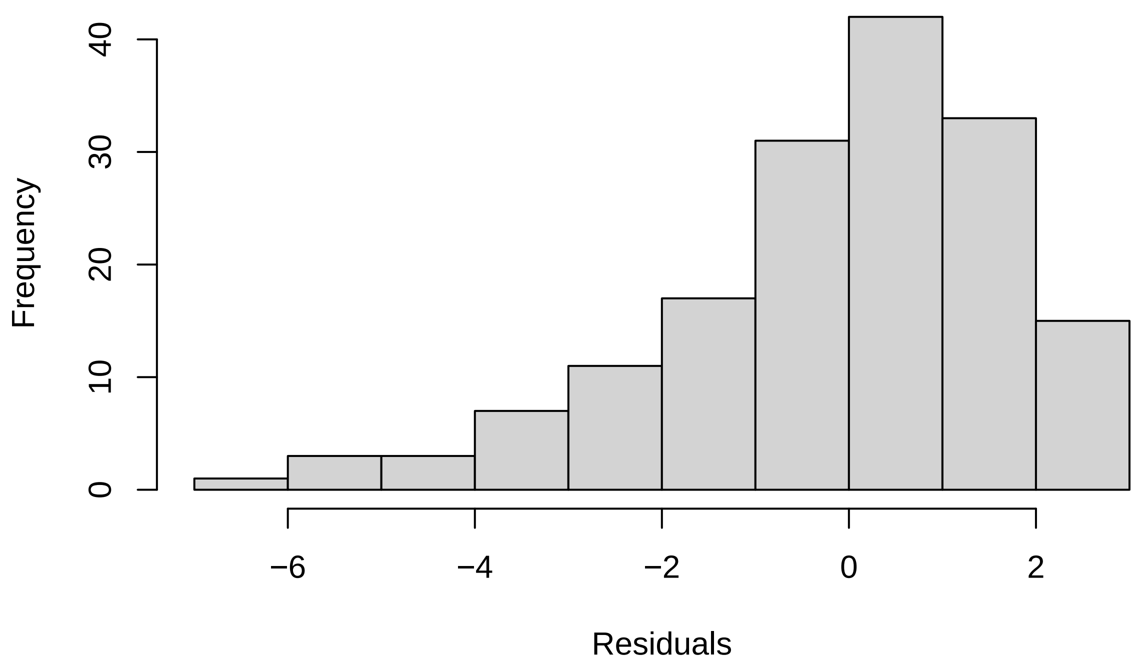


Figure 8: Histogram of residuals for Cards memory test.

```r
qqnorm(anova_vocab$residuals, main = NULL)
qqline(anova_vocab$residuals)
```

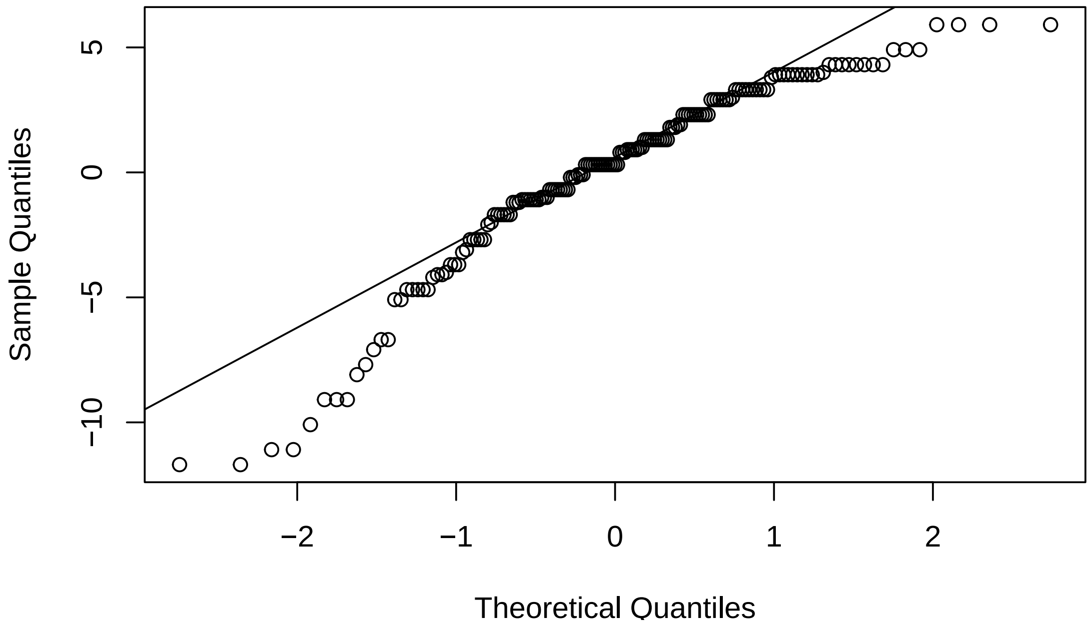


Figure 9: Normal Q-Q Plot of residuals for Vocabulary memory test.

```r
hist(anova_vocab$residuals, breaks = 10, main = NULL, xlab = "Residuals")
```

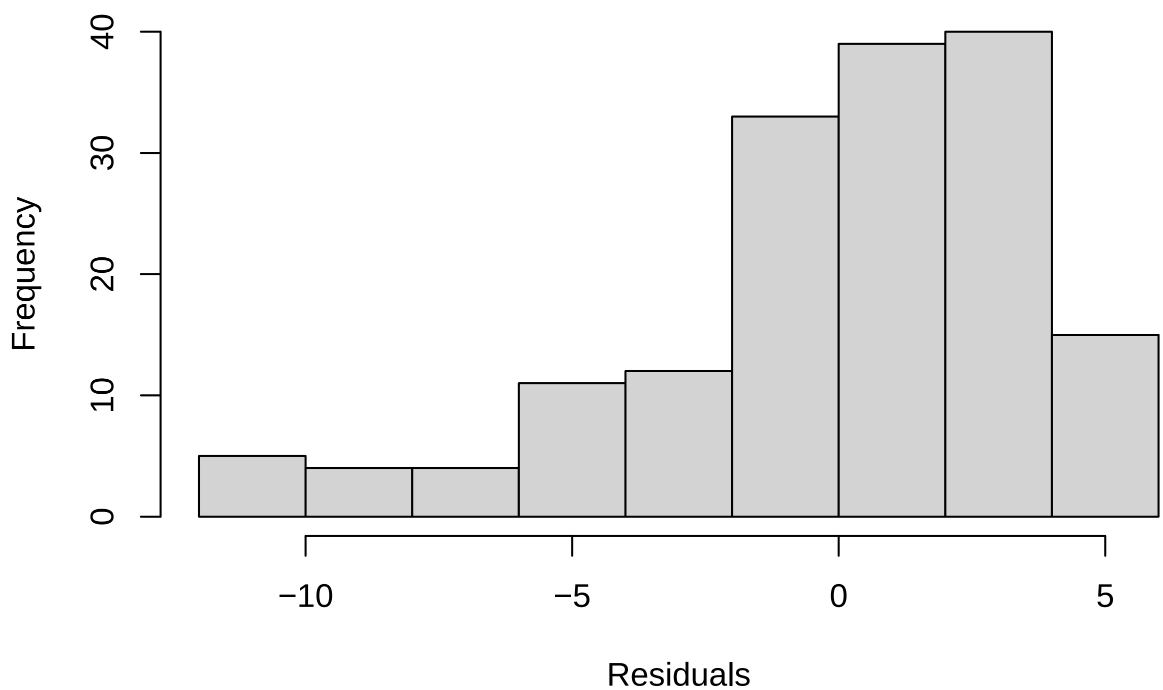


Figure 10: Histogram of residuals for Vocabulary memory test

From Figures 7-10, the data for both tests appears to be significantly left-skewed and not normally distributed. This pronounced left skew suggests memory test scores may be left-skewed in the population. This is another factor contributing to the potential unreliability of a one-way ANOVA test on this data.

Since the normality and equal variance conditions for the one-way ANOVAs were violated, a non-parametric test may be a better alternative. The Kruskal-Wallis rank sum test is a non-parametric analogue to one-way ANOVA which does not assume normality and equal variance, and only requires independence[8].

```
# ANOVA F tests
anova_cards <- aov(data$Cards ~ data$Alcohol_consumption)
anova_cards_sum <- summary(anova_cards)

anova_vocab <- aov(data$Vocab ~ data$Alcohol_consumption)
anova_vocab_sum <- summary(anova_vocab)
```

```
# display results - process shown in full code
kable(anova_results, caption = "One-way ANOVA F test results") %>% kable_styling()
```

Table 6: One-way ANOVA F test results

Test Type	F statistic	P value
Cards one-way ANOVA	1.816697	0.1282062
Vocab one-way ANOVA	3.326610	0.0120024

```
# kruskal tests
krus_cards <- kruskal.test(Cards ~ Alcohol_consumption, data = data)
krus_vocab <- kruskal.test(Vocab ~ Alcohol_consumption, data = data)
```

```
# display results - process shown in full code
kable(krus_results, caption = "Kruskal-Wallis rank sum test results") %>% kable_styling()
```

Table 7: Kruskal-Wallis rank sum test results

Test Type	Kruskal-Wallis chi-squared	P-value
Cards Kruskal-Wallis	6.90348	0.1410776
Vocab Kruskal-Wallis	14.12826	0.0068968

Since a significant difference was observed for the mean vocabulary memory test scores in the one-way ANOVA and Kruskal-Wallis tests ($p = 0.012$ and $p = 0.007$ respectively), a pairwise t-test using the Bonferroni correction was used to examine which groups have significantly different mean scores.

```
# run pairwise t test
# use as.data.frame to store p-values in data frame for presentation
pairwise <- as.data.frame(pairwise.t.test(data$Vocab, data$Alcohol_consumption, p.adj = "bonf")$p.value)

# replace NAs with - for clarity
pairwise[is.na(pairwise)] <- "-"

# display results
kable(pairwise,
      caption = "Pairwise comparisons for Vocab scores by Alcohol
      Consumption using t tests and Bonferroni correction") %>% kable_styling()
```

Table 8: Pairwise comparisons for Vocab scores by Alcohol Consumption using t tests and Bonferroni correction

	Once or twice a year	Once or twice each season	Several times each season	Once each day
Once or twice each season	0.5216892	-	-	-
Several times each season	0.0216865	0.173250224354024	-	-
Once each day	0.5864402	1	1	-
Couple of times each day	0.1831194	1	1	1

Considering the two categorical variables of alcohol consumption and self-reported forgetfulness, a Chi-squared test would be appropriate to test whether the two variables appear to be independent or dependent. A small p-value from this test provides evidence that the two variables are dependent, suggesting that there is some correlation between them.

The Chi-squared test requires independent observations, which was established when evaluating the one-way ANOVA conditions above. The counts can successfully be organized into a two-way table, as seen in Table 3. Also from Table 3, it is apparent that there are several cells which have less than 5 observations and even some cells with 0 observations. So, the Chi-squared test results may not be accurate.

Since the sample size conditions of the Chi-squared test were not met, a Monte Carlo simulation Chi-squared test may be more appropriate. This test uses randomization, and does not require >5 observations in each cell[9].

```
# normal chi-squared
chis <- chisq.test(data$Alcohol_consumption, data$Forgetful)

# monte carlo
# set seed for reproducibility
set.seed(2024)
monte <- chisq.test(data$Alcohol_consumption, data$Forgetful, sim = T)
```

```
# display results - process shown in full code
kable(chis_results, caption = "Self-reported Forgetfulness Chi-squared results") %>% kable_styling()
```

Table 9: Self-reported Forgetfulness Chi-squared results

Test Type	Chi-squared statistic	P-value
Chi-squared	11.23233	0.1888796
Monte Carlo Simulation	11.23233	0.1814093

Conclusions

Since the p-value for the one-way ANOVA on mean cards memory scores (0.128) was greater than the significance level of 0.05, there is no evidence against the mean cards score for all alcohol consumption frequencies being the same. The p-value for the corresponding Kruskal-Wallis rank sum test on cards memory scores (0.141) was also greater than the significance level of 0.05[1]. So, this data does not provide evidence for a correlation between alcohol consumption frequency and Cards memory test scores.

The p-value for the one-way ANOVA on mean vocabulary memory scores ($p = 0.012$) was smaller than the significance level of 0.05, but not extremely small. This suggests that the data provides moderate evidence against the mean vocabulary score for all alcohol consumption frequencies being the same. The p-value for the corresponding Krukal-Wallis rank sum test on vocabulary memory scores ($p = 0.007$) was actually somewhat smaller than the p-value from the one-way ANOVA. As a result, the data may actually provide strong evidence for a significant difference in mean vocabulary memory test score for one or more alcohol consumption frequency groups. This supports the presence of an association between alcohol consumption frequency and vocabulary memory performance.

The subsequent pairwise t-tests on mean vocabulary memory scores did not find significance between most groups (Table 8). However, one exception to this was between the *Several times a season* and *Once or twice a year* groups ($p = 0.0216$), which indicates that there was a statistically significant difference between them. This agrees with the one-way ANOVA results that at least one of the means differs from the others.

[1]Note that the Kruskal-Wallis rank sum test should not be interpreted as detecting differences between means when the distributions of groups are significantly different, but rather detecting differences between the groups in general[8].

The Chi-squared test between self-reported forgetfulness and alcohol consumption frequency yielded a non-significant p-value of 0.1888. The corresponding Monte Carlo simulation also yielded a similar non-significant p-value of 0.1814. As a result, there is no evidence that the level of self-reported forgetfulness is dependent on the frequency of alcohol consumption.

Discussion

References

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Appendix

Dataset Info

Variable Name	Description
House	House number of participant. Corresponds to house numbers in Arcadia on The Islands. Randomly generated using Excel.
Name	Name of participant.
Alcohol_consumption	Alcohol consumption frequency. As reported by the participant after being asked "How often do you drink alcohol?". Responses fall into one of the following categories: ("Rarely/Once or twice a year", "Once or twice each season", "Several times each season", "Once each day", "Couple of times each day"). Categorical ordinal variable. Participants who did not provide consent, empty houses, or duplicates have "NO CONSENT", "EMPTY", "DUPLICATE", or "NONE" in this entry.
Cards	Cards memory test score. Number of cards recalled in one minute, out of 10 drawn from a 52 card deck. Numerical discrete variable.
Vocab	Vocabulary memory test score. Number of words recalled in 30 seconds, out of a list of 20 words seen for 1 minute. Numerical discrete variable.
Forgetful	Subjective forgetfulness. As reported by the participant after being asked "How forgetful do you feel right now?". Responses fall into one of the following categories: ("Not at all", "A little", "Moderately"). Categorical ordinal variable.

The dataset can be accessed by clicking here (access file -> download as csv).