

DATAANALYSTBLOGBLOG

Test a Perceptual Phenomenon – Stroop Effect

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Information

In cognitive psychology, the **Stroop effect** (or Jaensch effect) is an example of variation in reaction time while performing a specific task.

The task that is experiencing the Stroop effect is one in which you have to say aloud the color name with which a word is printed (for example, you have to say RED, when the word is printed in red), when the semantic meaning of such word is a different color from that with which it was printed (for example, the word green colored red).

The Stroop effect consists in the word of the color processing delay, which is reflected in a slowing of reaction times and the increase of errors in the incongruent condition (green word written in red) than that congruent (red word written in red) .

The effect is named after its discoverer, John Ridley Stroop, who published in 1935 the article Studies of interference in serial verbal reactions in the Journal of Experimental Psychology magazine. The article is one of the most cited works in the history of experimental psychology.

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

The **independent variable** is whether the words shown are congruent with the ink colors or if they are incongruent with ink colors

The **dependent variable** is the reaction 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.

Our **Null Hypothesis** would be the mean of the reaction time for the congruent sample will be equal to the mean of the reaction time for the incongruent sample.

Our **Alternative Hypothesis** would be the mean of the reaction time for the congruent sample will be significantly different from the mean of the reaction time for the incongruent sample.

However, we know that we are using limited data (based on our samples) in order to make inferences about the populations (and the **population means**). So, to explain the Null and alternative hypothesis in more accurate way, we may assume that:

Our **Null Hypothesis** is the average population reaction to execute the congruent task will be equal to the average population reaction to execute the incongruent task.

H₀: $\mu_{\text{congruent}} = \mu_{\text{incongruent}}$;

Our **Alternative Hypothesis** is the average population reaction to execute the congruent task will be significantly different from the average population reaction to execute the incongruent task.

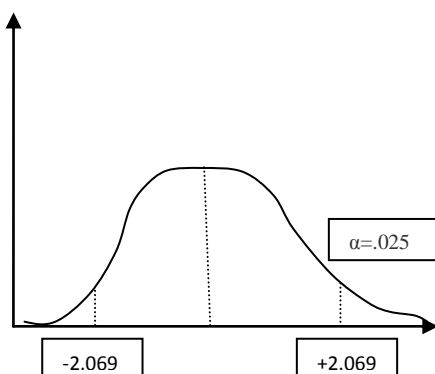
H_a: $\mu_{\text{congruent}} \neq \mu_{\text{incongruent}}$

We will use a **t-test** because we don't know population parameters and we aim to compare the means of the two related groups to determine whether there is a statistically significant difference between these means.

We have to use a dependent t-test (or "repeated-measures" statistical test) because, in our case, the same participants are tested more than once (i.e. are present in both groups).

The sample sizes are very small, therefore, the test is more sensitive to the assumption that both samples are drawn from populations with a normal distribution.

We are going to use a **two-tailed test** because, although we could argue that the effect will cause increased times for the incongruent condition group, we are looking for an effect in either direction, with $\alpha=.05$ to determine statistical significance.



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

Measures of Central Tendency

Mean for Congruent: 14.051125

Mean for Incongruent: 22.01591667

The **variability** means how spread out a group of these data?

We can say that the second group of data (incongruent) is more spread out, because the variance is bigger than the first group:

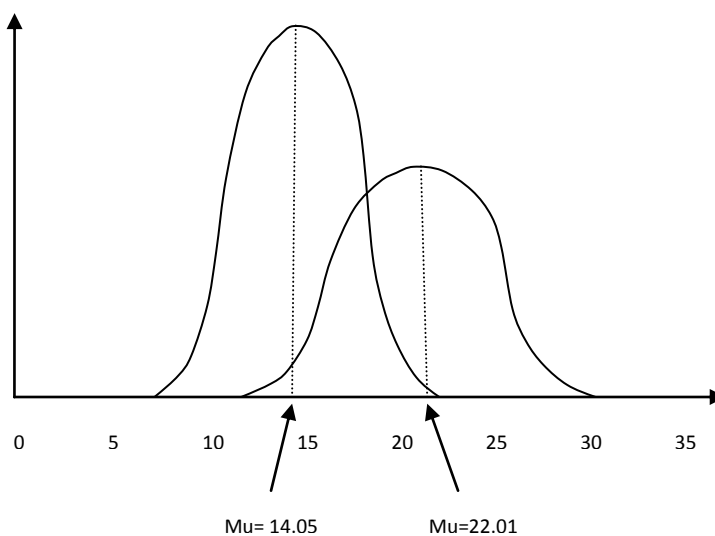
variancy_congruent = 12,66902909

variancy_incongruent = 23,01175791

Sd_congruent = 3,55935796

Sd_incongruent = 4,797057214

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.



We can note that:

- The congruent distribution is skinnier than the incongruent;
- The normal distributions differ in mean and standard deviation;
- The incongruent distribution is more spread up than the other one.

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?

We will find the t-critical values for a two-tailed test at $\alpha = 0.05$ (considering $df = 23$)

T-critical = 2.069

The confidence level is 95%.

Now we are going to calculate t-statistic:

t-statistic = M/SE

$SE = SD_{\text{between_two_samples}} / \sqrt{n}$

SD=4.86

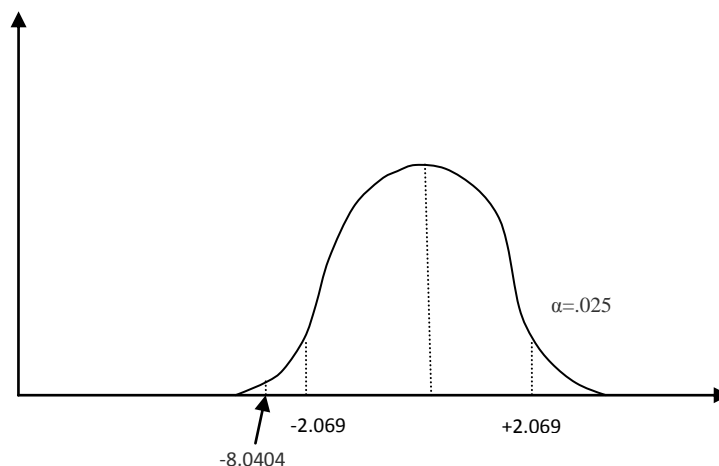
n= 24

$SE = 4.86/4.89 = 0.993865$

t-statistic = $(14.05 - 22.01) / 0.993865 = -8.0404$

We can note that t-statistic falls in the negative critical region, so we have to **reject the Null** because the t is **statistically significant**.

The Stroop effect is True. This it's OK with my expectation.



Now we calculate the Confidence Interval

CI = $M \pm \text{Critical values (SE)}$

CI = -10.01; -5.91

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 answer to the cause of the observed effect lies in our brain:

The two hemispheres of our brain (the right, creative, and the left, rational) go in conflict. The left hemisphere will try to read the written word, while the latter will try to read the color.

An alternative to the Stroop Color-Word Test (SCWT), denominated the Colored Numbers Test (CNT), was developed to evaluate the selective attention of illiterate individuals.

Reference

1. [Stroop effect – Wikipedia](#)
2. <https://books.google.it/books?id=6lbuAwAAQBAJ&pg=PA205&lpg=PA205&dq=effetto+stroop+emisfero+del+cervello&source=bl&ots=WpvAD6myGp&sig=3-w3Diw2Z98LrvDIJlEDXJnkZI&hl=it&sa=X&ved=0ahUKEwifuZ337bzPAhWF6x4KHVMuARgQ6AEIjAB#v=onepage&q=effetto%20stroop%20emisfero%20del%20cervello&f=false>
3. <http://www.tandfonline.com/doi/abs/10.1080/13854040601186964?journalCode=ntcn20>