Stroop Effect Test
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Introduction

The Stroop effect is a demonstration of interference in the reaction time of a task. When the name of a color (e.g., "blue", "green", or "red") is printed in a color that is not denoted by the name (e.g., the word "red" printed in blue ink instead of red ink), naming the color of the word takes longer and is more prone to errors than when the color of the ink matches the name of the color.

In this project, we are testing the effect through comparing the time needed to read two lists of colored words from a set of participants. Each participant first reads a list of words that are colored by the same color that it is donated with (congruent) and then with another list that with colors that is not denoted by the name (incongruent). The time needed by each participant is recorded for both trials.

The dataset provided is the time for 24 participants to complete each trial.

Variables

The independent variable in this study is whether the colors match their corresponding words (congruent or incongruent) while the depended variable is the time needed to read the list of words.

Hypotheses and Statistical Test

The null hypothesis is that there is no time difference between taking the congruent and incongruent tests for each participant. The alternative hypothesis that the time the the time needed for incongruent tests is more that the time needed for the congruent test. Mathematically, the hypotheses can be written as follows:

- Null hypothesis: H_0: $u_i - u_c = 0$
- Alternative hypothesis: H_1: $u_i - u_c > 0$ (upper-tailed)

u_i is the mean for times needed to take the incongruent test and u_c is the mean for times needed to take the congruent test.

The statistical test appropriate to use in this case is paired sample t-test, because we want to test the difference between pairs of observations while we have only less than 30 observations and we don't know what the population standard deviation is.

The assumptions to do the paired t test is that the data is on a continues scale, normally distributed and the each pair is independent from the others.

Descriptive Statistics

I calculated two measures of centrality (mean and median) and two measures of variability (standard deviation and range) for both groups and the difference between the pairs' values.

Test	Congruent	Incongruent	Difference
Mean	14.05	22.02	7.96
Median	14.36	21.02	7.67
Standard Deviation	3.56	4.80	4.86
Range	13.70	19.57	19.97

Visualization
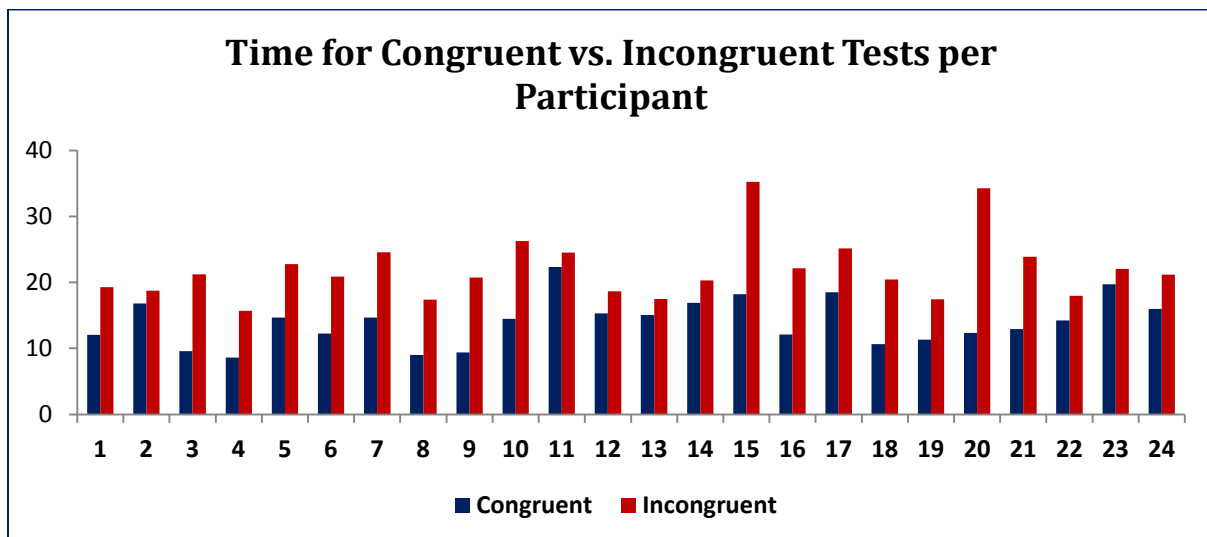
This graph shows that for all participants, the time to do the incongruent test was higher than the time to do the congruent test. Still, the statistical test is needed to assess if this difference is significant.

Test

Using the Data Analysis Add-in in Excel, I performed the Paired Sample t-test:

t Statistic	8.021
t critical value	1.714
p-value	2.05E-08

So, because the t statistic is larger than the t critical value, we can reject the null hypothesis. The p-value is much less than 0.01 which means that the difference between the pairs is highly significant.

Conclusion

One possible cause of this effect as suggested by research is that, as put by nobel-prize winner psychologist Daniel Kahneman, we have two modes of thought: "System 1", the fast and instinctive, and "System 2", the slow and deliberative. The test puts these systems into conflict because reading the word is automatic while recognizing colors is not.
The *emotional Stroop test* is also another test that study the response time of participants to name colors of negative emotional words.

References
Wikipedia
Stroop Effect Experiment
Book: Thinking, Fast and Slow by Daniel Kahneman
Statistics How To