Project: Test of a Perceptual Phenomenon

Introduction:

Stroop effect is one of the most famous phenomena in psychology. Stroop effect occurs when there is an interference in the psychology process. In this experiment, subjects took their time identifying the colours of the words rather than the words itself. If the colours and the words are consistent (for eg, the word PINK with font coloured in pink), this is a congruent stimuli. If the colours and words are different (for eg, the word PINK with font coloured in **black**), this is an incongruent stimuli.

Congruent Stimuli	Incongruent Stimuli
Orange	Blue
Yellow	Orange
Blue	Green

Figure 1: Examples of congruent and incongruent

Subjects have been reported of making more errors and take a longer time when presented with incongruent stimuli

Dataset:

This data was downloaded from Google Drive at Udacity Project: Test of Perceptual Phenomenon. Samples were gathered from 24 participants. Each participant took part in both the congruent and incongruent tasks and their time was recorded in the dataset.

Experimental design:-

This is a repeated measures design experiments since the same participants are doing the same experiments twice. The first task requires them to name the colours in Congruent Sample correctly. Then, they repeated the same task with Incongruent Sample.

Participants:-

A couple of assumptions were made regarding the participants of this experiment:-

1. Participants can understand words related to colours in English
2. Participants do not have visual challenges that prevent them from identifying colours (eg; colourblinds)

The participants took the test in controlled environment. It can be taken online or inside the lab. This is to ensure some lurking variables could be eliminated or its effects reduced.

Variables:

The independent variables in this experiment are the congruent and incongruent words.

The dependent variables are the time taken (in seconds) to name the font colours correctly.

Hypothesis:

Null hypothesis H_0 : There is no significance difference in mean of the time taken between congruent and incongruent sample

Alternate Hypothesis H_A**:** There is statistically difference in mean of the time taken between congruent and incongruent samples.

Note: The μ_d is used to denote the mean difference between the two populations.

$\mu_{d=} \mu_{Congruent} - \mu_{Inongruent}$

H_0: $\mu_d = 0$

$H_{A:} \mu_d \neq 0$

Statistical Test:

Paired t-test is chosen due to the hypothesis above, where we need to determine if the mean difference is zero. We also used t-test when we do not know the population parameters (ie, population standard deviation) and when our sample size is small, ie, less than 30 (in this case, n=24). In t-test, we will be using the t-distribution table. t-distribution curve is more spread out and has a thicker tails compared to the normal distributions due to this small sample size.

In paired sample, each participant is measured twice (with congruent and incongruent samples). The paired t-test made a few assumptions:-

- Variables can be measured in continuous scales (ie, time taken in seconds)
- Samples were selected randomly from the population
- This dataset is linked through repeated measurement (ie, the same participant is taking the same tests twice with different independent variables).
- No significant outliers in dependent variables (ie, the dataset is 'clean').

Descriptive Statistic Results:

	Congruent Task	Incongruent Task
Mean values (in seconds)	14.05	22.02
Standard Deviation	3.56	4.78

Calculations were done in MS Excel. The standard deviation above was derived by using the below formula:

$$s = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \overline{x})^2}{N-1}}.$$

Data Plots:

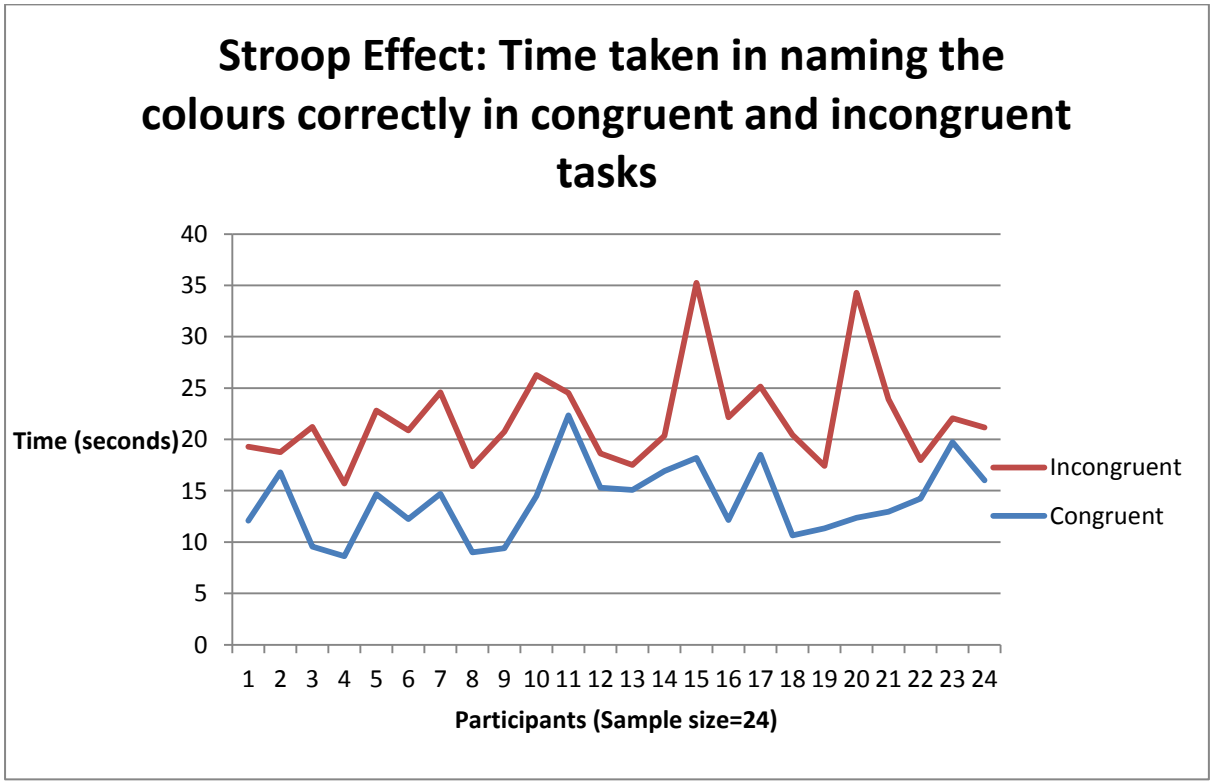

Figure 2: Comparison in time taken in naming the colours correctly in congruent and incongruent tasks.

Overall, all the participants took a longer time in naming the colours in incongruent task. The longest time it takes for a participant to name the correct colour is 35 seconds, while the shortest time for incongruent same is 16 seconds. Meanwhile, the longest time it takes for participant is 22 seconds in congruent task and their shortest time is 9 seconds.

Inferential:

The two-tailed p<0.0001 for t=-8.04 at df=23. This is a statistically significant result. In this case, we reject the null hypothesis. We accept the alternate hypothesis that $\mu_d \neq 0$.

Note: Calculations can be found in **Appendix: Inferential Calculation**

Discussion:

The result shows there is a statistically significant difference between congruent and incongruent words. Overall, participants took a longer time to get the correct colours when the words do not match.

Interestingly, Stroop Effect has showcased that most language processing is automated. Whenever we see a word, our brain is interpreting the meaning of the word first, only then we will notice that the colour did not match. It does place an importance in written words, and some interesting experiments can be done with non-native speakers to see if Stroop Effect also plays a major role.

Appendix: Inferential Calculation

Items	**Formula**	**Calculations and Results:**
Mean difference	$\bar{d}$	**= - 7.96**
Standard Deviation of the difference	**S_d**	**= 4.86**
Standard Error	$SE(\bar{d}) = \frac{s_d}{\sqrt{n}}$	$\frac{4.86}{\sqrt{24}} = \frac{4.86}{4.9}$ **= 0.99**
T-statistics	$T = \frac{\bar{d}}{SE(\bar{d})}$	$\frac{-7.96}{0.99}$ **= - 8.04**
p-value	t-table used: https://s3.amazonaws.com/udacity-hosted-downloads/t-table.jpg	**The two-tailed p< 0.0001 for t=-8.04 at df=23.**