

1. What is our independent variable? What is our dependent variable?

The independent variable is the congruent and incongruent conditions in which words are displayed in the same color (congruent) or in a different color (incongruent).

The dependent variable is the time taken for participants to read out loud the color the words are in.

2. What is an appropriate set of hypotheses for this task? What kind of statistical test do you expect to perform? Justify your choices.

The Stroop task was designed to provide evidence that reaction time is affected by interference (Wikipedia, 2016), and that the said interference will make reaction time longer.

H_0 :

We will stipulate that for the null hypothesis, there is no difference in reaction time between reading the congruent and incongruent list. This is the same as stating the population mean of congruent is equal or greater than the population mean of incongruent.

H_A :

The alternate hypothesis will be that the incongruent list will take a longer time to read. Hence the population mean of congruent will be less than the population mean of incongruent.

$$H_0: \mu_{\text{congruent}} \geq \mu_{\text{incongruent}}$$

$$H_A: \mu_{\text{congruent}} < \mu_{\text{incongruent}}$$

Due to the small sample size of 24, the statistical test performed will be that of a dependent one-tailed t-test on the negative end. Since we expect the time taken to read the incongruent list to be longer than the congruent list, we expect the difference to lie in the negative end when subtracting congruent from incongruent. It is a dependent t-test because the same participant goes through reading both the congruent and incongruent list.

3. Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.

The mean of the sample dataset are:

$$\bar{X}_{\text{congruent}} = 14.05$$

$$\bar{X}_{\text{incongruent}} = 22.02$$

$$\bar{X}_D = -7.96$$

Standard deviation of the difference is

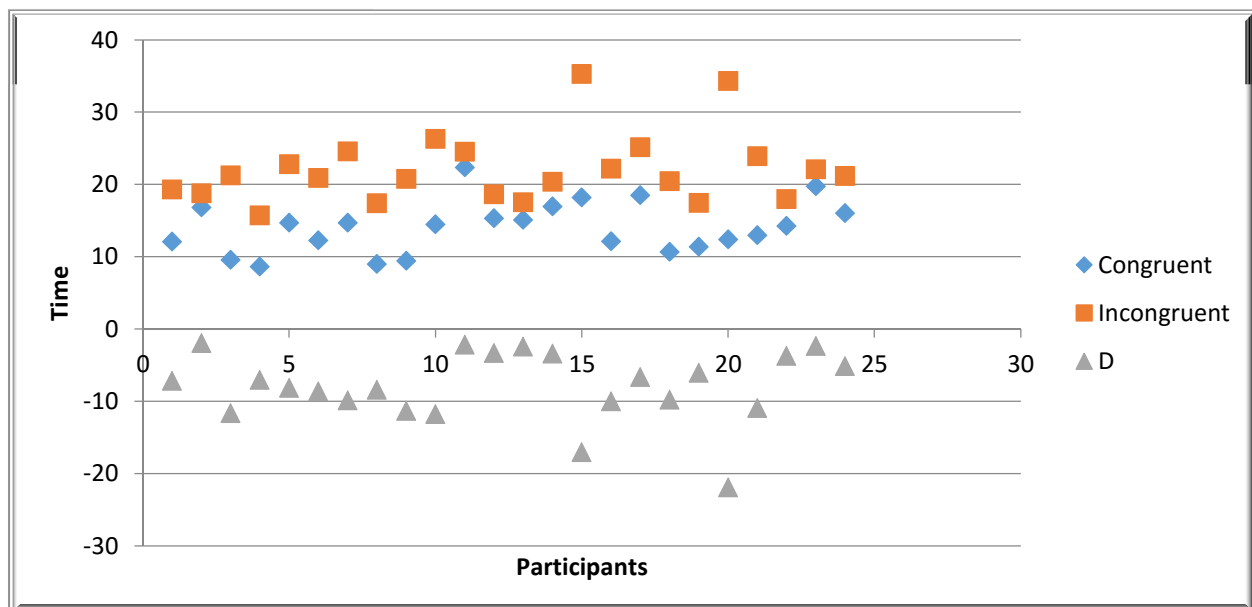
$$S = 4.86$$

The standard error is

$$SE = \frac{S}{\sqrt{n}} = 0.99 \quad \text{where } n = 24.$$

4. Provide one or two visualizations that show the distribution of the sample data. Write one or two sentences noting what you observe about the plot or plots.

The below graph is a plot for every participants with their corresponding time.



We can see that for every participant, the incongruent dots (orange) are at above the congruent (blue) dots. This shows that it took longer for all participants to read the incongruent list than the congruent list. Also the gray dots, which shows the difference between congruent and incongruent, is below 0 which means that all numbers are negative. This again is evidence that incongruent takes longer to be read.

5. Now, perform the statistical test and report your results. What is your confidence level and your critical statistic value? Do you reject the null hypothesis or fail to reject it? Come to a conclusion in terms of the experiment task. Did the results match up with your expectations?

The degrees of freedom $df = n - 1 = 23$

Therefore, $t(23) = \bar{X}_D / SE = -7.96 / 1.01 = -8.04$

At $\alpha = 0.05$, the $t_{critical} = -1.71$

Based on the t and the $t_{critical}$ values, we reject the null hypothesis because the $p < 0.05$.

The margin of error is $t_{critical} * SE = -1.70$

Confidence interval on the mean difference at 95% is $(-9.67, -6.26)$.

Since we reject the null hypothesis, we can conclude that the reaction time is affected by the interference of changing the ink color of the words to be different from the word itself. The effect was that participants took longer to read the incongruent list as compared to the congruent list. This result is in accordance to the graph above as it shows an increase in time in incongruent and also by the negative values of the difference.

6. Optional: What do you think is responsible for the effects observed? Can you think of an alternative or similar task that would result in a similar effect? Some research about the problem will be helpful for thinking about these two questions!

One explanation was that the brain uses different parts to process different information. According to (Hough, 2013), one side of the brain automatically decodes letters and read words. Another side processes colors and visual cues. When the 2 sides have conflicting results, we will rely on the anterior cingulate to choose the correct answer. This process lengthens the time taken to provide a correct answer.

An alternative task suggested by (Chudler, 1996) which will have the same effect will be to use positions instead of colors. In a box, we can put words in positions such as the top, bottom, left and right. We can then create boxes with words in the correct positions (congruent) and boxes with words in the wrong position (incongruent). I believe it will create the same results of taking longer for participants to say the positions.

Works Cited

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<https://faculty.washington.edu/chudler/words.html>

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