

2 x 2 Within-Subjects ANOVA

This worksheet will take you through the steps to practice the procedure for using SPSS to analyse data from studies where more than one within-subjects IV has been studied for their effect upon a DV. The specific analysis documented here is a 2 x 2 within-subjects ANOVA.

We will use the example of data collected to rate *attractiveness of candidate* (DV). For this study, you are interested in looking at the following within-subjects IV's:

- Gender – within-subjects with two levels [female / male]
- Facial expression – within-subjects with two levels [smiling / neutral]

Remember that, when you have within-subjects IV's, all participants are exposed to, or take part in, **all** combinations of the conditions presented by the IV's. So, in this case, there are four conditions:

1. Female and smiling
2. Female and neutral
3. Male and smiling
4. Male and neutral

Scores for the DV (attractiveness) are taken in all four conditions.

Step 1)

Input the variables into the 'variable view' as shown below, making sure to create your within-subjects variables appropriately.

	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
1	F_Smiling	Numeric	8	2		None	None	8	Right	Scale	Input
2	F_Neutral	Numeric	8	2		None	None	8	Right	Scale	Input
3	M_Smiling	Numeric	8	2		None	None	8	Right	Scale	Input
4	M_Neutral	Numeric	8	2		None	None	8	Right	Scale	Input

Step 2)

Click back to the 'Data view' tab and enter the data as shown below. The DV of attractiveness scores are provided for each of the four conditions/

	 F_Smiling	 F_Neutral	 M_Smilin g	 M_Neutra l
1	30.00	17.00	20.00	19.00
2	28.00	15.00	25.00	23.00
3	21.00	20.00	17.00	27.00
4	20.00	14.00	11.00	28.00
5	24.00	22.00	10.00	24.00
6	26.00	23.00	16.00	30.00
7	24.00	11.00	14.00	24.00
8	25.00	12.00	14.00	20.00
9	19.00	18.00	20.00	23.00
10	25.00	20.00	18.00	27.00
11	19.00	16.00	16.00	28.00
12	28.00	21.00	17.00	20.00
13	24.00	10.00	12.00	26.00
14	25.00	15.00	15.00	25.00
15	28.00	15.00	17.00	23.00
16	30.00	16.00	16.00	19.00
17	18.00	19.00	20.00	27.00
18	26.00	18.00	14.00	30.00
19	27.00	14.00	16.00	29.00
20	30.00	20.00	18.00	28.00
21				

Remember: one row of data = one participant

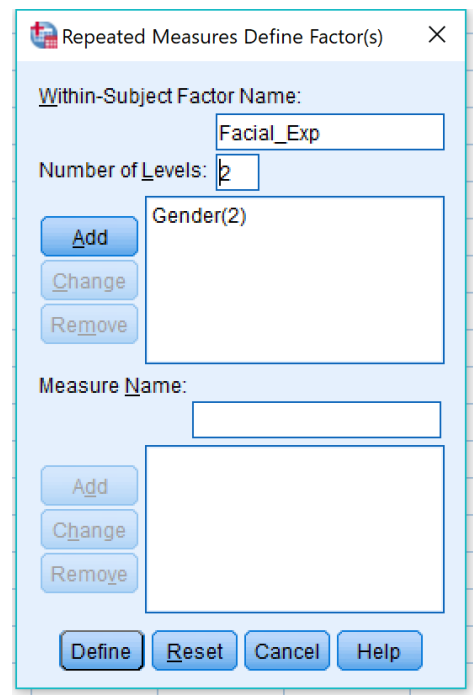
Step 3)

Now you can start to run the ANOVA analysis. On the 'Analyze' menu, selection the option for 'General linear model' and then the option for 'Repeated measures'.

You will see the following dialogue box. You need to define each of the two within-subjects IV's here:

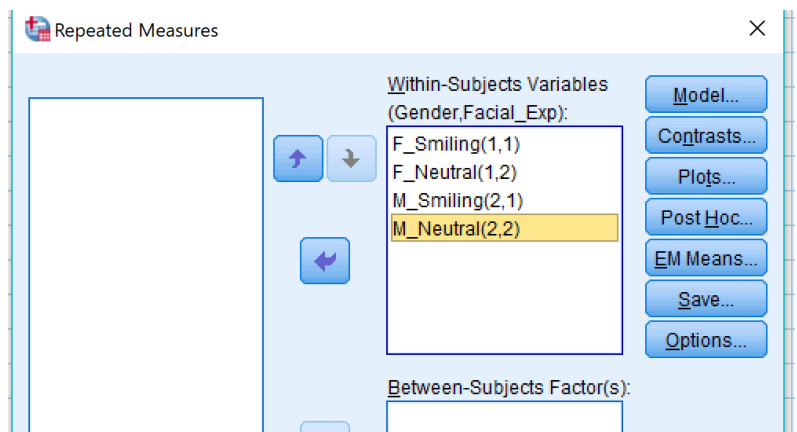
1. Gender – 2 levels (Add)
2. Facial_exp – 2 levels (Add)

Click Define.



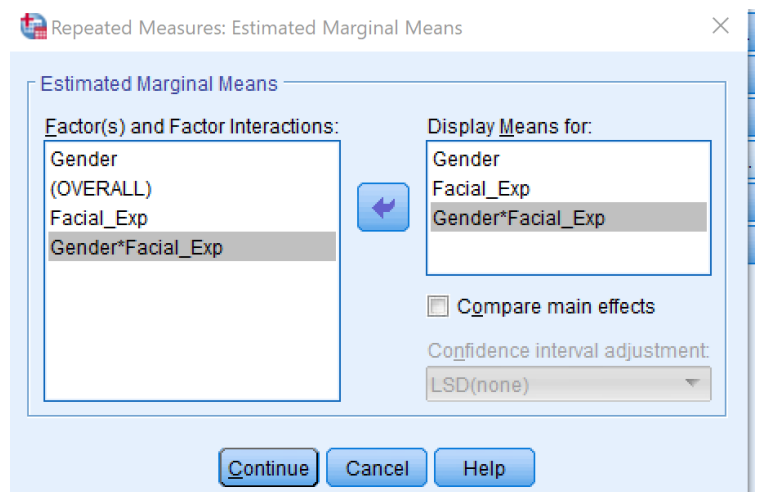
Step 4)

Move each of the four conditions to the box labelled 'Within-subjects variables'.



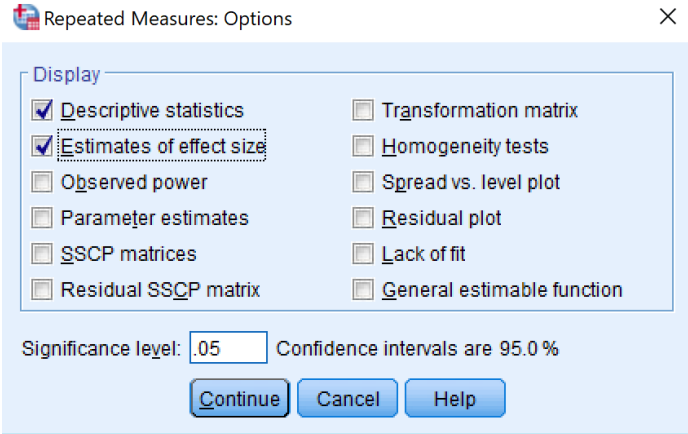
Step 5)

Select 'EM Means'. Here, select the three options shown to the box labelled 'Display means for'. Click Continue.



Step 6)

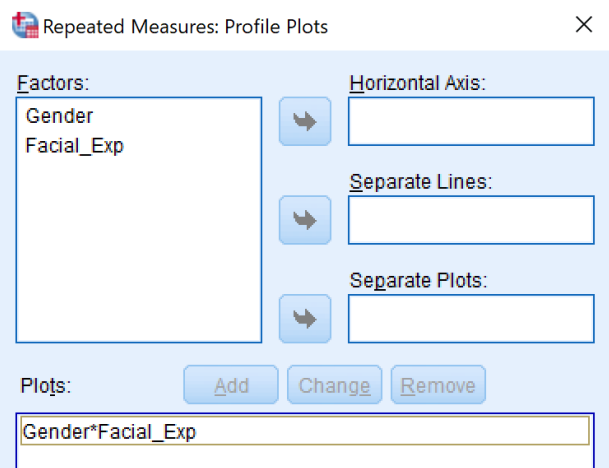
Now, select the 'Options' button and select '**Descriptive statistics**' and '**Estimates of effect size**'. Click Continue.



The 'Repeated Measures: Options' dialog box is shown. Under the 'Display' section, the following options are checked: 'Descriptive statistics', 'Estimates of effect size', 'Observed power', 'Parameter estimates', 'SSCP matrices', and 'Residual SSCP matrix'. The 'Significance level' is set to .05, and 'Confidence intervals are 95.0 %'. The 'Continue' button is highlighted.

Step 7)

Next, select 'Plots'. In here, move one of the IV's to the 'Horizontal axis' box, and the other to the 'Separate lines' box. Click Add and then Continue.



The 'Repeated Measures: Profile Plots' dialog box is shown. The 'Factors' list contains 'Gender' and 'Facial_Exp'. The 'Horizontal Axis' box is empty. The 'Separate Lines' box is empty. The 'Separate Plots' box is empty. The 'Plots' list contains 'Gender*Facial_Exp'. The 'Add' button is highlighted.

Step 8)

Select OK to run the analysis.

SPSS Output – the important parts

Descriptive statistics:

In this table, the descriptives are shown for the different conditions of your study. This is useful for referring back to in order to interpret and understand what is happening in your data.

Remember that you cannot infer significance from descriptive statistics.

Mauchly's Test of Sphericity

This tests whether the assumption of sphericity has been met. You only need to look at this table when at least one of your repeated measures variables has more than two levels! If this is the case, then you want the values within the Sig. column of this table to be non-significant (i.e., $> .05$), otherwise you have violated the assumption of sphericity.

Tests of Within-Subjects effects:

This is the most important table in the output and you will be using the data contained within this table to infer significance (or not).

The first thing you need to do is check for the possibility of an interaction effect. In the SPSS output, look at the line labelled Gender*Facial_Exp. Check the Sig. column for whether the interaction is significant or not.

Secondly, you need to check the Main Effects of each IV. Find the column you are interested in (e.g., Gender). To determine whether there is a main effect for each IV, check in the column marked Sig. next to each variable.

REMEMBER:

When you have a **statistically significant interaction**, reporting **the main effects** can be misleading. Therefore, you will need to report **the simple main effects**. This would involve determining the mean difference in attractiveness scores between genders according to each facial expression, as well as between facial expressions for each gender. Unfortunately, SPSS does not allow you to do this using the graphical interface you will be familiar with (i.e., plots below), but requires you to use syntax.

If you do not have a statistically significant interaction, you can interpret the main effects as normal.

Report the effect sizes (Partial eta squared).

Profile Plots

This graph will provide a good graphical illustration of your results. An interaction effect can usually be seen as a set of non-parallel lines. If the lines actually cross each other, you might expect a statistically significant interaction effect (which you can confirm using the statistics).

Write out the necessary output data (using the output tables you have now produced) in the correct format (as shown below). This should include an analysis of the interaction effect and the main effects for both IV's.

$F(df1, df2) = F\text{-value}, p < / > .05$

