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?
   1. The independent variables are the condition of the words displayed. That is, congruent, or incongruent.
   2. The dependent variable is the difference in time between naming congruent colors and incongruent colors. Going forward this will be calculated as Incongruent time – Congruent time .
2. What is an appropriate set of hypotheses for this task? What kind of statistical test do you expect to perform? Justify your choices.
   1. We will be looking at otherwise stated as the mean of the differences between the congruent observations and the incongruent observations.
   2. Null: (Our null assumption is that the processing time does not change between differing conditions) and therefore the mean of the differences is 0, or not statistically different than 0.)
   3. Alternative: (Our first alternative hypothesis is that the processing time changes when moving to the incongruent condition. This is a two tails test).
   4. Alternative: (our second alternative hypothesis is that the processing time increases when moving to the incongruent condition).
   5. 99% confidence (alpha = 0.01)
   6. We will be doing a T-test (since we don’t know the population parameters) and will be comparing two different means to see if they are significantly different. Under the first test we will see if there was a change in processing time. In the second test we will look further to see if there was a slow down in processing time (as opposed to just a change).

Now it’s your chance to try out the Stroop task for yourself. Go to [this link](https://www.google.com/url?q=https://faculty.washington.edu/chudler/java/ready.html&sa=D&ust=1481988835097000&usg=AFQjCNFQ2TZeX0vYt0gvP0X_mPMT9jwqiw), 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](https://www.google.com/url?q=https://drive.google.com/file/d/0B9Yf01UaIbUgQXpYb2NhZ29yX1U/view?usp%3Dsharing&sa=D&ust=1481988835097000&usg=AFQjCNG9eDku__nk0XJUoeDp1fCpkfsnTQ) 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.

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

|  |  |  |  |
| --- | --- | --- | --- |
| Observations | 24 |  |  |
| Degrees Freedom | 23 |  |  |
|  |  |  |  |
|  | Congruent |  | Incongruent |
| Average | 14.051 |  | 22.016 |
| Median | 14.357 |  | 21.018 |
| Standard Deviation | 3.559 |  | 4.797 |
|  |  |  |  |
| Mean Difference | 7.965 |  |  |
| STD of Different | 4.865 |  |  |
| Standard Error | 0.993 |  |  |
|  |  |  |  |
| T Stat | 8.021 |  |  |

1. 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.
   1. In the below plot, we can see that there a appears to be an increase in processing time when moving to incongruent words and colors. The plot shows a general upward movement in times highlighted in the regression. However, there are also some outliers in the incongruent dataset (mean is much higher than median). So that could be throwing off the regression and visuals.
   3. To view this another way, I have created a histogram of the differences in means between the two methods of processing (congruent and incongruent). With no change, we would expect this to be somewhat centered on 0. Instead we see that there is not 1 observation below 0, which means that all of our sample took longer under the incongruent test.
   4. 
2. 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?
   1. T Critical value based on 2-tail (H1) and 99% confidence is +/- 2.087
   2. T Critical value based on 1-tail (H2) and 99% confidence is 2.500
   3. Based on the included spreadsheet, the T Stat for comparing a change in means is 8.021
   4. Since 8.021 is greater than the upper critical t value of 2.087 and 2.500, we reject the null hypothesis in both tests.
   5. Our t-stat is in the critical region showing us the processing times have shown a statistically significant change (H1) and that the change was in fact an increase in time (H2).
   6. This is what we would expect as it is more difficult to name the correct color under incongruent conditions.
3. 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!
   1. When attempting to complete the task, there are multiple pieces of information hitting your brain. Colors and words. In the congruent condition, they are both saying the same thing, and thus speed appears to be lower. Under the incongruent condition, they say different things to our brain. The extra processing time may come from parsing the information from the word, and the information from the color, identifying which is from the color, and then saying that one. We have gone from performing 1 task (reading), to 3 tasks (reading, parsing, identifying).
   2. Looking further into this, I went to (<https://faculty.washington.edu/chudler/words.html)>. There are two reasons listed there:
      1. Speed -> we can read words faster than colors. We could test this by having people read the word instead of the color and compare it to the incongruent time. If it was the same, then the speed at which we read words compared to colors doesn’t seem to impact.
      2. Selective Attention -> The fact that our brain requires more attention to name a color than a word.
   3. Other tasks that require us to differentiate information include anything where we have to choose where our attention goes and what is important. Some things that come immediately to mind include:
      1. Texting and driving
      2. Multitasking at work
      3. Listening to music and studying