Chapter 16: GLM 5: Mixed designs

Labcoat Leni's Real Research

Keep the faith(ful)?

Problem

Schützwohl, A. (2008). *Personality and Individual Differences*, *44*, 633–644.

People can be jealous. People can be especially jealous when they think that their partner is being unfaithful. An evolutionary view of jealousy suggests that men and women have evolved distinctive types of jealousy. Specifically, a woman's sexual infidelity deprives her mate of a reproductive opportunity and could burden him with years investing in a child that is not his. Conversely, a man's sexual infidelity does not burden his mate with unrelated children, but may divert his resources from his mate's progeny. This diversion of resources is signalled by emotional attachment to another female. Consequently, men's jealousy mechanism should have evolved to prevent a mate's *sexual* infidelity, whereas in women it has evolved to prevent *emotional* infidelity. Achim Schützwohl reasoned that if this is the case, women should be on the look-out for emotional infidelity, whereas men should be watching out for sexual infidelity.

He put this hypothesis to the test in a unique study in which men and women saw sentences presented on a computer screen (Schützwohl, 2008). At each trial, participants saw a target sentence that was emotionally neutral (e.g., 'The gas station is at the other side of the street'). However, before each of these targets, a distractor sentence was presented that could also be affectively neutral, or could indicate sexual infidelity (e.g., 'Your partner suddenly has difficulty becoming sexually aroused when he and you want to have sex') or emotional infidelity (e.g., 'Your partner doesn't say "I love you" to you anymore'). The idea was that if these distractor sentences grabbed a person's attention then (1) they would remember them, and (2) they would not remember the target sentence that came afterwards (because their attentional resources were focused on the distractor). These effects should show up only in people currently in a relationship. The outcome was the number of sentences that a participant could remember (out of 6), and the predictors were whether the person had a partner or not (**Relationship**), whether the trial used a neutral distractor, an emotional infidelity distractor or a sexual infidelity distractor, and whether the sentence was a distractor or the target following a distractor. Schützwohl analysed men and women's data seperately. The predictions are that women should remember more

emotional infidelity sentences (distractors) but fewer of the targets that followed those sentences (target). For men, the same effect should be found but for sexual infidelity sentences. The data from this study are in the file **Schützwohl(2008).sav**. Labcoat Leni wants you to carry out two three-way mixed ANOVAs (one for men and the other for women) to test these hypotheses.

Solution

We want to run these analyses on men and women separately; therefore, we could (to be efficient) split the file by the variable **Gender** (see Chapter 6), as shown in Figure 7.

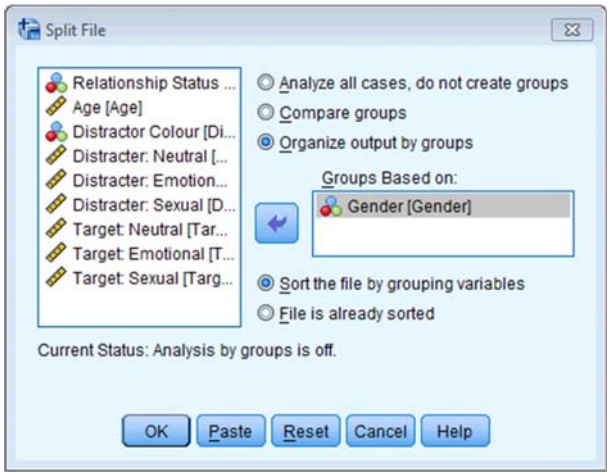

Figure 17

To run the ANOVA, select the repeated-measures ANOVA dialog box (Analyze General Linear Model ▸ Repeated Measures...). We have two repeated-measures variables: whether the sentence was a distractor or a target (let's call this **Sentence_Type**) and whether the distractor used on a trial was neutral, indicated sexual infidelity or emotional infidelity (let's call this variable **Distracter_Type**). The resulting ANOVA will be a 2 (relationship: with partner or not) × 2 (sentence type: distractor or target) × 3 (distractor type: neutral, emotional infidelity or sexual infidelity) three-way mixed ANOVA with repeated measures on the last two variables. First, we must define our two repeated-measures variables (Figure 8).

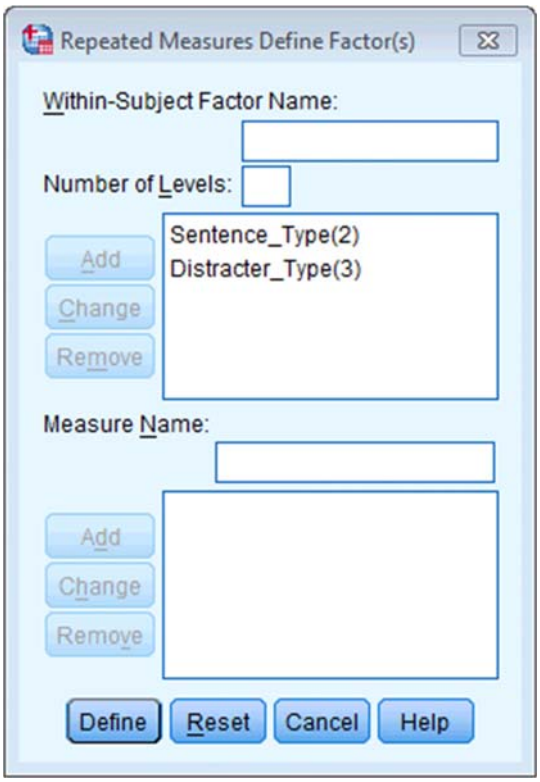

Figure 28

Next, we need to define these variables by specifying the columns in the data editor that relate to the different combinations of the type of sentence and the type of trial. As you can see in Figure 9, we specified **Sentence_Type** first, therefore we have all of the variables relating to distractors specified before those for targets. For each type of sentence there are three different variants, depending on whether the distractor used was neutral, emotional or sexual. Note that we have use the same order for both types of sentence (neutral, emotional, sexual) and that we have put neutral distractors as the first category so that we can look at some contrasts (neutral distractors are the control).

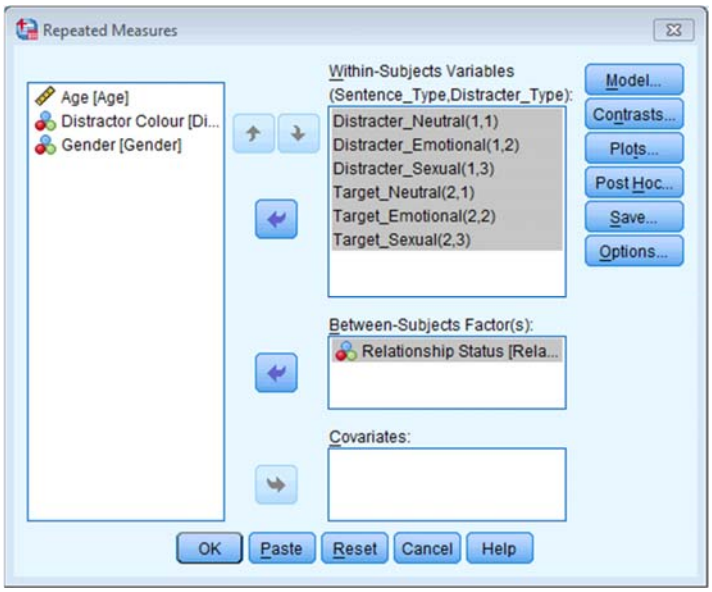

Figure 39

To do some contrasts, select Contrasts... and select some simple contrasts comparing everything to the first category (Figure 10).

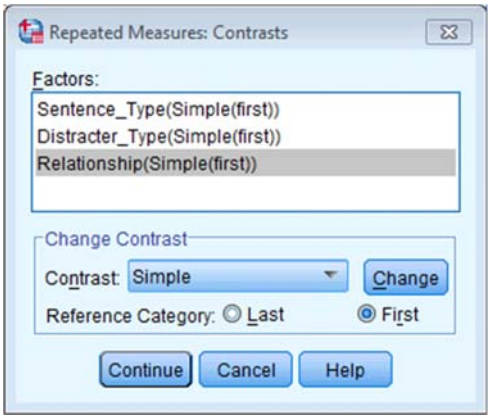

Figure 410

You could also ask for an interaction graph for the three-way interaction (Figure 11).

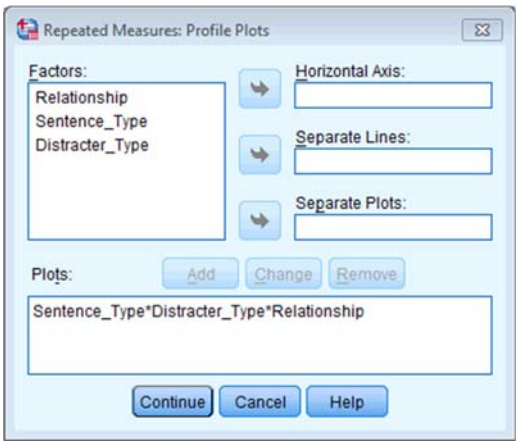

Figure 5~~11~~

You can set other options as in the book chapter.

Let's look at the men's output first. Sphericity tests, shown in Output 8, are fine (all non-significant) so I've simplified the main ANOVA table in Output 9 to show only the sphericity assumed tests.

Mauchly's Test of Sphericity[b,c]

Measure:MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[a]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Sentence_Type	1.000	.000	0	.	1.000	1.000	1.000
Distracter_Type	.956	1.603	2	.449	.958	1.000	.500
Sentence_Type * Distracter_Type	.997	.124	2	.940	.997	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. Gender = male

c. Design: Intercept + Relationship
Within Subjects Design: Sentence_Type + Distracter_Type + Sentence_Type * Distracter_Type

Output 1~~8~~

Tests of Within-Subjects Effects[a]

Measure:MEASURE_1
Epsilon Corrections:Sphericity Assumed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Sentence_Type	81.250	1	81.250	53.973	.000
Sentence_Type * Relationship	2.925	1	2.925	1.943	.172
Error(Sentence_Type)	55.699	37	1.505		
Distracter_Type	1.286	2	.643	.812	.448
Distracter_Type * Relationship	6.209	2	3.105	3.920	.024
Error(Distracter_Type)	58.603	74	.792		
Sentence_Type * Distracter_Type	1.628	2	.814	1.146	.323
Sentence_Type * Distracter_Type * Relationship	5.389	2	2.694	3.794	.027
Error(Sentence_Type*Distracter_Type)	52.551	74	.710		

a. Gender = male

Output 2~~9~~

We could report these effects as follows:

- ✓ A three-way ANOVA with current relationship status as the between-subjects factor and men's recall of sentence type (targets vs. distractors) and distractor type (neutral, emotional infidelity and sexual infidelity) as the within-subjects factors yielded a significant main effect of sentence type, $F(1, 37) = 53.97$, $p < .001$, and a significant interaction between current relationship status and distractor content, $F(2, 74) = 3.92$, $p = .024$. More important, the three-way interaction was also significant, $F(2, 74) = 3.79$, $p = .027$. The remaining main effects and interactions were not significant, $F < 2$, $p > .17$.

To pick apart the three-way interaction we can look at the table of contrasts (Output 10).

Tests of Within-Subjects Contrasts[a]

Measure:MEASURE_1

Source	Sentence_Type	Distracter_Type	Type III Sum of Squares	df	Mean Square	F	Sig.
Sentence_Type	Level 2 vs. Level 1	Distracter_Type	54.167	1	54.167	53.973	.000
Sentence_Type * Relationship	Level 2 vs. Level 1	Distracter_Type	1.950	1	1.950	1.943	.172
Error(Sentence_Type)	Level 2 vs. Level 1	Distracter_Type	37.132	37	1.004		
Distracter_Type	Sentence_Type * Distracter_Type	Level 2 vs. Level 1	.721	1	.721	.855	.361
		Level 3 vs. Level 1	1.157	1	1.157	1.836	.184
Distracter_Type * Relationship	Sentence_Type * Distracter_Type	Level 2 vs. Level 1	1.696	1	1.696	2.011	.165
		Level 3 vs. Level 1	1.413	1	1.413	2.243	.143
Error(Distracter_Type)	Sentence_Type * Distracter_Type	Level 2 vs. Level 1	31.202	37	.843		
		Level 3 vs. Level 1	23.317	37	.630		
Sentence_Type * Distracter_Type	Level 2 vs. Level 1	Level 2 vs. Level 1	.013	1	.013	.005	.945
		Level 3 vs. Level 1	4.628	1	4.628	1.590	.215
Sentence_Type * Distracter_Type * Relationship	Level 2 vs. Level 1	Level 2 vs. Level 1	.013	1.000	.013	.005	.945
		Level 3 vs. Level 1	15.705	1.000	15.705	5.394	.026
Error(Sentence_Type*Distracter_Type)	Level 2 vs. Level 1	Level 2 vs. Level 1	98.962	37	2.675		
		Level 3 vs. Level 1	107.731	37	2.912		

a. Gender = male

Output 3~~10~~

This table tells us that the effect of whether or not you are in a relationship and whether you were remembering a distractor or target was similar in trials in which an emotional infidelity distractor was used compared to when a neutral distractor was used, $F(1, 37) < 1$, $p = .95$ (level 2 vs. level 1 in the table). However, as predicted, there is a difference in trials in which a sexual infidelity distractor was used compared to those in which a neutral distractor was used, $F(1, 37) = 5.39$, $p < .05$ (level 3 vs. level 1).

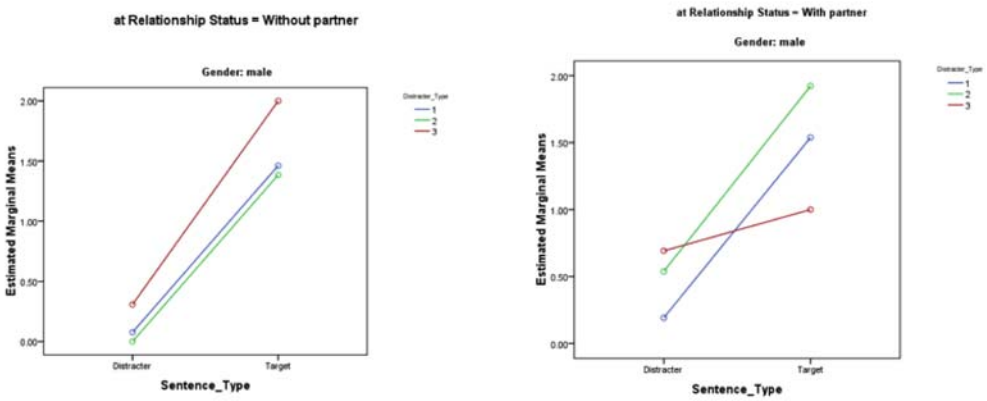

Figure 6~~12~~

To see what these contrasts tell us, look at the graphs in Figure 12 (I've edited these a bit so that they are clearer). First off, those without partners remember many more targets than they do distractors, and this is true for all types of trials. In other words, it doesn't matter whether the distractor is neutral, emotional or sexual; these people remember more targets than distractors. The same pattern is seen in those with partners *except* for distractors that indicate sexual infidelity (the red line). For these, the number of targets remembered is reduced. Put another way, the slope of the green and blue lines is more or less the same for those in and out of relationships (compare graphs) and the slopes are more or less the same as each other (compare green with blue). The only difference is for the red line, which is comparable to the green and blue lines for those not in relationships, but is much shallower for those in relationships. They remember fewer targets that were preceded by a sexual infidelity distractor. This supports the predictions of the author: men in relationships have an attentional bias such that their attention is consumed by cues indicative of sexual infidelity.

Let's now look at the women's output. Sphericity tests, shown in Output 11, are fine (all non-significant) so I've simplified the main ANOVA table in Output 12 to show only the sphericity assumed tests.

Mauchly's Test of Sphericity[b,c]

Measure:MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[a]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Sentence_Type	1.000	.000	0	.	1.000	1.000	1.000
Distracter_Type	.968	1.231	2	.540	.969	1.000	.500
Sentence_Type * Distracter_Type	.945	2.139	2	.343	.948	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. Gender = female

c. Design: Intercept + Relationship
Within Subjects Design: Sentence_Type + Distracter_Type + Sentence_Type * Distracter_Type

Output 4~~11~~

Tests of Within-Subjects Effects[a]

Measure:MEASURE_1
Epsilon Corrections:Sphericity Assumed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Sentence_Type	72.139	1	72.139	39.681	.000
Sentence_Type * Relationship	2.026	1	2.026	1.114	.298
Error(Sentence_Type)	70.901	39	1.818		
Distracter_Type	5.465	2	2.732	4.236	.018
Distracter_Type * Relationship	.099	2	.049	.077	.926
Error(Distracter_Type)	50.308	78	.645		
Sentence_Type * Distracter_Type	8.092	2	4.046	4.625	.013
Sentence_Type * Distracter_Type * Relationship	9.327	2	4.664	5.331	.007
Error(Sentence_Type*Distracter_Type)	68.234	78	.875		

a. Gender = female

Output 5~~12~~

We could report these effects as follows:

- ✓ A three-way ANOVA with current relationship status as the between-subject factor and men's recall of sentence type (targets vs. distractors) and distractor type (neutral, emotional infidelity and sexual infidelity) as the within-subject factors yielded a significant main effect of sentence type, $F(1, 39) = 39.68$, $p < .001$, and distractor type, $F(2, 78) = 4.24$, $p = .018$. Additionally, significant interactions were found between sentence type and distractor type, $F(2, 78) = 4.63$, $p = .013$, and, most important, sentence type × distractor type × relationship, $F(2, 78) = 5.33$, $p = .007$. The remaining main effect and interactions were not significant, $F < 1.2$, $p > .29$.

To pick apart the three-way interaction we can look at the table of contrasts (Output 13).

Tests of Within-Subjects Contrasts[a]

Measure:MEASURE_1

Source	Sentence_Type	Distracter_Type	Type III Sum of Squares	df	Mean Square	F	Sig.
Sentence_Type	Level 2 vs. Level 1	Distracter_Type	48.093	1	48.093	39.681	.000
Sentence_Type * Relationship	Level 2 vs. Level 1	Distracter_Type	1.350	1	1.350	1.114	.298
Error(Sentence_Type)	Level 2 vs. Level 1	Distracter_Type	47.267	39	1.212		
Distracter_Type	Sentence_Type * Distracter_Type	Level 2 vs. Level 1	4.617	1	4.617	6.174	.017
		Level 3 vs. Level 1	3.503	1	3.503	5.487	.024
Distracter_Type * Relationship	Sentence_Type * Distracter_Type	Level 2 vs. Level 1	.056	1	.056	.075	.786
		Level 3 vs. Level 1	.088	1	.088	.138	.712
Error(Distracter_Type)	Sentence_Type * Distracter_Type	Level 2 vs. Level 1	29.163	39	.748		
		Level 3 vs. Level 1	24.899	39	.638		
Sentence_Type * Distracter_Type	Level 2 vs. Level 1	Level 2 vs. Level 1	19.448	1	19.448	4.505	.040
		Level 3 vs. Level 1	28.277	1	28.277	9.053	.005
Sentence_Type * Distracter_Type * Relationship	Level 2 vs. Level 1	Level 2 vs. Level 1	32.618	1.000	32.618	7.556	.009
		Level 3 vs. Level 1	.960	1.000	.960	.307	.582
Error(Sentence_Type*Distracter_Type)	Level 2 vs. Level 1	Level 2 vs. Level 1	168.357	39	4.317		
		Level 3 vs. Level 1	121.820	39	3.124		

a. Gender = female

Output 6~~13~~

This table tells us that the effect of whether or not you are in a relationship and whether you were remembering a distractor or target was significantly different in trials in which a emotional infidelity distractor was used compared to when a neutral distractor was used, $F(1, 39) = 7.56$, $p = .009$ (level 2 vs. level 1 in the table). However, there was not a significant

difference in trials in which a sexual infidelity distractor was used compared to those in which a neutral distractor was used, $F(1, 39) = 0.31$, $p = .58$ (level 3 vs. level 1).

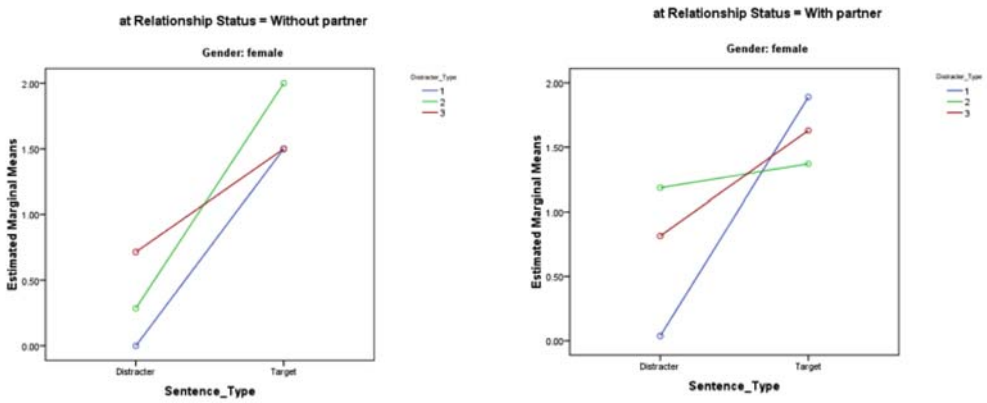

Figure 7~~13~~

To see what these contrasts tell us look at the graphs in Figure 13 (I've edited these a bit so that they are clearer). As for the men, women without partners remember many more targets than they do distractors, and this is true for all types of trials (although it's less true for the sexual infidelity trials because this line has a shallower slope). The same pattern is seen in those with partners *except* for distractors that indicate emotional infidelity (the green line). For these, the number of targets remembered is reduced. Put another way, the slope of the red and blue lines is more or less the same for those in and out of relationships (compare graphs). The only difference is for the green line, which is much shallower for those in relationships. They remember fewer targets that were preceded by a emotional infidelity distractor. This supports the predictions of the author: women in relationships have an attentional bias such that their attention is consumed by cues indicative of emotional infidelity.