The Stroop Task

Experiment

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.

Experiment Statistics

The experiment is performed on a set of participants for both congruent and incongruent word conditions. And the sample time and difference in times were recorded. With this experiment we try to figure out if there is a significant difference between time taken to read aloud the names of colors the words are printed in for congruent and incongruent words.

Independent variable: Word Color Congruency

Dependent variable: Time taken for each participant to name the ink color

Initial Data from Experiment

Congruent (T1)	Incongruent (T2)	T1 - T2
12.079	19.278	-7.199
16.791	18.741	-1.95
9.564	21.214	-11.65
8.63	15.687	-7.057
14.669	22.803	-8.134
12.238	20.878	-8.64
14.692	24.572	-9.88
8.987	17.394	-8.407
9.401	20.762	-11.361
14.48	26.282	-11.802
22.328	24.524	-2.196
15.298	18.644	-3.346
15.073	17.51	-2.437
16.929	20.33	-3.401
18.2	35.255	-17.055
12.13	22.158	-10.028
18.495	25.139	-6.644
10.639	20.429	-9.79
11.344	17.425	-6.081
12.369	34.288	-21.919
12.944	23.894	-10.95
14.233	17.96	-3.727
19.71	22.058	-2.348
16.004	21.157	-5.153

	Sample Average	-7.964791667
	Sample Standard deviation	4.86482691
	N	24
	Degree of Freedom	23

Congruent (T1) and Incongruent (T2)
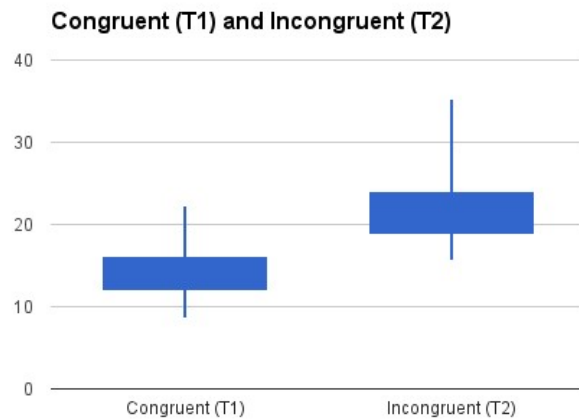
The box plots above show measures of central tendency for both congruent word and incongruent word reading tasks. For the sample provided, the minimum time taken for congruent and incongruent tasks is 8.63 seconds and 15.687 seconds respectively. Similarly maximum time taken for congruent and incongruent tasks is 22.328 seconds and 35.255 seconds respectively. Box plot also shows bottom and top 25% data values for Congruent and incongruent word tasks.

	Summary of the Data			
	Minimum	Lower Quartile	Upper Quartile	Maximum
Congruent (T1)	8.63	11.89525	16.20075	22.328
Incongruent (T2)	15.687	18.71675	24.0515	35.255

Frequency Distribution of Time Difference
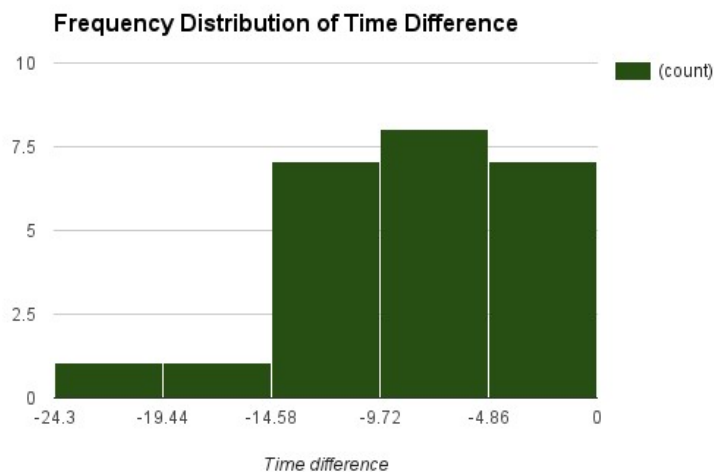
The graph above shows frequency distribution of time difference of the sample data. Participants of the sample on an average take 7.96 seconds more to read aloud the color of incongruent words than congruent words, with a variation of 4.86 seconds. The histogram is negatively skewed as all the participants in sample take more time to pass the incongruent words test than congruent words test.

Average time taken by participants for congruent words = μ_c = 14.05 seconds

Average time taken by participants for incongruent words = μ_i = 22.01 seconds

Null Hypothesis: Time taken to read aloud the color of congruent set of words is the same as time taken to read aloud the color of incongruent set of words

H_o: $\mu_c = \mu_i$ (or H_o: $\mu_c - \mu_i = 0$)

Alternate Hypothesis: Time taken to read aloud the color of congruent set of words significantly differs from time taken to read aloud the color of incongruent set of words.

H_a: $\mu_c <> \mu_i$ (or H_a: $\mu_c - \mu_i <> 0$)

Point estimate = $\bar{x}$ = $\mu_c - \mu_i$ = -7.96 seconds

<u>**Two tailed T test for dependent samples details**</u>

Assumption: We assume here that sample provided is a random sample of a defined robust population, and by central limit theorem for a larger sample size the distribution of differences of times taken for congruent and incongruent word tasks is normally distributed. The deviations are significant at a 0.05 level, but not so much that we could not justify using a t-test.

Since every participants take both test (tested more than once on same dependent variable undertow different conditions: repeated measures) and the task does not mention whether it will take higher or lower amount of time to read incongruent words color, hence with no sense of direction we will perform a two tailed T test for dependent samples(for 95% confidence).

Sample size is 24

Degree of freedom = 23

For an alpha value of 0.05 (95% confidence) the T critical values are ± 2.069

Point estimate = $\bar{x}$ = -7.96

Sample standard deviation = 4.86

T statistic = -7.96/(4.86/sqrt(24)) = -8.02

<u>**Decision**</u>

Since the t statistic is way smaller than t critical values for sample size, the probability of this sample mean is by chance is very low (Less than 0.0001). Hence we **Reject the Null** hypothesis.

So by our alternate hypothesis,

Time taken to read aloud the color of congruent set of words significantly differs from time taken to read aloud the color of incongruent set of words.

Ha: μc <> μi (or Ha: μc - μi <> 0)

As this was an experimental design we can say that the congruency of words had a causal effect on the Time taken to read the words.

Effect size measure

Cohen's d = -7.96/4.86 = -1.64

Confidence Interval for population mean = (-7.96 –(2.069*(4.86/sqrt(24))), -7.96 +(2.069*(4.86/sqrt(24)))))

= (-10.02,-5.91)

By the control interval on an average participants will take about 5 to 10 seconds less to read congruent word color than incongruent word color.

Personal Score as participant

Congruent words	19.08
Incongruent words	40.231

Yes the results did match up with my expectations; there was a significant difference between time taken to read congruent words and incongruent words. I took about 20 seconds less in reading the congruent words than incongruent words.

Explanation:

The words themselves have a strong influence over your ability to say the color. The interference between the different information (what the words say and the color of the words) your brain receives causes a problem. There are two theories that may explain the Stroop effect:

- Speed of Processing Theory: the interference occurs because words are read faster than colors are named.
- Selective Attention Theory: the interference occurs because naming colors requires more attention than reading words.

Some similar tasks could be

- Read words of one language written in script of another language
- Read negative Vs positive emotion/motivating words
- Read the words upside down or inside out or rotated on an angle
- Read non sense words
- Read long and short words
- Read words that are split colored

Link to spreadsheet

https://docs.google.com/spreadsheets/d/1e9aWP-7Ebh3UTpuy5kHuII3hoaWrbRM5fVUHXdGq174/edit?usp=sharing