Testing a perceptual phenomenon

Introduction

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.

1.Variables of Interest

- Independent variable: Word list (congruent/incongruent)
- Dependent variable: Response Time in seconds

2. Hypothesis

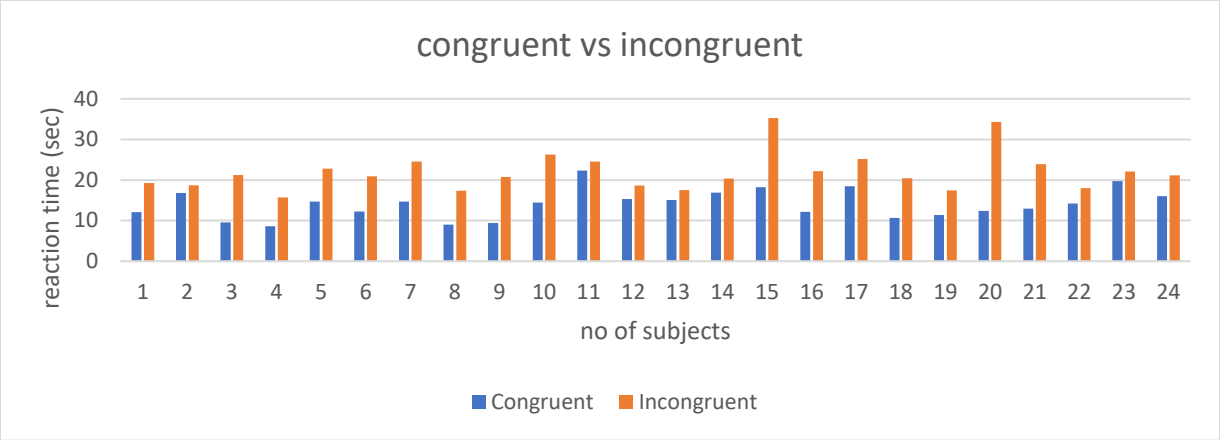
$\mu_{congruent}$ - Population mean of reaction time in congruent setting
$\mu_{Incongruent}$ -Population mean of reaction time in incongruent setting

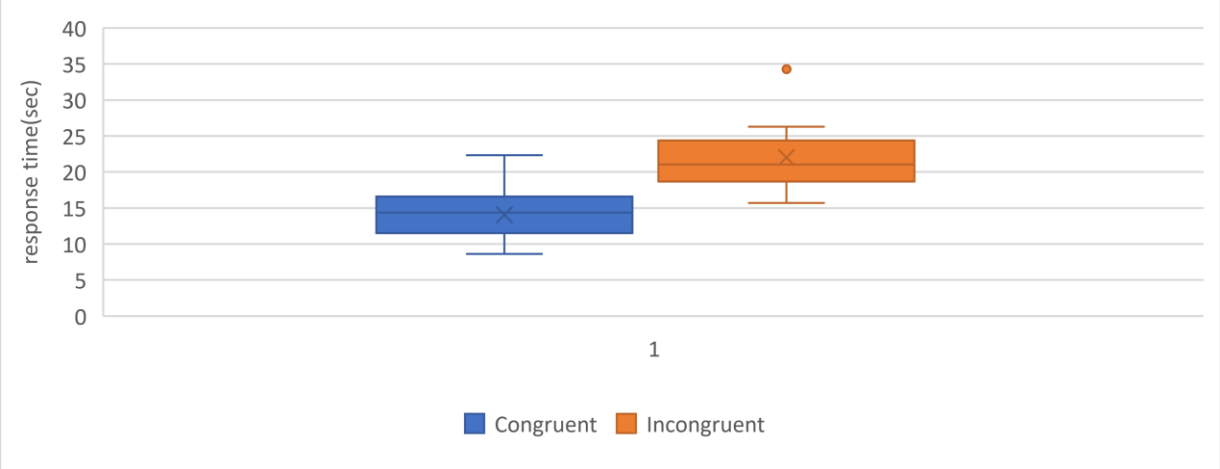
- $H_0 = \mu_{Iincongruent} - \mu_{congruent} \leq 0$ (The mean time it takes to complete incongruent test is less than or equal to the mean time it takes to complete the congruent test)
- $H_A = \mu_{Incongruent} - \mu_{congruent} > 0$ (The mean time it takes to complete incongruent test is greater than the mean time it takes to complete the congruent test)
- As we have a small sample size($n<30$), The appropriate test to perform is the paired one sample right tailed t-test, as the test is performed on the same sample for congruent and incongruent inputs, and no population parameters were provided. We anticipate the parameter to be greater than the hypothesized value so we use right tailed t-test.
- To perform the t-test we assume our data to be approximately normally distributed

3. Descriptive Statistics

- Congruent setting
  Average = 14.05
  Corrected standard deviation= 3.55
- Incongruent setting
  Average = 22.01
  Corrected standard deviation= 4.79
- Sample mean of time difference = 7.96
- Standard deviation of time difference = 4.86

4. Visualizations





A higher response time is observed among the subjects in an incongruent setting when compared to the reaction time in the congruent setting. Few outliers can be observed in incongruent setting from the box plot which means response time is significantly higher in the incongruent setting. A statistical test is necessary to confirm the results.

5. Statistical test

```
> mydata=read.table("stroopdata.txt",header=T)
> mydata
   Congruent Incongruent
1     12.079      19.278
2     16.791      18.741
3      9.564      21.214
4      8.630      15.687
5     14.669      22.803
6     12.238      20.878
7     14.692      24.572
8      8.987      17.394
9      9.401      20.762
10    14.480      26.282
11    22.328      24.524
12    15.298      18.644
13    15.073      17.510
14    16.929      20.330
15    18.200      35.255
16    12.130      22.158
17    18.495      25.139
18    10.639      20.429
19    11.344      17.425
20    12.369      34.288
21    12.944      23.894
22    14.233      17.960
23    19.710      22.058
24    16.004      21.157
```

```
> t.test(x=mydata$Incongruent,y=mydata$Congruent,mu=0,alternative="greater",conf.level=0.95,paired=T)

        Paired t-test

data:  mydata$Incongruent and mydata$Congruent
t = 8.0207, df = 23, p-value = 2.052e-08
alternative hypothesis: true difference in means is greater than 0
95 percent confidence interval:
 6.262868      Inf
sample estimates:
mean of the differences
               7.964792
```

Confidence level = 95%

α = 0.05

t-statistic = 8.0207

t-critical value = 1.71387153

As the t-statistic is greater than the t-critical value at alpha level 0.05, we reject the null hypothesis

Conclusion: we can conclude that the time it takes for a subject to complete the test in an incongruent setting is larger than the time it takes for the same subject to complete the test in a congruent setting.