Test a Perceptual Phenomenon - Stroop Effect

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?

Dependent variable: Time to name ink colours

Independent variable: Word Condition (congruent/incongruent)

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

Hypothesis test:

I choose 't-test'. Why?

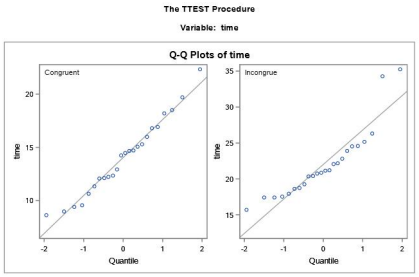
H0: $\mu 0 \leq \mu a$

HA: $\mu 0 > \mu a$

In this analysis, I am curious about whether people spend different time to read in either congruent or incongruent condition.

The following assumptions are required for t-test for dependent means:

1) They are independent observation



2) Q-Q plots shown the data is roughly normally distributed.

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	23	23	1.82	0.1599

3) The F Value in Equality of Variances equals to 1.82, more than 1, so it is the evidence against the assumption of variance equality.

A one-tailed test is appropriate under the assumption.

3. Report some descriptive statistics regarding this dataset.

Variable: time

wordCondition	N	Mean	Std Dev	Std Err	Minimum	Maximum
Congruent	24	14.0511	3.5594	0.7266	8.6300	22.3280
Incongrue	24	22.0159	4.7971	0.9792	15.6870	35.2550
Diff (1-2)		-7.9648	4.2238	1.2193		

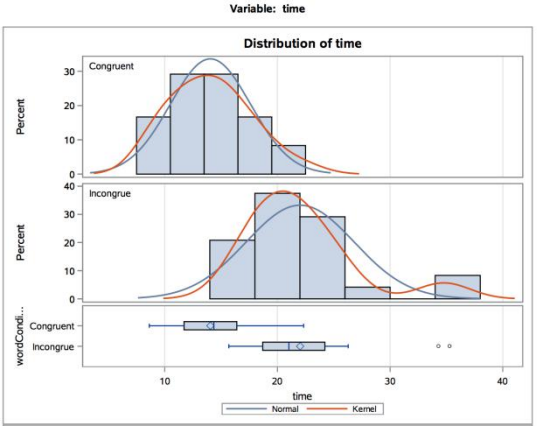
Congruent:

Mean: 14.05; SD: 3.6

Incongruent:

Mean: 22.02; SD: 4.80

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.



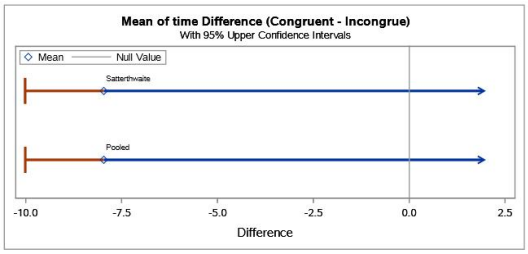
Congruent tasks appear to be consistently completed faster than incongruent tasks.

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?

wordCondition	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Congruent		14.0511	12.5481	15.5541	3.5594	2.7664	4.9929
Incongrue		22.0159	19.9903	24.0415	4.7971	3.7283	6.7291
Diff (1-2)	Pooled	-7.9648	-10.0116	Infty	4.2238	3.5099	5.3050
Diff (1-2)	Satterthwaite	-7.9648	-10.0151	Infty			

Method	Variances	DF	t Value	Pr > t
Pooled	Equal	46	-6.53	1.0000
Satterthwaite	Unequal	42.434	-6.53	1.0000

Because the variance is equal, so I choose the pooled method, and the Pr>t equals to 1, this number bigger than α 0.05. So time is significantly different between congruent and incongruent task. The mean under 95% confident level from -10.01 to infinity, include 0, still support I don't have enough evidence to say that the difference of the means is significantly different from 0 at the 95% confident level. All of these, support our null hypothesis which people have low speed when the word's meaning and its color dis-match. The result confirms my expectation.



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!

The brain is focus on reading the word first rather than recognizing the color when the eyes are presented with a colored word. So when the word dis-match to the color, there is a time gap brain needed to override the natural tendency to reading the word. This process will costs more time for people recognize text-color .

"Warped Words" is similar situation.