Stroop Effect

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October 2017

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.

The stroop effect and the experiment were best explained in the last paragraph. The dependent variable are the time to name the ink color in two different conditions. This two conditions the congruent and the incongruent tests are the independent variable.

Analysis

In this study we will use a paired t-test to compare two population means of measures for two different treatments. The t-test is the most appropriate for this case first because we do not have the population parameters and second because we have a small sample. The t-test will show us how different the means are from each other and also how significant the differences are.

The null Hypothesis, H_0 , is that there is no difference in population means of response time under incongruent (μ_i) and congruent (μ_c) scenarios. Otherwise, the alternative hypothesis, H_a , assumes that there is a difference in population means of response time under incongruent (μ_i) and congruent (μ_c) conditions.

Hypothesis:
H_0: $\mu_i = \mu_c$
H_a : $\mu_i \neq \mu_c$

To perform this test we will calculate the difference for each subject between the second measure (incongruent condition) and the first measure (congruent condition) and then calculate the mean of the difference (μ_d).

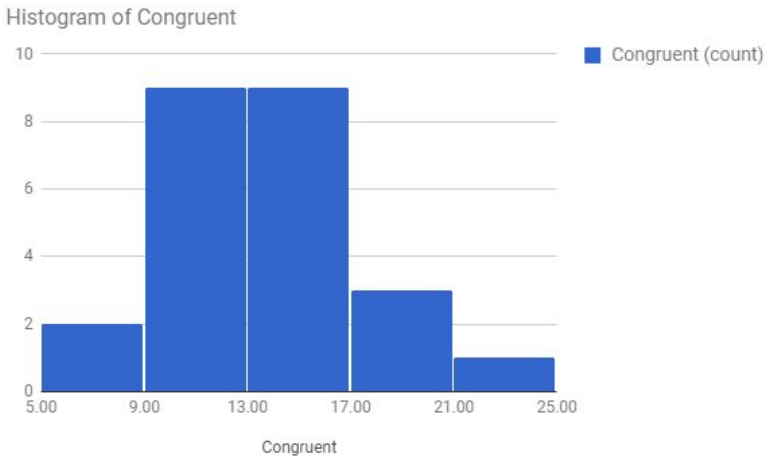
Some descriptive statistics over the sample:

	Congruent	Incongruent
count	24.000000	24.000000
mean	14.051125	22.015917
std	3.559358	4.797057
min	8.630000	15.687000
25%	11.895250	18.716750
50%	14.356500	21.017500
75%	16.200750	24.051500
max	22.328000	35.255000

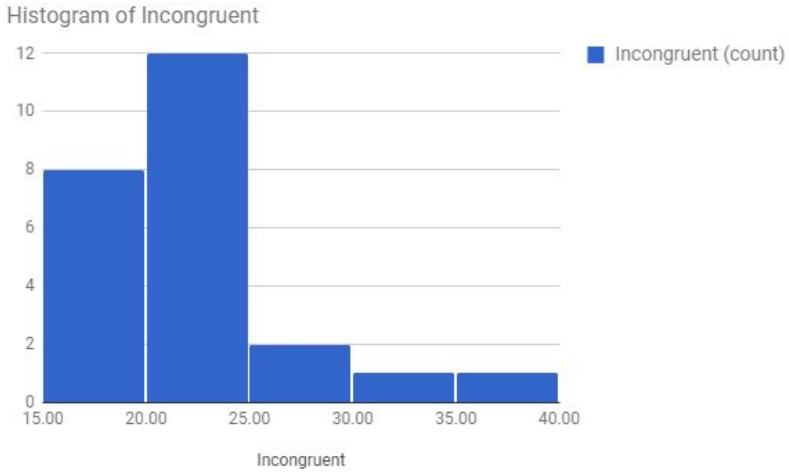
1 - Measures of center and variability of the sample.

	Difference
count	24.000000
mean	7.964792
std	4.864827
min	1.950000
25%	3.645500
50%	7.666500
75%	10.258500
max	21.919000

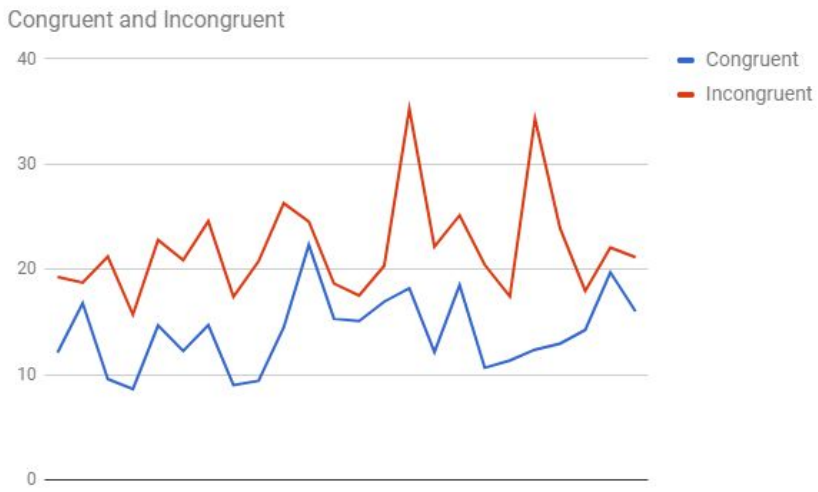
2 - Measures of center and variability of the difference.



3 - Histogram of congruent.



4 - Histogram of Incongruent.



5 - Line chart comparing the two measures.

T test results

With an α = .05 ; the t test results are t(23) = 8,02, p< .01, two tailed. Confidence interval on the mean difference ; 95% CI= (5.95, 9.98).

As expected regarding the descriptive analysis where the mean on congruent is equal 14.07 and incongruent 22.02 the difference are not by chance, they are statistically significant. Based on the results the P-value is less than the α level, so we reject the null hypotheses.

In psychology, the Stroop effect is a demonstration of interference in the reaction time of a task [1]. There are many studies that suggests the reasons behind this difference. The Stroop effect are named after John Ridley Stroop who first published the effect in English. Stroop used the Automaticity Theory to explain the interference, when the mind automatically determines the semantic meaning of the word and must intentionally check itself and identify instead the color of the word [1].

Other theories are also common like the selective attention and the parallel distributed processing. In the Selective Attention Theory the hypothesis is that color recognition as opposed to reading a word, requires more attention, the brain needs to use more attention to recognize a color than to word encoding, so it takes a little longer [1]. The Parallel Distributed Processing Theory suggests that as the brain analyzes information, different and specific pathways are developed for different tasks. Some pathways, such as reading, are stronger than others, therefore, it is the strength of the pathway and not the speed of the pathway that is important. In addition, automaticity is a function of the strength of each pathway, hence, when two pathways are activated simultaneously in the Stroop effect, interference occurs between the stronger (word reading) path and the weaker (color naming) path, more specifically when the pathway that leads to the response is the weaker pathway [1].

In my opinion the Parallel Distributed Processing Theory is a better explanation for the process mixing concepts of the Automaticity Theory (the reading is more strong than color recognition) and the Selective Attention Theory(takes more time because two pathways are created to process the information).

References

1 - Stroop Effect - Wikipedia [https://en.wikipedia.org/wiki/Stroop_effect].
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3 - Statistics - Paired T-Test - [http://www.statstutor.ac.uk/resources/uploaded/paired-t-test.pdf].
4 - T Test : definitions and examples [http://www.statisticshowto.com/probability-and-statistics/t-test/].
5 - Hypothesis Testing: T-Tests [https://erc.barnard.edu/spss/t_tests].