

## Assignment 8: Within-Subjects T-Test vs. Between-Subjects T-Test

Due: Wednesday, November 19<sup>th</sup> on Canvas

### Part 1: Within-Subjects T-Test

**Within-subjects:** each participant completes both conditions; each person serves as his/her own control  
-Samples are Dependent or Paired

(1) Open "Assignment8\_DataFile" in SPSS

--Go to "Variable View" and assure all data is "Type: Numeric"

--Note: each row represents 1 participant

--You should have 4 columns for each participant:

(a) Condition

-1 = Interference / Control

-2 = Control / Interference

(b) Section

-1 = 9am

-2 = 3pm

(c) Interference

-how long it takes in the right-side-up condition

-time should be in seconds

(d) Control

-how long it takes in the upside-down condition

-time should be in seconds

(2) Click "Analyze" → Click "Compare Means" → Click "Paired-Samples T-Test"

(a) Move "Interference" over into Variable 1

(b) Move "Control" over into Variable 2

(c) Click "Options"

→ Assure that the "Confidence Interval Percentage" is set to 95%

→ Click "Continue"

→ Click "OK"

(3) SPSS Output

→ You should get 3 tables:

(a) Paired-Samples Statistics

(b) Paired-Samples Correlations

(c) Paired-Sample Test

(4) Within-Subjects Interpretation

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	Interference - Control	2.667	9.977	1.663	-.709	6.042	1.604	35	.118

  

**Mean of the Differences**  
 $\bar{X}_D$  OR  $\bar{D}$

**t-obtained**  
You compare this value to t-critical

$$t = \frac{\bar{X}_D - \mu_D}{SEM}$$

$$t = \frac{2.667 - 0}{1.663}$$

t = 1.604

**Degrees of Freedom**  
N - 1

**Significance Level**  
The difference is significant only if this value is less than .05

Here, you conclude there is no significant difference

**SEM**  
Calculated by dividing SD by the  $\sqrt{N}$

$$SEM = \frac{9.977}{\sqrt{36}} = 1.623$$

**Note:** Is there a significant difference between conditions? Simply look at the *Significance Level* (i.e., “Sig. (2-tailed)”) and compare it to your alpha value, which in most cases is .05. The Significance Level tells you the probability that the difference observed between conditions (interference mean – control mean = 2.667) is due to chance. If the probability is less than .05, then we decide to reject the null hypothesis. If we reject the null, we conclude that there is a significant difference between the 2 conditions. The other information (i.e., Mean, SD, SEM, t, df) is reported so you can report it in a research paper and so have a more complete idea as to what is going on between groups.

[The next 3 steps (5-7) demonstrate by performing a One-Sample T-test on the difference scores (Condition 1-Condition 2, you get the exact same results as a Paired-Sample T-test)]

- (5) Click “Transform” → Click “Compute Variable”  
 -Fill in “Target Variable” as *Difference Scores*  
 -Numeric Expression: “Interference – Control”  
 → Click “OK”

-Note: A new column labeled “Difference Scores” will appear in the spreadsheet

(6) Now, you will perform a One Sample T-Test on the Difference Scores to demonstrate that what a Within-Subjects T-Test is showing. You are basically testing whether the average difference score is significantly different from 0.

- Click “Analyze” → Click “Compare Means” → Click “One Sample T-Test”
- Move “Difference Scores” over into “Test Variable(s)”
- Set Test Value to 0

- (7) You will get 2 Output Tables  
 (a) One-Sample Statistics  
 (b) One-Sample Test

→ Observe the output values and compare to the Paired-Samples T-Test. They should be identical. Take home: Paired-samples T-test is just like a One-Sample T-test, except it is performed on the difference scores.

## Part 2: Independent Means T-Test

Using the same data file as in Part 1, you will now ask a different research question. The Paired-Samples T-test assessed whether there was a difference between conditions (interference vs. control). However, now you want to assess whether there was an effect of order. Said another way, does the order in which you complete the 2 conditions matter? It is possible that practice or fatigue effects produce these order effects.

→ This analysis requires an Independent-Means T-Test

**-Between-subjects:** you have 2 separate groups of participants and you compare them to each other  
 -samples are Independent  
 -this test will usually be less sensitive (i.e., will have less statistical power) than a dependent means t-test, but in instances like these, it is more appropriate given our question

- (1) Click “Analyze” → Click “Compare Means” → Click “Independent-Samples T-Test”
  - Move only “Interference” to “Test Variables”
  - Move “Condition” to “Grouping Variable”
    - Click “Define Groups...”
      - Group 1: 1
      - Group 2: 2
    - Click “Continue” → “OK”

**T-Test**

[DataSet0] C:\Users\jess\Desktop\Assignment8\_DataFile.sav

Group Statistics					
	Condition	N	Mean	Std. Deviation	Std. Error Mean
Interference	1	18	36.61	11.392	2.685
	2	18	32.56	10.711	2.525

Independent Samples Test											
		Levene's Test for Equality of Variances			t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper	
Interference	Equal variances assumed	.384	.539	1.100	34	.279	4.056	3.686	-3.435	11.546	
	Equal variances not assumed			1.100	33.871	.279	4.056	3.686	-3.436	11.547	

→ Look at the Sig. (2-tailed value) – is it less than .05?

- (3) Click “Analyze” → Click “Compare Means” → Click “Independent-Samples T-Test”
  - Move only “Control” to “Test Variables”
  - Move “Condition” to “Grouping Variable”
    - Click “Define Groups...”
      - Group 1: 1
      - Group 2: 2
    - Click “Continue” → “OK”

**T-Test**

[DataSet0] C:\Users\jess\Desktop\Assignment8\_DataFile.sav

Group Statistics					
	Condition	N	Mean	Std. Deviation	Std. Error Mean
Control	1	18	30.50	13.263	3.126
	2	18	33.33	11.077	2.611

Independent Samples Test											
		Levene's Test for Equality of Variances			t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper	
Control	Equal variances assumed	.113	.739	-.696	34	.491	-2.833	4.073	-11.111	5.444	
	Equal variances not assumed			-.696	32.95	.492	-2.833	4.073	-11.120	5.454	

→ Look at the Sig. (2-tailed value) – is it less than .05?

- (4) Click “Analyze” → Click “Compare Means” → Click “Independent-Samples T-Test”  
 → Move only “Difference Scores” to “Test Variables”  
 → Move “Condition” to “Grouping Variable”  
 → Click “Define Groups...”  
 → Group 1: 1  
 → Group 2: 2  
 → Click “Continue” → “OK”

• T-Test

[DataSet0] C:\Users\jess\Desktop\Assignment8\_DataFile.sav

Group Statistics

Condition	N	Mean	Std. Deviation	Std. Error Mean
Difference 1	18	6.1111	10.45938	2.46530
Difference 2	18	-.7778	8.39156	1.97791

Independent Samples Test

		Levene's Test for Equality of Variances		t-Test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Difference	Equal variances assumed	.238	.629	2.180	34	.036	6.88889	3.16067	.46564	13.31214
	Equal variances not assumed			2.180	32.488	.037	6.88889	3.16067	.45450	13.32328

→ Look at the Sig. (2-tailed value) – is it less than .05?

**Assignment 8: What to hand in?**

**Tables from Part 1:**

- (a) Paired Samples Statistics on Interference vs. Control
- (b) Paired Samples Correlations on Interference vs. Control
- (c) Paired Sample Test on Interference vs. Control
- (d) One-Sample Statistics on Difference Scores
- (e) One-Sample Test on Difference Scores

**Tables from Part 2:**

- (a) Group Statistics on Interference
- (b) Independent Samples T-Test on Interference
- (c) Group Statistics on Control
- (d) Independent Samples T-Test on Control
- (e) Group Statistics on Difference Scores
- (f) Independent Samples T-Test on Difference Scores

**Follow-up questions:**

(1) Paired-Sample T-test

→ What were the degrees of freedom used in the *Paired-Sample T-Test*: \_\_\_\_\_

→ What was the significance level for the *Paired Sample T-Test on Interference vs Condition*: \_\_\_\_\_

(2) Independent-Sample T-test

→ What were the degrees of freedom used in the *Independent-Sample T-Test*: \_\_\_\_\_

→ What was the significance level for the *Independent Sample T-Test on Interference*: \_\_\_\_\_

→ What was the significance level for the *Independent Sample T-Test on Control*: \_\_\_\_\_

→ What was the significance level for the *Independent Sample T-Test on Difference Scores*: \_\_\_\_\_

(3) Why are the degrees of freedom different in the Paired-Sample T-Test and the Independent-Sample T-Test?

\_\_\_\_\_

(4) Were any of the t-test significant? \_\_\_\_\_

-If yes, which one(s): \_\_\_\_\_

(5) I want to compare performance between the 9am section and the 3pm section.

(a) Is this between-subjects or within-subjects? \_\_\_\_\_

(b) Which procedure would I run in SPSS? \_\_\_\_\_