

Test a Perceptual Phenomenon: The Stroop Effect

Background Information

In this project we take a look at the Stroop Effect. Participants are given a list of words describing a color with each word displayed in a colored ink. The participants are tasked with verbally identifying the *color of the ink* in which the word is printed. The task has two conditions: a congruent condition, and an incongruent condition. In the *congruent* condition, the words are printed in the color of ink that the word describes e.g., RED, BLUE. In the *incongruent* condition, the words are printed in a color of ink that the word does not describe e.g., PURPLE, ORANGE. For each condition, the time taken to identify the ink colors is recorded, with lists in both conditions being of equal size. Each participant performs the task in both conditions.

Questions for Investigation

1. What are our independent and dependent variables?

Independent variable – Our independent variable in this experiment is the condition in which the list of words are displayed, i.e. *congruent* or *incongruent*.

Dependent variable – Our dependent variable in this experiment is the time it takes for a participant to perform each task.

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

Our assumption is that an average person would take longer to read the word list in an incongruent condition. Therefore, we will say the following hypotheses are appropriate.

Null Hypothesis: H_0

The population mean response time for the task in a congruent condition ($\mu_{\text{congruent}}$) will be greater than or equal to the population mean response time for the task in an incongruent condition ($\mu_{\text{incongruent}}$).

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

Alternative Hypothesis: H_A

The population mean response time for the task in a congruent condition ($\mu_{\text{congruent}}$) will be less than the population mean response time for the task in an incongruent condition ($\mu_{\text{incongruent}}$).

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

Statistical Test

We have a sample of 24 participants ($n=24$). Due to the relatively small size of our sample, it is appropriate to use a t-test to determine if there is a statistically relevant difference between the two conditions. Our assumption is that the incongruent condition will take longer to complete, rather than just differ, so we will use a one-tailed t-test. Since our participants each completed the task in both conditions, we will use a dependent t-test (or paired t-test). We would prefer a high degree of certainty that our assumption is correct, so we will set our alpha level to .01 ($\alpha=0.01$). Therefore, we will test our hypotheses using a one-tailed dependent t-test with an alpha level of $\alpha=0.01$.

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

Descriptive Statistics		
	Congruent	Incongruent
Mean	14.05	22.02
Median	14.36	21.02
Variance	12.67	23.01
Std Dev	3.56	4.80

- 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.

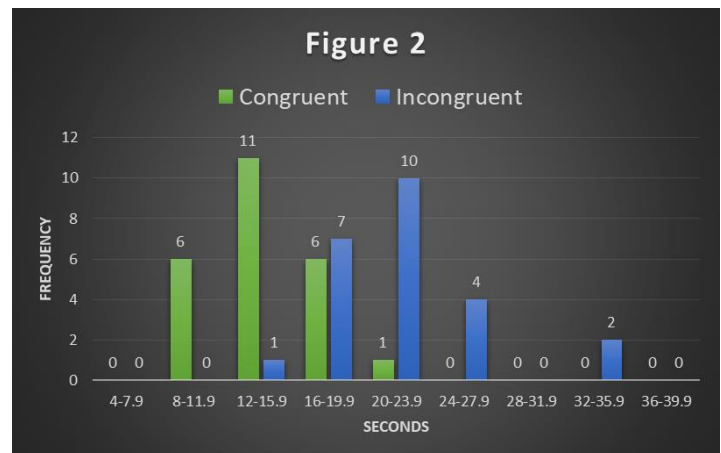
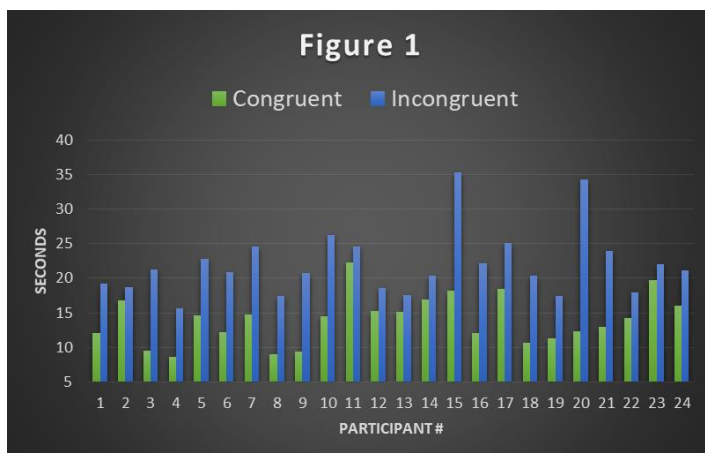


Figure 1 shows how every participant takes longer for the incongruent task. Figure 2 shows the difference in distribution between the two conditions by plotting the data in a frequency column chart.

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?

Figures 1 and 2 show a difference in time taken between the two conditions. However, we must perform a statistical test to be sure the difference is statistically relevant and not due to chance. We have previously chosen an alpha level of $\alpha=0.01$, so our confidence level will be 99%. The critical statistic value for a one-tailed dependent t-test with 23 degrees of freedom ($df=23$) is a t_{critical} of -2.5. If we calculate a $t_{\text{statistic}}$ of less than -2.5, we can conclude that the null hypothesis should be rejected. We calculate a $t_{\text{statistic}}$ of -8.02, far below the t_{critical} of -2.5. Therefore, we reject the null hypothesis and can say that there is a statistically significant difference between the two conditions, with the incongruent condition taking significantly longer, at $p < 2.05\text{E-}08$.

After performing the statistical test we can conclude that there is indeed a statistically relevant difference between the congruent and incongruent word conditions. The results are aligned with our original assumption that the incongruent condition task would take longer to perform.