

Statistics: The Science of Decisions

Project Instructions

Background Information

In a Stroop task, participants are presented with a list of words, with each word displayed in a color of ink. The participant's task is to say out loud the *color of the ink* in which the word is printed. The task has two conditions: a congruent words condition, and an incongruent words condition. In the *congruent words* condition, the words being displayed are color words whose names match the colors in which they are printed: for example RED, BLUE. In the *incongruent words* condition, the words displayed are color words whose names do not match the colors in which they are printed: for example PURPLE, ORANGE. In each case, we measure the time it takes to name the ink colors in equally-sized lists. Each participant will go through and record a time from each condition.

Questions For Investigation

As a general note, be sure to keep a record of any resources that you use or refer to in the creation of your project. You will need to report your sources as part of the project submission.

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

Independent Variable: the variable that cannot be changed by other variables, in a Stroop task, the time spent in the congruent and incongruent words condition are independent variables.

Dependent Variable: the variable that depends on independent variables, the independent variable causes a change in the dependent variable. In this task, it will be the time difference between two conditions.

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

Now it's your chance to try out the Stroop task for yourself. Go to [this link](#), which has a Java-based applet for performing the Stroop task. Record the times that you received on the task (you do not need to submit your times to the site.) Now, download [this dataset](#) which contains results from a number of participants in the task. Each row of the dataset contains the performance for one participant, with the first number their results on the congruent task and the second number their performance on the incongruent task.

Null Hypothesis: the mean time that participants in two different conditions are same.

Alternative Hypothesis: the mean time that participants in two different conditions are not same.

$H_0: \mu_1 - \mu_2 = 0$

$H_A: \mu_1 - \mu_2 \neq 0$

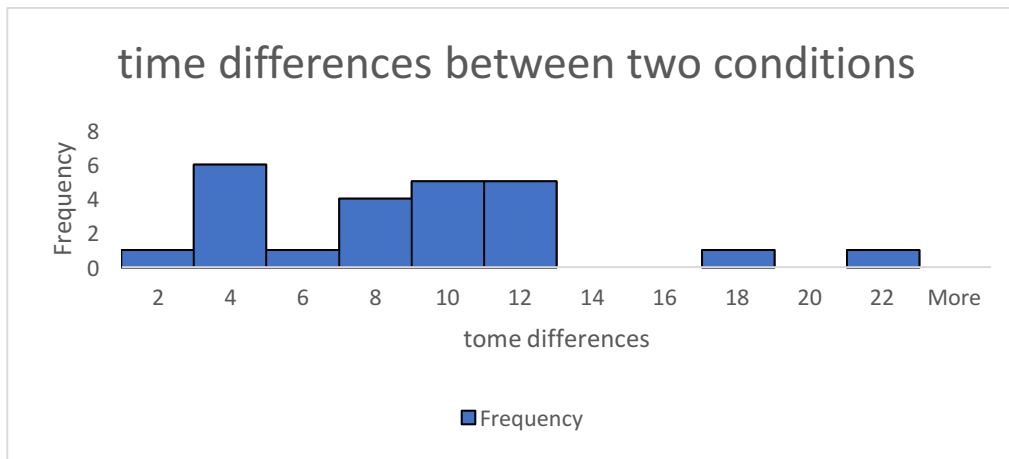
I would use t-test for the following reasons:

- 1. the population's standard deviation is unknown.*
- 2. the number of sample is less than 30.*
- 3. assume that the distributions are Gaussian.*

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

	<i>congruent words condition</i>	<i>incongruent words condition</i>
Mean	14.051125	22.01591667
Variance	12.66902907	23.01175704
Standard Deviation	3.559357958	4.797057122

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 most participants's time difference is 2-4 seconds, and more than half participants use 6-12 second in the incongruent words condition.

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?

Calculate the time differences: $\Delta t = t_2 - t_1$

Congruent	Incongruent	difference
12.079	19.278	7.199
16.791	18.741	1.95
9.564	21.214	11.65
8.63	15.687	7.057
14.669	22.803	8.134
12.238	20.878	8.64
14.692	24.572	9.88
8.987	17.394	8.407
9.401	20.762	11.361
14.48	26.282	11.802
22.328	24.524	2.196
15.298	18.644	3.346

15.073	17.51	2.437
16.929	20.33	3.401
18.2	35.255	17.055
12.13	22.158	10.028
18.495	25.139	6.644
10.639	20.429	9.79
11.344	17.425	6.081
12.369	34.288	21.919
12.944	23.894	10.95
14.233	17.96	3.727
19.71	22.058	2.348
16.004	21.157	5.153

The mean difference $\bar{\Delta t} = \frac{\sum \Delta t}{24} = 7.965$

Standard deviation of time difference $\sigma_{\Delta t} = \sqrt{\frac{1}{24} \times \sum_{i=1}^{24} (\Delta t_i - \bar{\Delta t})^2} = 4.865$

Standard Error of time difference $SE(\Delta t) = \frac{\sigma_{\Delta t}}{\sqrt{24}} = 0.993$

$t\text{-value} = \frac{\bar{\Delta t}}{SE(\Delta t)} = \frac{7.965}{0.993} = 8.021$

With 95% confidence interval, 23 degrees and the two-tail test, $p\text{-value}$ is 0.025, $t_{.975}=2.069 < 8.021$, so reject the null hypothesis, specifically, participants don't spend the same time in two different conditions.

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!

People always speak the words they saw directly but need time to process to say the color they observed. The alternative task could be like this: say the shape that surrounds the word, not what the word says. For example, you should say "triangle".

