

A Clinical Study: The Effect of Caffeine and Exercise on Attention

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1 Abstract

Many studies have shown that caffeine and exercise lead to an increase in attention span. In this study, I wanted to further the research on this effect: I studied if amount of caffeine and length of run significantly affect attention span and how these 2 factors can work together to affect attention span. I used a 2 way basic factorial design with both factors having 3 levels. We sampled 198 women from the ages of 18-50 using the online resource *The Island*. Our results showed that there is no significant correlation between our 2 factors and our response variable. Therefore, we can conclude that the amount of caffeine and length of run do not cause a significant change in attention span.

2 Introduction

In the lives of students, attention span has become increasingly important. Students need long attention spans in order to endure multiple hour tests that can dramatically affect their future such as the SAT, ACT, MCAT, LSAT, and many more. These tests play a crucial role in whether or not students make it into top colleges, medical schools, and law schools.

Due to the increased importance of long attention spans, I wanted to research how students can improve their attention before an important test. Many studies have suggested that caffeine and exercise can improve attention, so in this study, I decided to further research those factors.

3 Methods

3.1 Participants

Our participants will be virtual from an online resource called *The Islands*.

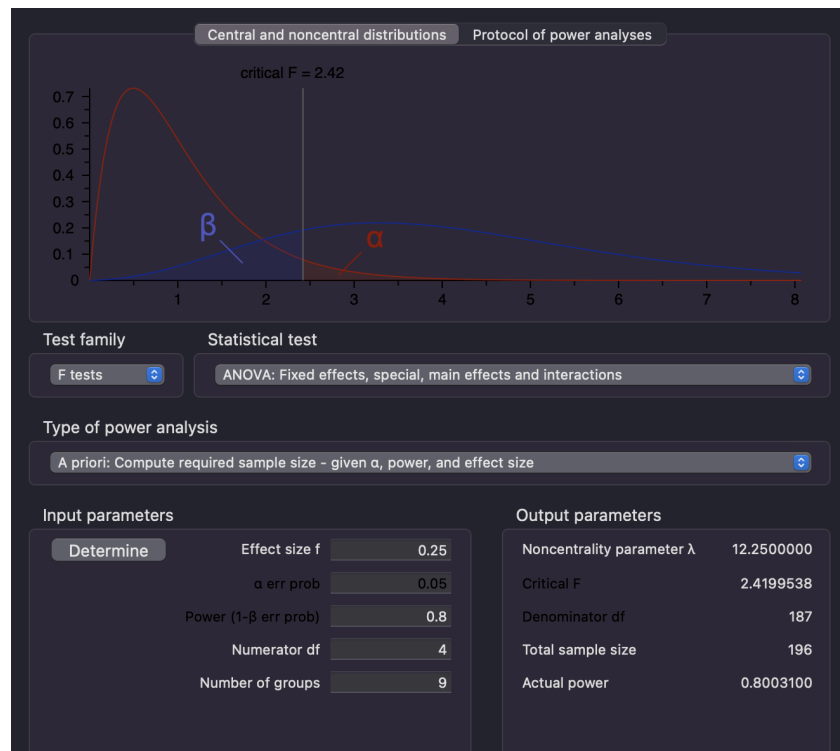
It is unclear whether attention differs between sexes. Some studies show that there is no difference between males and females, while other studies indicate that men have better vigilance (Blatter et al., 2006). To ensure that sex did not affect our results, I only sampled women in this study.

Attention span differs throughout one's lifetime (Simon et al., 2023). Children tend to have a shorter attention span, and attention tends to decline in old age. Therefore, I decided to only sample participants in the age range from 18-50 years old.

To obtain participants, I went into the different islands and cities and requested consent from women who fit our age criteria.

3.2 Sample Size Determination

I decided to use a power of 0.8 which is the probability that we will correctly reject the false null hypothesis. We used the typical alpha level of 0.05, and an effect size of 0.25 which tells us how meaningful the difference between groups is. Using G power, I found that I need to use a sample size of 196. However, I want a balanced design so I will increase the sample size of 198. That way, there are 22 women per group.

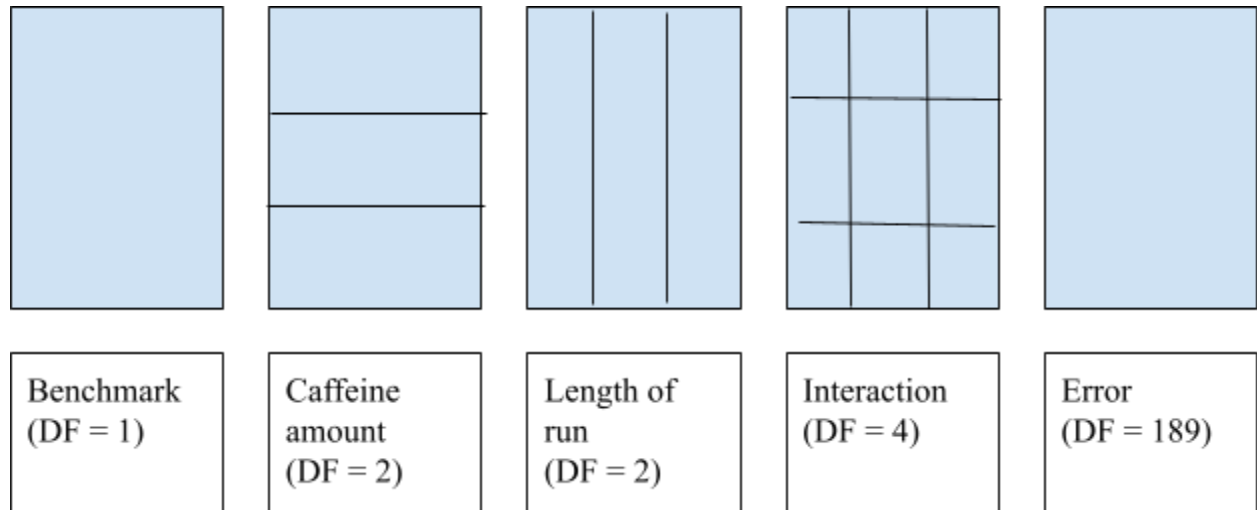


3.3 Design

To complete my experiment, I used a 2 way basic factorial design. The 3 levels of each factor and the 9 interaction groups are shown below:

	Green tea 250mL	Coffee 250mL	Coffee 500mL
Run outdoors 100m	Green tea + 100m	Coffee 250mL + 100m	Coffee 500mL + 100m
Run outdoors 1km	Green tea + 1km	Coffee 250mL + 1km	Coffee 500mL + 1km
Run outdoors 5km	Green tea + 5km	Coffee 250mL + 5km	Coffee 500mL + 5km

The factor diagram is below:



3.4 Instruments

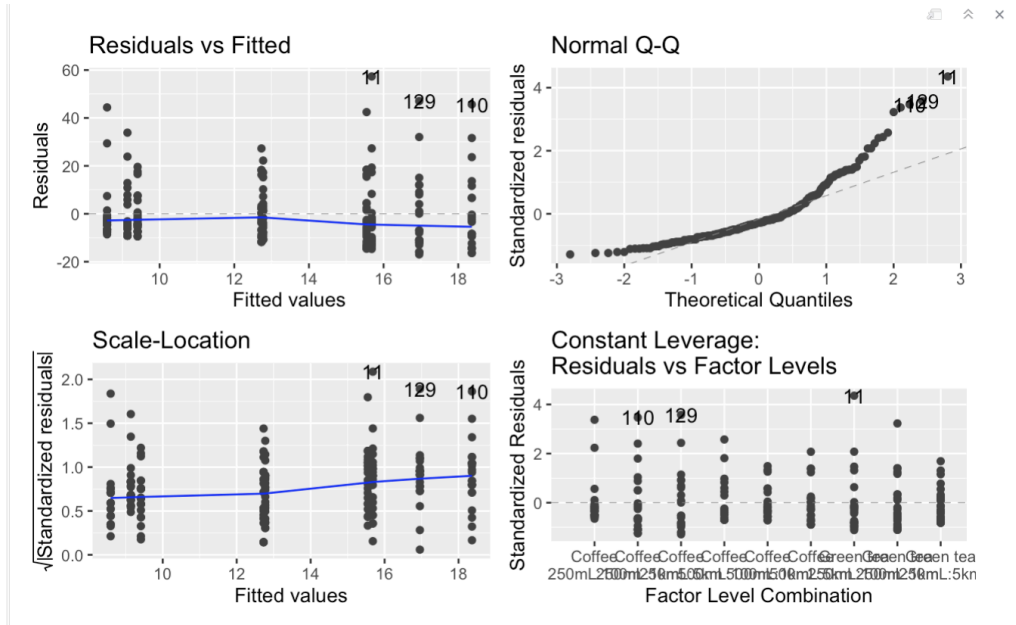
We used the online resource called *The Island* (<http://island.maths.uq.edu.au/index.php>) to obtain our data. Through that website, we were able to simulate administering our treatments on people. We used google spreadsheets to track our data and R studio to analyze our results and create visualizations.

3.5 Procedure

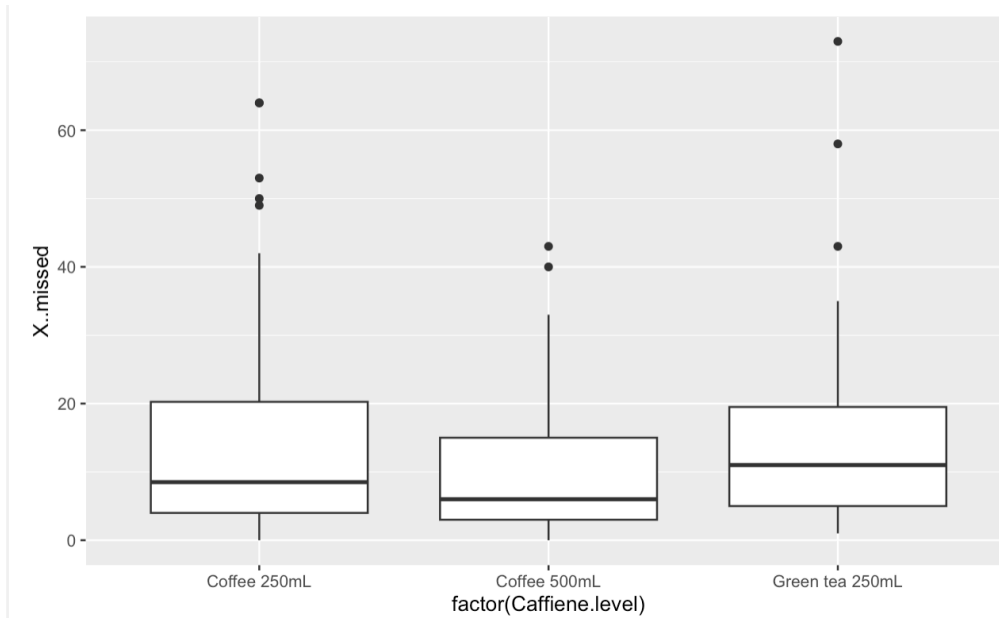
We administered our treatments to our islanders in the following order. First, we gave them their drink depending on which group we were obtaining data for. The 3 levels were “Green Tea 250mL”, “Coffee 250mL”, and “Coffee 500mL”, with increasing amounts of caffeine. Next, we had the exercise; they either ran outdoors for 100m, 1km, or 5km. 45 minutes after giving them the caffeine, we had them take a 10 minute attention test. In this test, the participants watch a series of letters appear and press a button every time they see the letter “Z”. This tests whether they are able to remain attentive to the letters or if they get distracted and miss the letter “Z”. We chose to give participants the attention test 45 minutes after finishing their drink because the largest effect of caffeine occurs after 45 minutes according to the Committee on Military Nutrition Research (Committee on Military Nutrition Research, 2002).

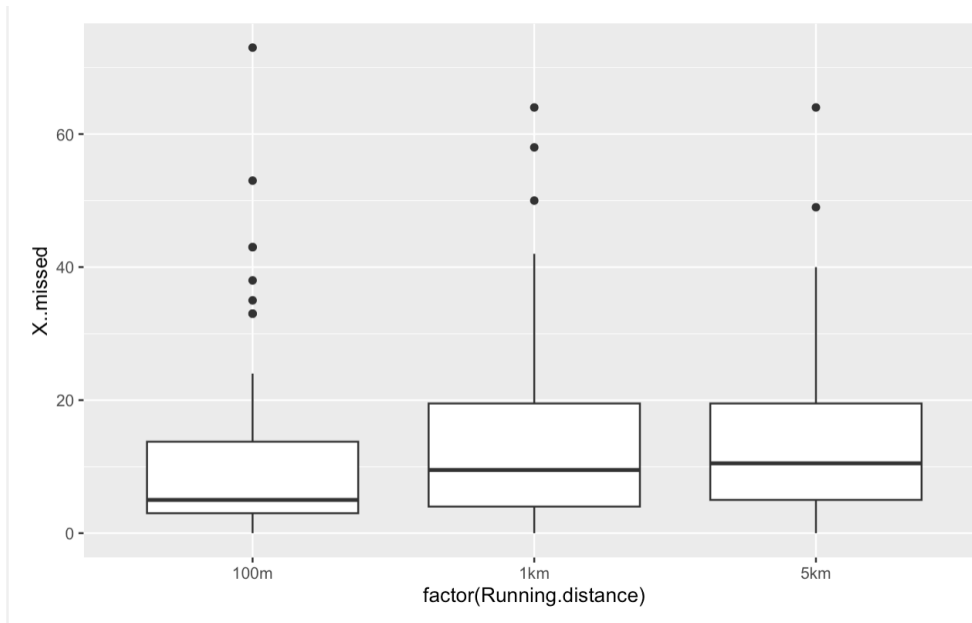
4 Results

4.1 Checking Assumptions



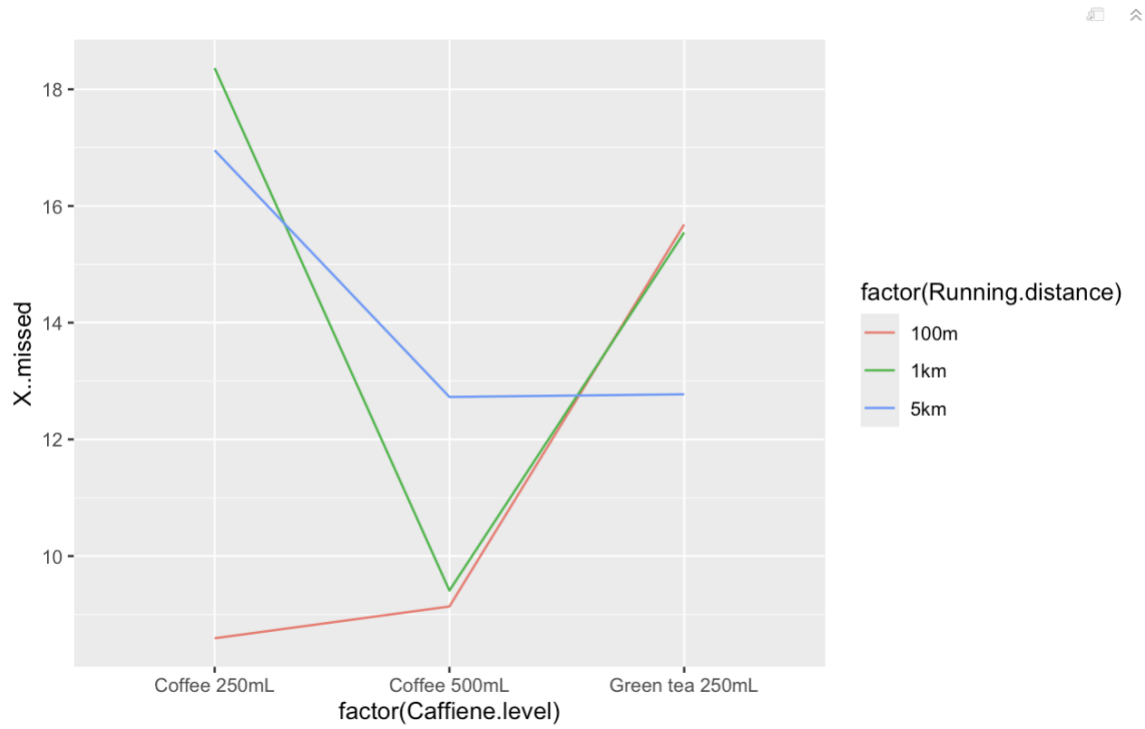
4.2 Boxplots





4.3 Interaction Plot

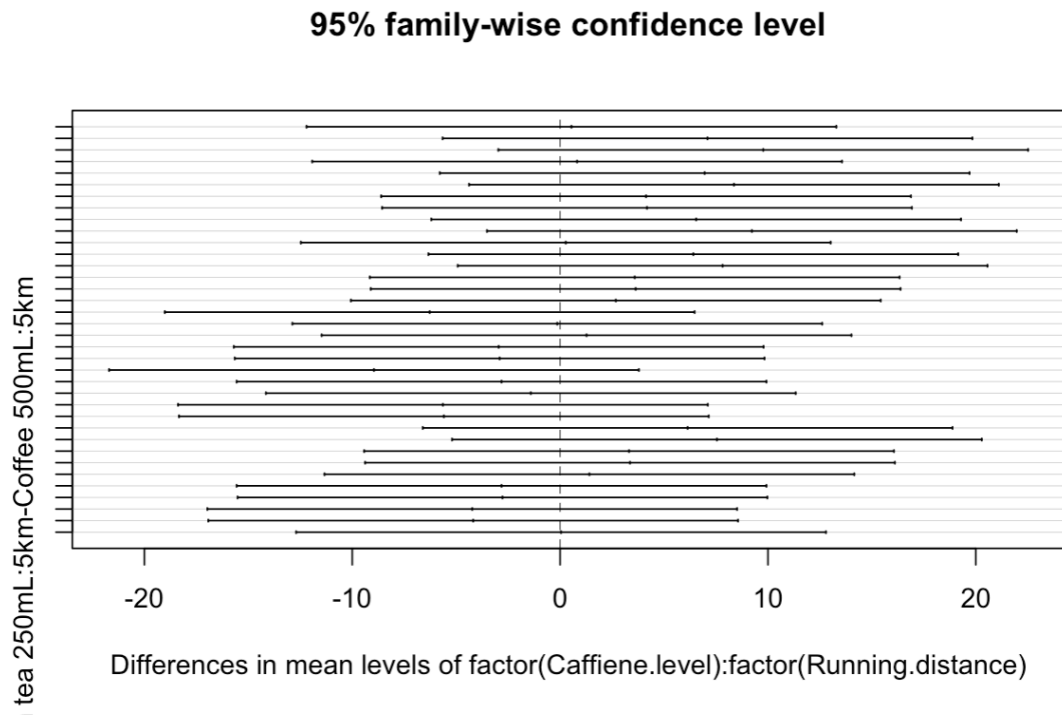
factor(Caffiene.level) <fctr>	factor(Running.distance) <fctr>	X..missed <dbl>
Coffee 250mL	100m	8.590909
Coffee 500mL	100m	9.136364
Green tea 250mL	100m	15.681818
Coffee 250mL	1km	18.363636
Coffee 500mL	1km	9.409091
Green tea 250mL	1km	15.545455
Coffee 250mL	5km	16.954545
Coffee 500mL	5km	12.727273
Green tea 250mL	5km	12.772727



4.4 ANOVA

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
factor(Caffiene.level)	2	786	393.2	2.167	0.117
factor(Running.distance)	2	442	220.9	1.218	0.298
factor(Caffiene.level):factor(Running.distance)	4	1080	270.1	1.489	0.207
Residuals	189	34288	181.4		

4.5 Tukey Test



4 Discussion

The interaction plot shows us that there is no clear pattern. When running 100m, the average number of missed clicks is highest for green tea, decreases drastically for coffee 250mL, and increases slightly for coffee 500mL. When running 1km, the average number of missed clicks is around 15.5 for green tea, increases to the highest average for coffee 250mL, and then drastically decreases for coffee 500mL. When running 5km, the average number of missed clicks is around 13 for green tea, increases for coffee 250mL, and then decreases back to around 13 for coffee 500mL.

To summarize, for 100m, coffee 250mL had the least number of missed clicks on average and green tea had the greatest number of missed clicks. For 1km, coffee 500mL had the lowest number and coffee 250mL had the highest. For 5km, coffee 250mL had the highest while the other 2 beverages were very close to one another.

The interaction plot does not show a clear pattern or relationship between caffeine, running distance, and the number of missed clicks. This suggests that caffeine and running distance don't have a significant effect on attention span.

This suggestion was reaffirmed in our boxplots. In both box plots, the three boxplots were overlapping, indicating that there isn't a significant difference between the means.

The analysis of variance summary shows us that the p value for both factors as well as their interaction is less than 0.05. This tells us that both factors and the interaction do not have a significant effect on attention span. The Tukey Test furthers this conclusion, showing that there is no significant difference between any of the group means.

References

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