

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?

The independent variable is the condition of the words, whether they are congruent or incongruent. The dependent variable is the time it takes the participant to say out loud the color of the ink of the word depending on whether the word condition is congruent or incongruent.

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.

The null hypothesis would be that the mean time it takes to say out loud the color of the ink of the word is not significantly different when the word condition is congruent or incongruent.

Thus, we let μ_C be the mean time it takes to say out loud the color of the ink of a congruent word. And we let μ_I be the mean time it takes to say out loud the color of the ink of an incongruent word. Mathematically, this would be:

H₀: $\mu_C = \mu_I$

The alternate hypothesis would be that the mean time it takes to say out loud the color of the ink of the congruent word is significantly different from the mean time it takes to say out loud the color of the ink of the incongruent word.

H₀: $\mu_C \neq \mu_I$

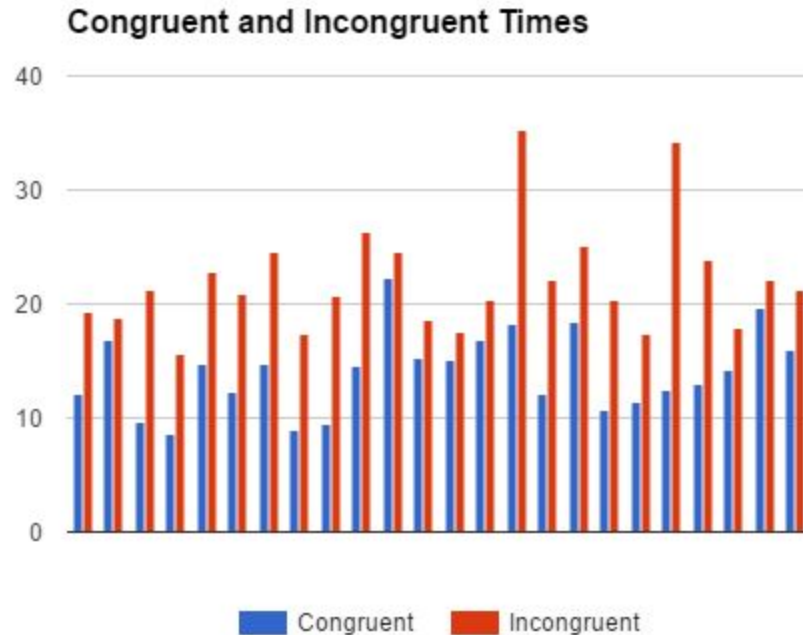
I would expect to perform a two sided (or “two-tailed”) dependent t-test since we don’t know what the true standard deviation and true mean are for the population. A t-test would also be appropriate as the sample size (n = 25) is less than 30. The t-test is dependent (as opposed to independent) as we are studying the same population for the two word conditions. Also, a t-test is appropriate since I am assuming that the population is normally distributed.

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 time when the word condition is congruent is 14.051 and the mean time when the word is incongruent is 22.0159. The standard deviation of the times when the word condition is congruent is 3.559 The standard deviation of the times when the word condition is incongruent is 4.797. The standard deviation of the differences is 4.865 and the standard error is 0.973. All measures have been rounded to 3 decimal places.

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 recorded times for when the word condition is incongruent is always greater across the board. There are at least two very noticeable data points on the right side of the plot where the difference between the two times are greater than the other participants’ times.



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?

For an alpha level of 0.05, the t-critical statistic value is ± 2.069 . I calculated a t-statistic of -8.021, which lies within the critical range so I would reject the null hypothesis. I conclude that the time it takes to say a word out loud is greater when the word condition is incongruent than when it is congruent. This is what I would expect since I would expect some mental dissonance for when the word's ink color is different from the word (e.g. ORANGE as in the above introduction). The participant would probably have to think about it a bit more when the word ink didn't match the word.

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!

The observed effect is probably due to cognitive bias (source: https://en.wikipedia.org/wiki/Cognitive_bias). When participants see a word and color together, they expect the color to match what is written so that the word condition is congruent. When the word condition is incongruent, the participants have to think about the color a bit more than when the word condition is congruent.