

Project 1 for Test a Perceptual Phenomenon

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.

Question 1: Independent & Dependent Variable

- Independent Variable:
 - 1) The color of each word in a list of words.
 - 2) Congruent words condition and Incongruent words condition.
- Dependent Variable:
 - 1) Time: it takes to name the ink colors in equally-sized lists.

Question 2: Hypotheses & Statistical test

- 2a: Hypothesis:

In this dataset, we only have samples data, and do not have population data, therefore, we use sample means (Mean of Congruent: $\bar{x}_c = 14.05$, Mean of Incongruent: $\bar{x}_i = 22.02$) to infer the population means (μ_c, μ_i)

- 1) Null Hypothesis: The times that take both Congruent and Incongruent tests do not have significant difference. That is

the population mean for Congruent (μ_c) and the population mean for Incongruent (μ_i) have no significant difference.

$$H_0: \mu_c = \mu_i$$

2) Alternative Hypothesis: the time that takes Incongruent task is longer than the time that takes Congruent task.

$$H_a: \mu_i > \mu_c \text{ (One-tailed in positive direction)}$$

- 2b: Statistical Test: Dependent t-test for paired samples

From the task background and the dataset information, both Congruent and Incongruent samples measure the same subjects, they are depend paired samples with size under 30, we assume both samples are normal distribution, but we don't know the population standard deviation (estimated from your sample data). Base on the above relevant assumptions, a dependent t-test for paired samples is the most appropriate analysis.

The point of estimate for $\mu_c - \mu_i$: $\bar{x}_i - \bar{x}_c = 7.97$

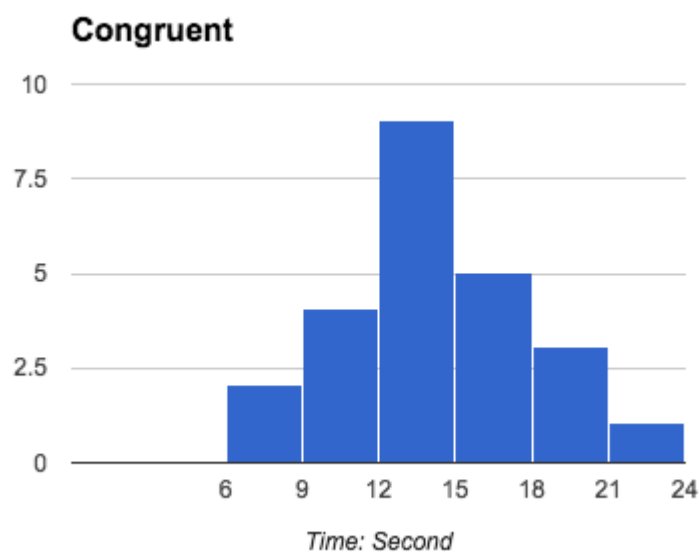
Question 3: Descriptive Statistics

- In this dataset, there are total 24 participants take two tasks (Congruent and Incongruent), all participants take more time on incongruent task than congruent task.
- Mean of Congruent: $\bar{x}_c = 14.05$, Median of Congruent = 14.36
- Mean of Incongruent: $\bar{x}_i = 22.02$, Median of Incongruent = 21.02
- Congruent sample standard deviation: $S_c = 3.56$
- Incongruent sample standard deviation: $S_i = 4.80$
- Standard deviation of two sample differences $S_d = 4.86$

Question 4: Visualizations

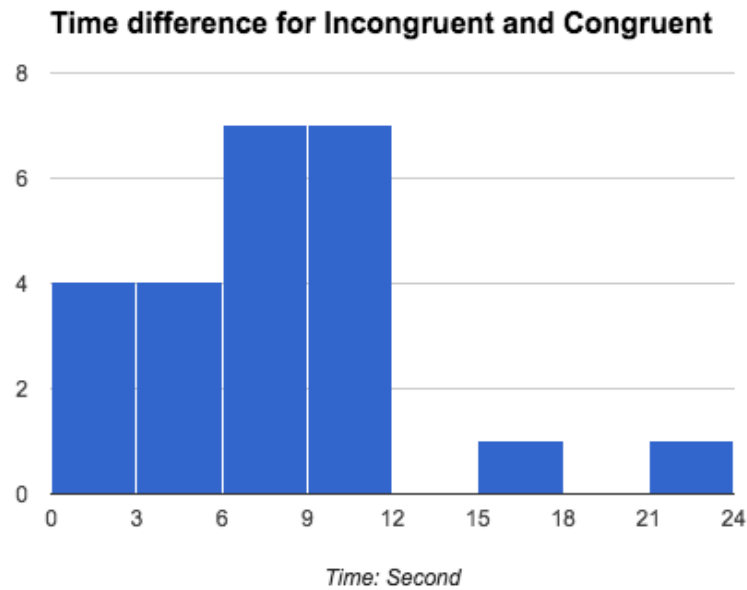
- Histogram of Congruent Sample:

Bin Size = 3, it is a normal distribution, where 95% of participants complete task within 21 seconds. Mode range is 12~15 seconds.

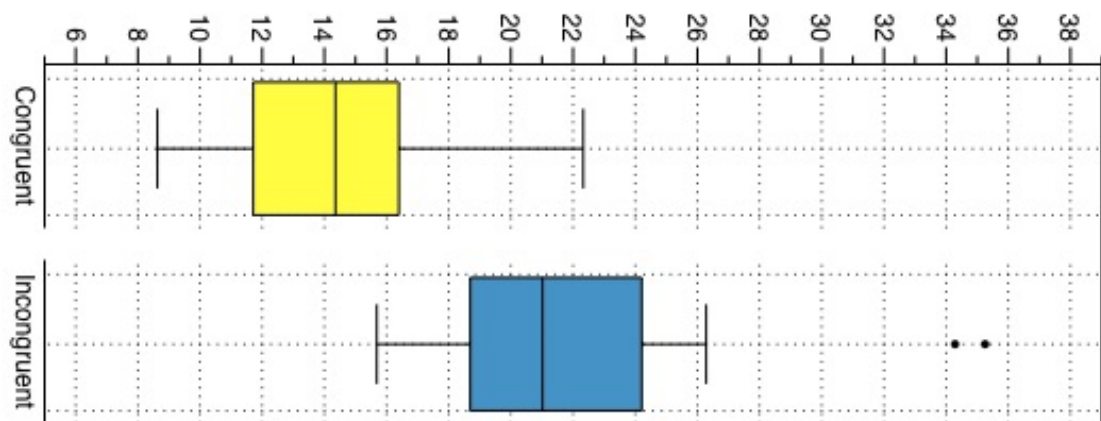


- Histogram of time difference:

Bin size = 3, it is a positive skew distribution, the time difference of 92% of participants is less than 12 seconds, Mode range is 6~12 seconds.



- Box plot shows the distribution and outliers.



Question 5: Inferential Statistics:

- Hypothesis test:
 - 1) Dependent t-test for paired samples ($\alpha=0.05$, one-tailed), $n=24$, $df=23$.
 - 2) By calculation:

$$\bar{x}_c = 14.05, \bar{x}_i = 22.02, S_d = 4.86, M_d = 7.96, SE = 0.99$$

$$t_{\text{critical}(0.05)} = 1.714, t = 8.02, P_{\text{value}} < 0.0001 < \alpha$$

$$95\% \text{ CI} = M_d \pm t_{(0.025)} \times SE = (5.91, 10.01)$$

3) Effect size measures:

$$\text{Cohen's } d = 1.64$$

$$r^2 = .73$$

According to the calculation that t_{value} is much bigger than t_{critical} , and P value less than α , so we reject the Null, which means congruent task takes longer than incongruent task. 95% of participants need more than about 6 ~ 10 seconds to finish the incongruent task. The results match up with my expectations.

Question 6: Effects observed

After looking up the Wikipedia, I knew that the Stroop task is to study the reaction time after interference, which has been widely used in psychology to measure a person's selective attention capacity and skills, as well as their processing speed ability. It is also used in conjunction with other neuropsychological assessments to examine a person's executive processing abilities, and can help in the diagnosis and characterization of different psychiatric and neurological disorders.

The Stroop test has additionally been modified to include other sensory modalities and variables, to study the effect of bilingualism, or to investigate the effect of emotions on interference, like **Warped words**, the warped words Stroop effect produces the same findings similar to the original Stroop effect. Much like the Stroop task, the printed word's color is different from the ink color of the word; however, the words are printed in such a way that it is more difficult to read (typically curved-shaped). The idea here is the way the words are printed slows down both the brain's reaction and processing time, making it harder to

complete the task.

References

- *Wikipedia: Stroop effect*
- Udacity forum: discussions.udacity.com
- Udacity Statistics course
- David R. Anderson, Dennis J. Sweeney, Tomas A. Williams
Statistics for Business and Economics (11th Edition)