Stroop Effect Experiment

by Fred W. Y. Toh

1. The independent variable in this experiment is the ink color of the words in the two test conditions. The dependent variable is the time taken for the participant in naming the ink colors in those two test conditions.

2. Let μ_D be the mean time difference in the Stroop effect experiment. A negative difference means that the time taken in the incongruent words condition is longer than the time taken in the congruent words condition, i.e., it is slower to name the ink colors in the incongruent words condition. The following is the set of hypotheses taken:

Null hypothesis, H_0: $\mu_D = 0$

Alternate hypothesis, H_A: $\mu_D < 0$ (One-tailed t-test)

Since we expect that it is going to be slower to carry out the task in the incongruent words condition, a one-tailed test is appropriate. A t-test is chosen based on the sample size of 24. The alpha level chosen is 0.05.

I went ahead and took the experiment and recorded my timings. They are as follow:

Time taken in congruent words condition, $x_{CONGRUENT}$ = 17.283 s

Time taken in incongruent words condition, $x_{INCONGRUENT}$ = 26.439 s

time difference, x_D = -9.156 s

3. The following are as calculated from the dataset. See workings attached for details.

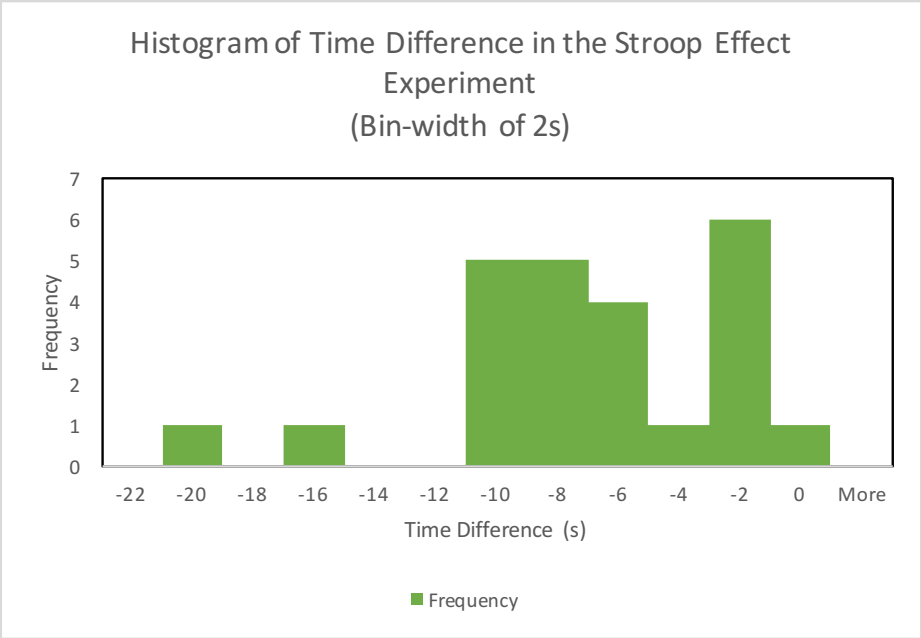
mean time taken in congruent words condition, $x\_bar_{CONGRUENT}$ = 14.051 s

mean time taken in incongruent words condition, $x\_bar_{INCONGRUENT}$ = 22.016 s

mean time difference, μ_D = -7.965 s

standard deviation of the differences in the sample, s_D = 4.865 s

4. The histogram below shows the time differences of the participants in the dataset. We note that the sample size is small and there is no distinct “bell curve” shape in the distribution. There also seem to be a couple of extreme values.



5. The statistical test is carried out as following:

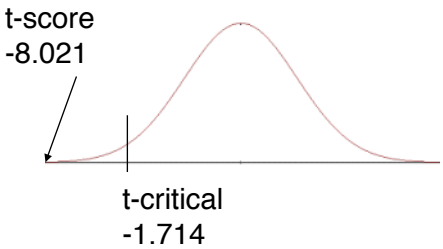
mean time difference, $\mu_D = -7.965$

standard deviation, $s_D = 4.865$

sample size, n = 24

standard error of the mean, se = 0.993

t-score = -8.021



At alpha = 0.05, degrees-of-freedom (dof) = 23,

$t\text{-critical}_{(23,0.05)} = -1.714$

Since the t-score of the sample distribution falls below the t-critical value, we reject the null hypothesis at 95% confidence level (i.e. alpha = 0.05).

Computing at 95% confidence interval around the sample mean of -7.965 s, we have the following:

t-critical$_{(23,0.025)}$ = 2.069

se = 0.993

Upper bound: -5.910 s

Lower bound: -10.019 s

My time difference was recorded at -9.156 s and it falls within the 95% confidence interval of the sample mean.

6. According to Eric H. Chudler, Ph.D. (See Ref. 3), there are two theories that may explain why it takes less time in the first part than the second part of the experiment. Note that in the first part, the participants may plainly read off the words since each color already matches the word even though the task is technically name the color, not read the word. Thus, there is the Speed of Processing Theory, which explains that it is plainly faster to read words than to name colors. The second theory is the Selective Attention Theory, which explains that it is not necessarily true that it is faster to read words than to name colors but when the brain is faced with words and colors, it prefers to process the words, even though the instruction is solely on the colors. And because of this confusion going on in the brain, it slows down the whole process.

For me, I wonder if there is a third component to the Stroop Effect that has not been explained for. In this case, we are presented with words that describe colors, which at the same time, we are tasked to deal with the colors, but not the words. It is evident that the association of the color words and the colors exists in the experiment. I note that the words are distracting even as I am intentionally shifting my attention on the colors. Thus I think the word/color association is also interfering the brain processing in this particular experiment.

Chudler suggests modifying the experiments, such as turning the words upside down or rotating them 90 degrees. I believe in this way we may then be able to control for the

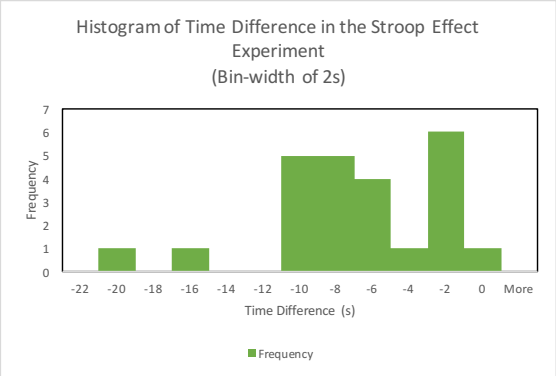
association effect. I think another approach could be switching out the color words with other kinds of words, say random adjectives, to see if the Stroop Effect persists.

EXTERNAL REFERENCES:

1. Data set of recorded timings stroopdata.csv, provided by uDacity
2. Stroop Effect experiment https://faculty.washington.edu/chudler/java/ready.html
3. Neuroscience for Kids https://faculty.washington.edu/chudler/words.html

Congruent	Incongruent	Difference	Squared Deviation From Mean	
12.079	19.278	-7.199	0.586	
16.791	18.741	-1.950	36.178	
9.564	21.214	-11.650	13.581	
8.63	15.687	-7.057	0.824	
14.669	22.803	-8.134	0.029	
12.238	20.878	-8.640	0.456	
14.692	24.572	-9.880	3.668	
8.987	17.394	-8.407	0.196	
9.401	20.762	-11.361	11.534	
14.48	26.282	-11.802	14.724	
22.328	24.524	-2.196	33.279	
15.298	18.644	-3.346	21.333	
15.073	17.51	-2.437	30.556	
16.929	20.33	-3.401	20.828	
18.2	35.255	-17.055	82.632	
12.13	22.158	-10.028	4.257	
18.495	25.139	-6.644	1.744	
10.639	20.429	-9.790	3.331	
11.344	17.425	-6.081	3.549	
12.369	34.288	-21.919	194.720	
12.944	23.894	-10.950	8.911	
14.233	17.96	-3.727	17.959	
19.71	22.058	-2.348	31.548	
16.004	21.157	-5.153	7.906	
			544.33	SUM
14.051	22.016	-7.965		AVERAGE

Bin	*Frequency*
-22	0
-20	1
-18	0
-16	1
-14	0
-12	0
-10	5
-8	5
-6	4
-4	1
-2	6
0	1
More	0



COMPUTED VALUES

median diefference	-7.667
mean difference	-7.965
sample size, n	24
sample std. dev. of the differences	4.865
standard error of the mean	0.993

HYPOTHESIS TEST:		DECISION:
H_0:	No difference	
H_a:	Slowed down (mean difference < 0)	
t-statistic	-8.021	Reject the null
dof	23	Because p < 0.05
alpha	0.05	
t-crit, (23,0.05)	-1.714	

95% CONFIDENCE INTERVAL:	
Sample mean	-7.965
Standard error	0.993
t-crit, (23,0.025)	2.069
Lower bound	-10.019
Upper bound	-5.910

OWN MEASUREMENTS:	
Congruent	17.283
Incongruent	26.439
Difference	-9.156
Conclusion:	Falls within the 95% confidence interval