Repeated Measures Twoway Analysis of Variance

A researcher was interested in whether frequency of exposure to a picture of an ugly or attractive person would influence one's liking for the photograph. In order to find out the researcher, at the start of each class he taught, pinned a large photograph of an ugly and attractive person in front of the class. At the end of the class period the students in the class were asked to rate on a 7 point liking scale the extent to which they found the persons depicted in the photos to be likeable on a scale similar to the one below.

unlikeable -3 -2 -1 0 1 2 3 likeable

The psychologist posted the pictures at the start of each class period and had the students rate their liking for the two pictures at the end of the lst class, again after 5 classes and finally again after 10 classes. Thus **each** student gave **3 ratings** for **each** of the two photographs (after 1 exposure, 5 exposures and 10 exposures).

To summarize, the researcher manipulated two variables. They were type of photograph (ugly, attractive) and frequency of exposure (1 time, 5 times, and 10 times). **Each student** was in **all** conditions of the experiment so we have a two factor repeated measures ANOVA (2 x 3 to be exact). The researcher then recorded the liking scores that each student gave in the following table.

Column Independent Variable
Frequency of Exposure

		Column 1 (Day 1)	**Column 2** (Day 5)	**Column 3** (Day 10)
	John	1	2	3
	Sue	2	1	3
Attractive Photo	Sally	2	2	2
(Row 1)	Frank	1	1	3
Row Independent Variable				
	John	-1	-2	-3
	Sue	0	0	-2
Ugly Photo	Sally	-1	-1	-3
(Row 2)	Frank	-2	-1	-3

1. Logon to system
2. **Click Start > Programs > SPSS for Windows > SPSS 10.1 for Windows**. At this point a window will appear asking you what you would like to do. Click on the circle next to Type in Data (2nd option in list) and then click **OK** at the bottom of the window.
3. A Data Editor will appear. Look in the lower left corner of the screen. You should see a **Data View** tab and to the right of it a **Variable View** tab. The **Variable View** tab will be used first for the Data **Definition** Phase of creating a data file. The Data **View** tab will be used to actually enter the raw numbers listed above. (See pages 1-3 for a more detailed explanation of creating data files.)

DATA DEFINITION PHASE

4.   Click on the **Variable View** tab in the lower left corner. A new screen will appear with the following words at the top of each column.
Name Type Width Decimals **Label Values** Missing Columns Align Measure

5.   Click on the white cell in **Row 1** under the word **Name** and type in the word **day1att**
6.   Click on the white cell in **Row 1** under the word **Label** and type in **day1 attractive**. (Doing this will provide you with a more expansive label in the results output).
7.   Click on the white cell in **Row 2** under the word **Name** and type in the word **day5att**
8.   Click on the white cell in **Row 2** under the word **Label** and type in **day5 attractive** (Doing this will provide you with a more expansive label in the results output).
9.   Click on the white cell in **Row 3** under the word **Name** and type in the word **day10att**
10.   Click on the white cell in **Row 3** under the word **Label** and type in **day10 attractive** (Doing this will provide you with a more expansive label in the results output).
11.   Click on the white cell in **Row 4** under the word **Name** and type in the word **day1ugly**
12.   Click on the white cell in **Row 4** under the word **Label** and type in **day1 ugly** (Doing this will provide you with a more expansive label in the results output).
13.   Click on the white cell in **Row 5** under the word **Name** and type in the word **day5ugly**
14.   Click on the white cell in **Row 5** under the word **Label** and type in **day5 ugly** (Doing this will provide you with a more expansive label in the results output).
15.   Click on the white cell in **Row 6** under the word **Name** and type in the word **day10ugl** (notice the y in ugly is not typed because variable names are limited to 8 characters).
16.   Click on the white cell in **Row 6** under the word **Label** and type in **day10 ugly** (Doing this will provide you with a more expansive label in the results output).

DATA ENTRY PHASE

17.   Click on the **Data View** tab in the lower left corner. The data **view** screen will now appear with Column 1 named **day1att**, Column 2 named **day5att**, Column 3 named **day10att**, Column 4 named **day1ugly**, Column 5 named **day5ugly**, and Column 6 named **day10ugl**
18.   Enter the **six** responses for each of the 4 participants (John through Frank). The six columns of numbers represent respectively participant responses for the conditions attractive day1; attractive day5; attractive day10; ugly day1; ugly day5; and ugly day10. Thus for John mouse to column 1 and enter:

1 tab 2 tab 3 tab -1 tab -2 tab -3 enter	(Then mouse to row two column 1 to enter the data for Sue etc.)
2 tab 1 tab 3 tab 0 tab 0 tab -2 enter	(These are Sue's responses)
2 tab 2 tab 2 tab -1 tab -1 tab -3 enter	(These are Sally's responses)
1 tab 1 tab 3 tab -2 tab -1 tab -3 enter	(These are Frank's responses)

Data Analysis

1.   Click **Analyze** at top of screen then
    a.   Click on **General Linear Model** then
    b.   Click on **GLM-Repeated Measures** (When you do this a **Define Factor(s)** Box will appear)
2.   In the within subject **Factor** name space, type in the word **appear** (for appearance) and then
    a.   Click on the Number of **Levels** space and enter a **2** since there are two levels of appearance and then
    b.   Click the **Add** button: appear(2) will now appear in the bottom white box
3.   In the within subject **Factor** name space, type in the word **day** and then

a.   Click on the Number of **Levels** space and enter a **3** since there are three levels of days and then

      b.   Click the **Add** button: day(3) will also appear in the bottom white box

4.   Click on the **Define** button. A list of the 6 conditions of the experiment will appear on the left and a series of   ? [1,1] will appear on the right

5.   Click on **day1att** to highlight it and then the right arrow to move it to the [1,**1**] slot

6.   Click on **day5att** to highlight it and then the right arrow to move it to the [1,**2**] slot

7.   Click on **day10att** to highlight it and then the right arrow to move it to the [1,**3**] slot

8.   Click on **day1ugly** to highlight it and then the right arrow to move it to the [**2**,1] slot

9.   Click on **day5ugly** to highlight it and then the right arrow to move it to the [**2**,2] slot

10.   Click on **day10ugl** to highlight it and then the right arrow to move it to the [**2**,3] slot

11.   Click on **OK**. Doing this will then result in the analysis being conducted. These results are below.

12.   After the results of the analysis of variance appear, to get **descriptive** statistics like the **mean** and **standard deviations** for each group of the experiment

      a.   Click on **Analyze** then

      b.   Click on **Descriptives** and you will get a descriptives box. Make sure all treatment names are in the **variables** box.

      c.   Click **options** and make sure mean and standard deviation are checked.

13.   Click **Continue**

14.   Click **OK.** Results of the analysis will then emerge in the results output at the tail end of the file.

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
APPEAR	Pillai's Trace	.980	147.000[a]	1.000	3.000	.001
	Wilks' Lambda	.020	147.000[a]	1.000	3.000	.001
	Hotelling's Trace	49.000	147.000[a]	1.000	3.000	.001
	Roy's Largest Root	49.000	147.000[a]	1.000	3.000	.001
DAY	Pillai's Trace	.250	.333[a]	2.000	2.000	.750
	Wilks' Lambda	.750	.333[a]	2.000	2.000	.750
	Hotelling's Trace	.333	.333[a]	2.000	2.000	.750
	Roy's Largest Root	.333	.333[a]	2.000	2.000	.750
APPEAR * DAY	Pillai's Trace	.964	27.000[a]	2.000	2.000	.036
	Wilks' Lambda	.036	27.000[a]	2.000	2.000	.036
	Hotelling's Trace	27.000	27.000[a]	2.000	2.000	.036
	Roy's Largest Root	27.000	27.000[a]	2.000	2.000	.036

a. Exact statistic

b.

   Design: Intercept

   Within Subjects Design: APPEAR+DAY+APPEAR*DAY

Mauchly's Test of Sphericity[b]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[a] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
APPEAR	1.000	.000	0	.	1.000	1.000	1.000
DAY	.720	.657	2	.720	.781	1.000	.500
APPEAR * DAY	.667	.811	2	.666	.750	1.000	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b.
Design: Intercept
Within Subjects Design: APPEAR+DAY+APPEAR*DAY

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
APPEAR	Sphericity Assumed	73.500	1	73.500	147.000	.001
	Greenhouse-Geisser	73.500	1.000	73.500	147.000	.001
	Huynh-Feldt	73.500	1.000	73.500	147.000	.001
	Lower-bound	73.500	1.000	73.500	147.000	.001
Error(APPEAR)	Sphericity Assumed	1.500	3	.500		
	Greenhouse-Geisser	1.500	3.000	.500		
	Huynh-Feldt	1.500	3.000	.500		
	Lower-bound	1.500	3.000	.500		
DAY	Sphericity Assumed	.333	2	.167	.600	.579
	Greenhouse-Geisser	.333	1.563	.213	.600	.548
	Huynh-Feldt	.333	2.000	.167	.600	.579
	Lower-bound	.333	1.000	.333	.600	.495
Error(DAY)	Sphericity Assumed	1.667	6	.278		
	Greenhouse-Geisser	1.667	4.688	.356		
	Huynh-Feldt	1.667	6.000	.278		
	Lower-bound	1.667	3.000	.556		
APPEAR * DAY	Sphericity Assumed	12.000	2	6.000	18.000	.003
	Greenhouse-Geisser	12.000	1.500	8.000	18.000	.008
	Huynh-Feldt	12.000	2.000	6.000	18.000	.003
	Lower-bound	12.000	1.000	12.000	18.000	.024
Error(APPEAR*DAY)	Sphericity Assumed	2.000	6	.333		
	Greenhouse-Geisser	2.000	4.500	.444		
	Huynh-Feldt	2.000	6.000	.333		
	Lower-bound	2.000	3.000	.667		

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	APPEAR	DAY	Type III Sum of Squares	df	Mean Square	F	Sig.
APPEAR	Linear		73.500	1	73.500	147.000	.001
Error(APPEAR)	Linear		1.500	3	.500		
DAY		Linear	.250	1	.250	.600	.495
		Quadratic	8.333E-02	1	8.333E-02	.600	.495
Error(DAY)		Linear	1.250	3	.417		
		Quadratic	.417	3	.139		
APPEAR * DAY	Linear	Linear	9.000	1	9.000	54.000	.005
		Quadratic	3.000	1	3.000	6.000	.092
Error(APPEAR*DAY)	Linear	Linear	.500	3	.167		
		Quadratic	1.500	3	.500		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	.667	1	.667	.857	.423
Error	2.333	3	.778		

Descriptive Statistics

	N	Mean	Std. Deviation
day1 attractive	4	1.5000	.57735
day5 attractive	4	1.5000	.57735
day10 attractive	4	2.7500	.50000
day1 ugly	4	-1.0000	.81650
day5 ugly	4	-1.0000	.81650
day10 ugly	4	-2.7500	.50000
Valid N (listwise)	4		

15. For the problem above the null and alternative hypotheses are spelled out below:

   Hnull: a) The mean liking responses for all appearance conditions will be equal (there will be no main effect for appearance).
   b) The mean liking responses for all day conditions will be equal (there will be no main effect for point in time when the liking evaluations are given).
   c) There will be no interaction between appearance and day of evaluation (the pattern of responses for the attractive photo across days will be no different than the pattern of responses for the ugly photo across days).

   Halt: a) The mean liking responses for the attractive photo will not equal the mean liking responses for the ugly photo (there will be a main effect for appearance).
   b) The mean liking responses for all day conditions will not be equal.
   c) The pattern of responses for the attractive photo across days will be different than the pattern of responses for the ugly photo across days.

16. **Interpretation and APA writing template for Results Above**

   A 2 x 3 repeated measures two way analysis of variance was conducted to determine whether attractiveness of photo and frequency of exposure to that photo influenced how much participants liked that photo. Results of the analysis indicated a main effect for photo attractiveness, $\underline{F}$ (1,3) = 147.00, $\underline{p}$ < .05, with the attractive photo ($\underline{M}$ = 1.916) liked more than the ugly photo ($\underline{M}$ = -1.583). There was no main effect for frequency of exposure to the photo, $\underline{F}$ (2,6) = .60, $\underline{p}$ > .05. The mean liking evaluations on day 1, after 5 days of exposure, and after 10 days of exposure were respectively 0.25, 0.25, and 0.00. There was, however, a significant attractiveness of photo by frequency of exposure interaction, $\underline{F}$ (2,6) = 18.00, $\underline{p}$ < .05. A Tukey test indicated that within the attractive condition, frequency of exposure did not significantly influence liking for the photograph. A comparison of the liking evaluations on day 1 ($\underline{M}$ = 1.50, $\underline{SD}$ = .577), day 5 ($\underline{M}$ = 1.50, $\underline{SD}$ = .577) and day 10 ($\underline{M}$ = 2.75, $\underline{SD}$ = .50) indicated that none of the differences between conditions were significant, $\underline{p}$ >.05. In contrast the Tukey test indicated that on day 10 participants had a significantly *less* favorable liking evaluation for the ugly photo ($\underline{M}$ = -2.75, $\underline{SD}$ = .50) than they did on either day 1 ($\underline{M}$ = -1.00, $\underline{SD}$ = .816), or day 5 ($\underline{M}$ = -1.00, $\underline{SD}$ = .816), $\underline{p}$ < .05.