Stroop Experiment

Background

In a Stroop task, participants are presented with a list of words, with each word displayed in a colour of ink. The participant's task is to say out loud the colour 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 colour words whose names match the colours in which they are printed: for example RED, BLUE. In the incongruent words condition, the words displayed are colour words whose names do not match the colours in which they are printed: for example PURPLE, ORANGE. In each case, we measure the time it takes to name the ink colours in equally-sized lists. Each participant will go through and record a time from each condition [1]

Experiment setup

The experiment attempts to determine whether it is more difficult or less difficult to associate words indicating colours to colours if the words are coloured with a colour that differs from the word.

The experiment participants will need to match incongruent words and congruent words. Their definition is in the Experiment background information-section.

The null hypothesis is hence the following:

$$H0 : x_{congruent} - x_{incongruent} = 0$$

And the alternative hypothesis:

$$H1 : x_{congruent} - x_{incongruent} \neq 0$$

The experiment test is therefore a two-sided statistical test to determine whether the two samples are different (in other words, whether their mean is different with a statistical significance).

Since we have no knowledge of the population parameters, a t-test will be used.

To determine statistical significance, the alpha level used will be the following:

$$\alpha = 0.95$$

Experiment data

The experiment consists of 21 samples of different individuals performing the experiment in both congruent and incongruent conditions. The data is provided as a .csv file.

Table 1 below defines some descriptive statistics for the dataset. As seen in the table, mean and median are quite close. And also, what is evident is that the mean-, median-, variance-, and std-values are significantly higher on the Incongruent sample dataset.

It should also be noted that the variances on the samples are not equal. Therefore a Welch's t-test should be used in the experiment analysis in favour of Students' t-test.

TABLE 1 - DESCRIPTIVE STATISTICS FOR BOTH SAMPLES

descriptive statistic	Congruent	Incongruent
mean	14.0511	22.0159
median	14.48	21.1570
variance	12.1412	22.0529
std	3.4844	4.6961

Figure 1 illustrates the distributions and the differences of both samples. As it can be seen, the incongruent timestamp and higher for every sample. And also they seem to higher by only a fixed amount (around 5s) with the exception of the final two data samples where the difference is higher.

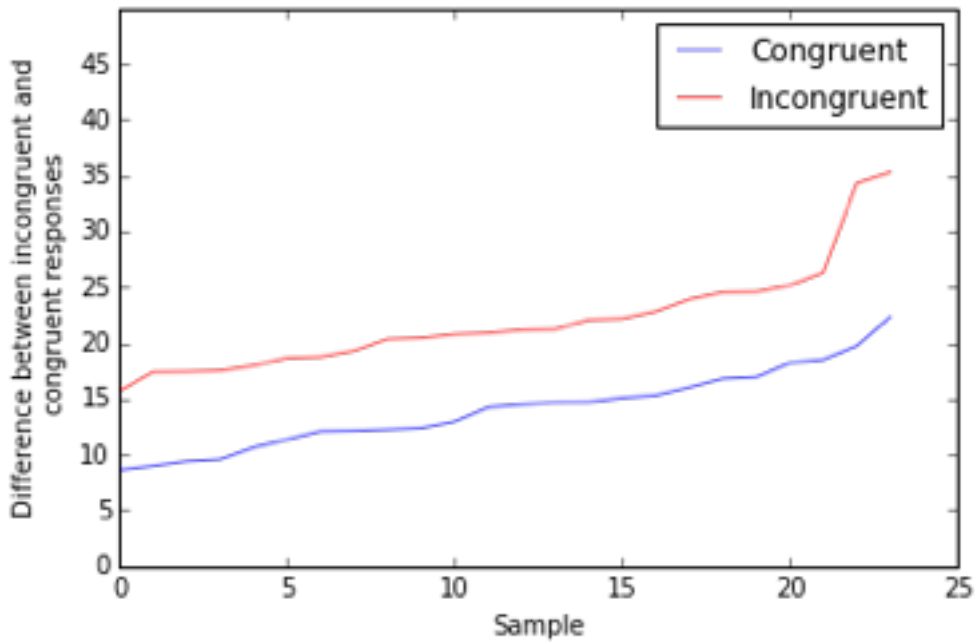

FIGURE 1 - CONGRUENT AND INCONGRUENT SAMPLE DISTRIBUTIONS

Based on the observations collected from the descriptive statistics and the distributions, it seems quite obvious that the incongruent responses take significantly longer than the congruent ones across the entire sample.

Experiment analysis

In the experiment, Welch's t-test is used to determine whether the sample means are equal with a statistical significance. As mentioned in the Experiment data-section, Welch's t-test should be used since the sample variances are not equal.

The experiment hypothesis are defined formally in the Experiment setup-section.

The experiment results are shown in Table 2.

TABLE 2 - WELCH'S T-TEST RESULTS

critical value (2-tail)	t-statistic	p-value	accept/reject null
0.25	6.53225	6.51017e-08	reject

Since the p-value is significantly less than the critical value, we reject the null hypothesis. Therefore we can conclude that the congruent and incongruent samples are different with statistical significance.

Conclusions

The experiment and it's results indicate that there indeed is a Stroop effect present in the samples collected. This result means that for the sample individuals it is clearly different to associate colors than it is to associate words. According to the experiment, it is a significantly more difficult cognitive task for humans to associate words than it is to associate colors.

References

[1] https://docs.google.com/document/d/1-OkpZLjG_kX9J6LIQ5IltsqMzVWjh36QpnP2RYpVdPU/pub