

# project 1: Test a Perceptual Phenomenon

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## Background Information

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.

## Questions For Investigation

### 1. What is our independent variable? What is our dependent variable?

- independent variable: the word, or more specific, the word condition (congruent or incongruent)
- dependent variable: the time it takes to name the ink colors in equally-sized lists

### 2. What is an appropriate set of hypotheses for this task? What kind of statistical test do you expect to perform? Justify your choices.

We have two sets of hypothesis test in the project. The first one is used to test the mean and the second one is to test the variance.

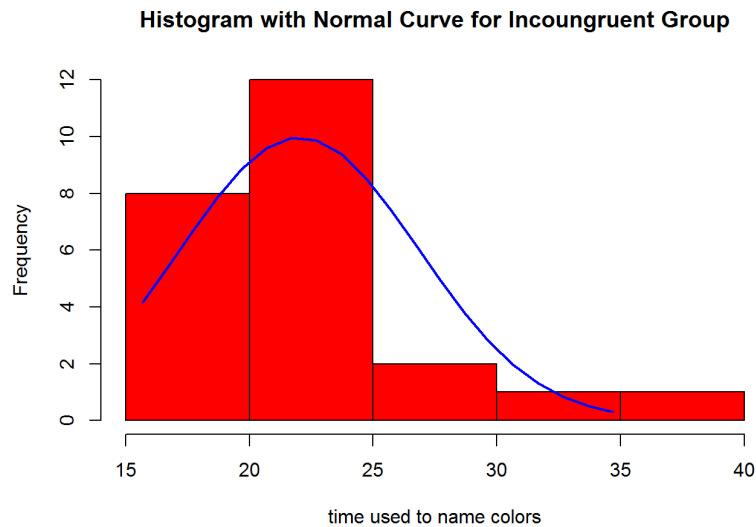
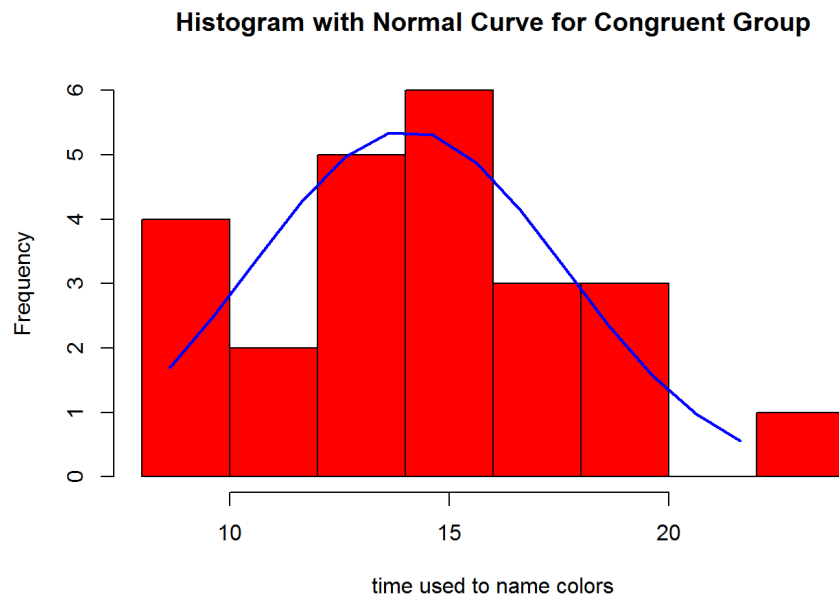
1. Set 1:
  - Null Hypothesis: Time takes to name the ink colors in the incongruent group is not longer than the one in congruent group.
  - Alternative Hypothesis: It takes longer time to name the ink colors in the incongruent group than the congruent group.
  - Statistical test: paired t-test. Paired t-test would outperform independent t-test in this case as two responding data in two groups were generated by the same individual.

- This is a one-tail test referencing the population. What we would like to know is based on the sample data we had, could we get to the conclusion that in general, it would take longer time for an individual to say the color of the word when interference was added.
1. Set 2:
- Null Hypothesis: Variance of time used in the Congruen Group is smaller than the one in the Incongruent Group.
  - Alternative Hypothesis: Variance of time used in the Congruen Group is greater than or equal to the one in the Incongruent Group.
  - Statistical test: F-test. F-test is used to test whether variances from two populations are equal.
  - This is a one-tail test referencing the population. What we want to infer from the sample is that, we know people performs differently from each other in the experiment, and whether this difference would be more obvious with the interference being added to the experiment.

**3. Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.**

- central tendency: Mean of "time" in Congruent Group is 14.05 and 22.02 in Incongruent Group.
- variability: Variance of "time" in Congruent Group is 12.669 and 23.01 in Incongruent Group.

4. Provide one or two visualizations that show the distribution of the sample data. Write one or two sentences noting what you observe about the plot or plots.



- Two histograms show the distributions of the time used to name ink colors for two groups. We can tell from the distributions that Incoungruent Group is more skew than

Congruent Group, which means data in this group has larger variance: people's behaviors in his group varied from each other more obviously than in the other group.

**5. Now, perform the statistical test and report your results. What is your confidence level and your critical statistic value? Do you reject the null hypothesis or fail to reject it? Come to a conclusion in terms of the experiment task. Did the results match up with your expectations?**

1. First we do paired t-test to test the hypothesis that "time used in the Congruent Groupd is not significantly less than time used in the other group."

```
##
## Paired t-test
##
## data: data[, 1] and data[, 2]
## t = -8.021, df = 23, p-value = 2.052e-08
## alternative hypothesis: true difference in means is less than 0
## 95 percent confidence interval:
##      -Inf -6.263
## sample estimates:
## mean of the differences
##      -7.965
```

- test result above shows that: in 95 percent confidence, p-value is smaller than 0.05, which leads to the rejection of the null hypothesis. This match our expectation that time used in the Congruent Group is significantly less than time used in Incongruent Group.
2. Then we do F-test to test the hypothesis that "Varience of time used in Congruent Groupd is not significantly less than that of time used in the Incongruent Group."

```
##
## F test to compare two variances
##
## data: data[, 1] and data[, 2]
## F = 0.5505, num df = 23, denom df = 23, p-value = 0.07993
## alternative hypothesis: true ratio of variances is less than 1
## 95 percent confidence interval:
##  0.000 1.109
## sample estimates:
## ratio of variances
##      0.5505
```

- test result above shows that: in 95 percent confidence, p-value is 0.07993, which is greater than 0.05. This leads to the failure to reject the null hypothesis, which does not match our expectation. This result shows that although people's performance is more

similar in the Congruent Group and differ more from each other in the Incongruent Group, this difference is not significant.

3. Final Conclusion: Time used to name colors in Congruent Group is significantly less than time used in the Incongruent Group. But differences of performances between people are not significantly affected by group.

**6. Optional: What do you think is responsible for the effects observed? Can you think of an alternative or similar task that would result in a similar effect? Some research about the problem will be helpful for thinking about these two questions!**

- In my point of view, it's the transformation from straight information to inferent information that leads to the difference in this two group. Similar task could be given a list of number and asked to name the order of the number in this list instead of the number itself.