

Chapter 16: GLM 5: Mixed designs

Labcoat Leni's Real Research

The objection of desire

Problem

Bernard, P., et al. (2012). *Psychological Science*, 23(5), 469–471.



There is a concern that images that portray women as sexually desirable objectify them. This idea was tested in an inventive study by Philippe Bernard (Bernard, Gervais, Allen, Campomizzi, & Klein, 2012). People find it harder to recognize upside-down (inverted) pictures than ones the right way up. This 'inversion effect' occurs for pictures of humans, but not for pictures of objects. Bernard et al. used this effect to test whether sexualized pictures of women are processed as objects. They presented people with pictures of sexualized (i.e., not wearing many clothes) males and females. Half of these pictures were inverted (**Inverted_Women** and **Inverted_Men**) and the remainder were upright (**Upright_Women** and **Upright_Men**). They noted the **Gender** of the participant. After each trial participants were shown two pictures and asked to identify the one they had just seen. The outcome was the proportion of correctly identified pictures. An inversion effect is demonstrated by higher recognition scores for upright pictures than inverted ones. If sexualized females are processed as objects you would expect an inversion effect for the male pictures but not the female ones. The data are in **Bernard et al (2012).sav**. Conduct a three-way mixed ANOVA to see whether picture gender (male or female) and picture orientation (upright or inverted) interact. Include participant gender as the between-group factor. Follow up the analysis with *t*-tests looking at (1) the inversion effect for male pictures, (2) the inversion effect for female pictures, (3) the gender effect for upright pictures, and (4) the gender effect for inverted pictures.

Solution

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 target picture was of a male or female (let's call this **TargetGender**) and whether the target picture was upright or inverted (let's call this variable **TargetLocation**). The resulting ANOVA will be a 2 (**TargetGender**: male or female) × 2 (**TargetLocation**: upright or inverted) ×

2 (**Gender**: male or female) three-way mixed ANOVA with repeated measures on the first two variables. First, we must define our two repeated-measures variables (Figure 1).

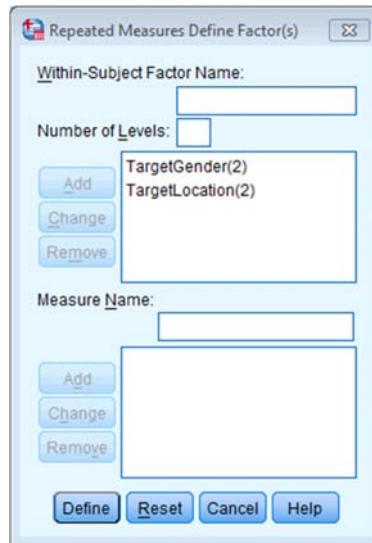


Figure 1

Next, we need to define these variables by specifying the columns in the data editor that relate to the different combinations of the gender and orientation of the picture (Figure 2).

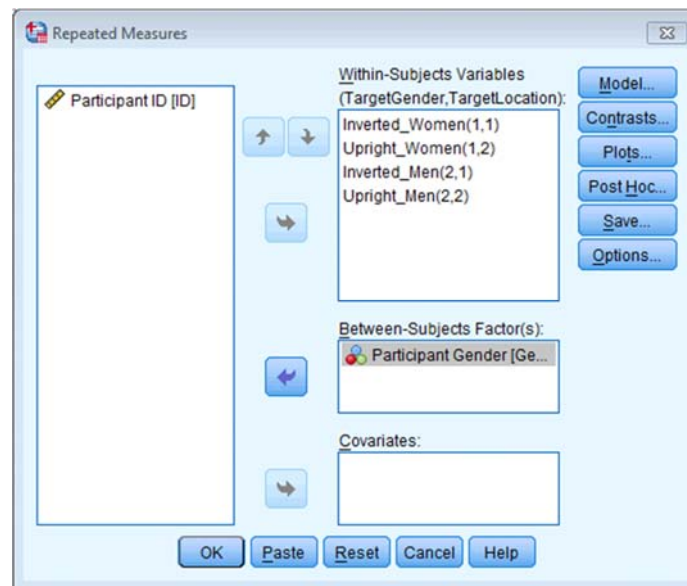


Figure 2

You could also ask for an interaction graph for the three-way interaction (Figure 3).



Figure 3

You can set other options as in the book chapter.

Because both of our repeated-measures variables have only two levels, we do not need to worry about sphericity. As you can see in Output 1, SPSS still produces the sphericity table; however, in the column labelled *Sig* there is simply a full stop to indicate that we do not need to worry about the assumption of sphericity.

Mauchly's Test of Sphericity^a

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon ^b		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
TargetGender	1.000	.000	0	.	1.000	1.000	1.000
TargetLocation	1.000	.000	0	.	1.000	1.000	1.000
TargetGender * TargetLocation	1.000	.000	0	.	1.000	1.000	1.000

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

a. Design: Intercept + Gender

Within Subjects Design: TargetGender + TargetLocation + TargetGender * TargetLocation

b. 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.

Output 1

Descriptive Statistics

	Participant Gender	Mean	Std. Deviation	N
Inverted Female Image (Proportion of correct responses)	Female	.8611	.12755	36
	Male	.8089	.17603	41
	Total	.8333	.15649	77
Upright Female Image (Proportion of correct responses)	Female	.8704	.13429	36
	Male	.8455	.18024	41
	Total	.8571	.15987	77
Inverted Male Image (Proportion of correct responses)	Female	.7407	.14608	36
	Male	.7215	.18598	41
	Total	.7305	.16770	77
Upright Male Image (Proportion of correct responses)	Female	.8495	.15914	36
	Male	.8516	.17531	41
	Total	.8506	.16685	77

Output 2

Output 2 is the table of the overall descriptive statistics; these will be useful for interpreting the direction of the results in the main ANOVA table. We can also use these values when we report the results.

Figure 4 is the plot for the two-way interaction between target gender and target location for female participants. Looking at the graph, we can see that when the target was of a female (i.e., when Target Gender = 1) female participants correctly recognized a similar number of inverted (blue line) and upright (green line) targets, indicating that there was no inversion effect for female pictures. We can tell this because the dots are very close together. However, when the target was of a male (Target Gender = 2), the female participants' recognition of inverted male targets was very poor compared with their recognition of upright male targets (the dots are very far apart), indicating that the inversion effect was present for pictures of males.

Figure 5 is the plot for the two-way interaction between target gender and target location for male participants. Looking at the graph, we can see that there appears to be a similar pattern of results as for the female participants: when the target was of a female (i.e., when Target Gender = 1) male participants correctly recognized a fairly similar number of inverted (blue line) and upright (green line) targets, indicating no inversion effect for the female target pictures. We can tell this because the dots are reasonably together. However, when the target was of a male (Target Gender = 2), the male participants' recognition of inverted male targets was very poor compared with their recognition of upright male targets (the dots are very far apart), indicating the presence of the inversion effect for male target pictures. The fact that the pattern of results were very similar for male and female participants suggests that there may not be a significant three-way interaction between target gender, target location and participant gender.

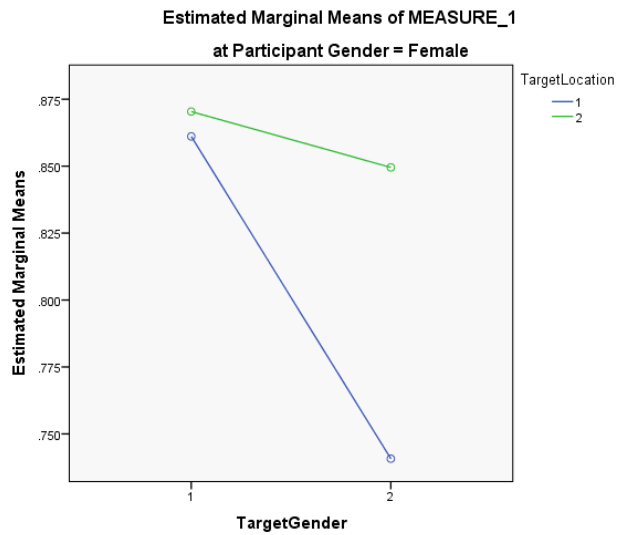


Figure 4

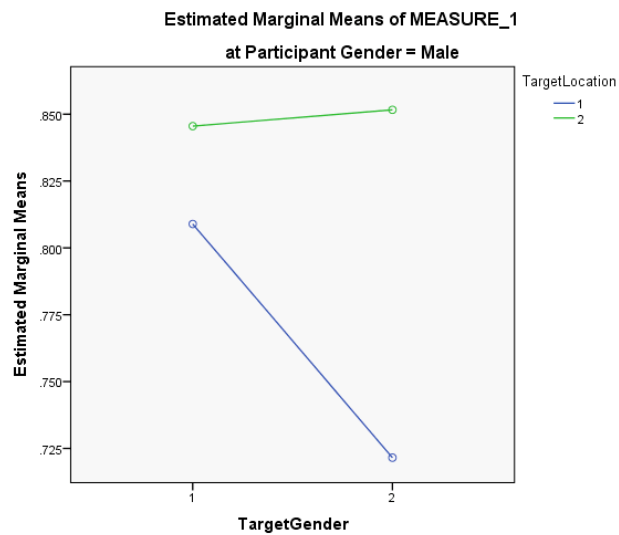


Figure 5

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	205.560	1	205.560	2838.616	.000
Gender	.042	1	.042	.586	.446
Error	5.431	75	.072		

Output 3

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
TargetGender	Sphericity Assumed	.237	1	.237	22.847	.000	.233
	Greenhouse-Geisser	.237	1.000	.237	22.847	.000	.233
	Huynh-Feldt	.237	1.000	.237	22.847	.000	.233
	Lower-bound	.237	1.000	.237	22.847	.000	.233
TargetGender * Gender	Sphericity Assumed	.017	1	.017	1.656	.202	.022
	Greenhouse-Geisser	.017	1.000	.017	1.656	.202	.022
	Huynh-Feldt	.017	1.000	.017	1.656	.202	.022
	Lower-bound	.017	1.000	.017	1.656	.202	.022
Error(TargetGender)	Sphericity Assumed	.779	75	.010			
	Greenhouse-Geisser	.779	75.000	.010			
	Huynh-Feldt	.779	75.000	.010			
	Lower-bound	.779	75.000	.010			
TargetLocation	Sphericity Assumed	.388	1	.388	32.859	.000	.305
	Greenhouse-Geisser	.388	1.000	.388	32.859	.000	.305
	Huynh-Feldt	.388	1.000	.388	32.859	.000	.305
	Lower-bound	.388	1.000	.388	32.859	.000	.305
TargetLocation * Gender	Sphericity Assumed	.011	1	.011	.958	.331	.013
	Greenhouse-Geisser	.011	1.000	.011	.958	.331	.013
	Huynh-Feldt	.011	1.000	.011	.958	.331	.013
	Lower-bound	.011	1.000	.011	.958	.331	.013
Error(TargetLocation)	Sphericity Assumed	.887	75	.012			
	Greenhouse-Geisser	.887	75.000	.012			
	Huynh-Feldt	.887	75.000	.012			
	Lower-bound	.887	75.000	.012			
TargetGender * TargetLocation	Sphericity Assumed	.179	1	.179	15.066	.000	.167
	Greenhouse-Geisser	.179	1.000	.179	15.066	.000	.167
	Huynh-Feldt	.179	1.000	.179	15.066	.000	.167
	Lower-bound	.179	1.000	.179	15.066	.000	.167
TargetGender * TargetLocation * Gender	Sphericity Assumed	.000	1	.000	.015	.904	.000
	Greenhouse-Geisser	.000	1.000	.000	.015	.904	.000
	Huynh-Feldt	.000	1.000	.000	.015	.904	.000
	Lower-bound	.000	1.000	.000	.015	.904	.000
Error (TargetGender*TargetLocation)	Sphericity Assumed	.889	75	.012			
	Greenhouse-Geisser	.889	75.000	.012			
	Huynh-Feldt	.889	75.000	.012			
	Lower-bound	.889	75.000	.012			

Output 4

Output 4 shows the summary table of the repeated-measures effects in the ANOVA with corrected F -values. As with factorial repeated-measures ANOVA, the output is split into sections for each of the effects in the model and their associated error terms. The interactions between our between-groups variable of gender and the repeated-measures effects are included in this table also. We could report these effects as follows:

- ✓ There was a significant interaction between target gender and target location, $F(1, 75) = 15.07$, $p < .001$, $\eta^2 = .167$, indicating that if we ignore whether the participant was male or female, the relationship between recognition of upright and inverted targets was different for pictures depicting men and women. The two-way interaction between target location and participant gender was not significant, $F(1, 75) = .96$, $p = .331$, $\eta^2 = .013$, indicating that if we ignore whether the target depicted a picture of a man or a woman, male and female participants did not significantly differ in their recognition of inverted and upright targets. There was also no significant three-way

interaction between target gender, target location and participant gender, $F(1, 75) = .02, p = .904, \eta^2 = .000$, indicating that the relationship between target location (whether the target picture was upright or inverted) and target gender (whether the target was of a male or female) was not significantly different in male and female participants.

The next part of the question asks us to follow up the analysis with t -tests looking at inversion and gender effects. To do this, we need to conduct four paired-samples t -tests (See Chapter 10). Once you have the *Paired-Samples T Test* dialog box open, you can transfer pairs of variables from the left-hand side to the box labelled *Paired Variables*. The first pair I am going to compare is **Upright Female** vs. **Inverted Female**, to look at the inversion effect for female pictures. The next pair will be **Upright Male** vs. **Inverted Male**, and this comparison will investigate the inversion effect for male pictures. To look at the gender effect for upright pictures we need to compare **Upright Female** vs. **Upright Male**. Finally, to look at the gender effect for inverted pictures we need to compare the variables **Inverted Female** and **Inverted Male**. Your completed dialog box should look like Figure 6.

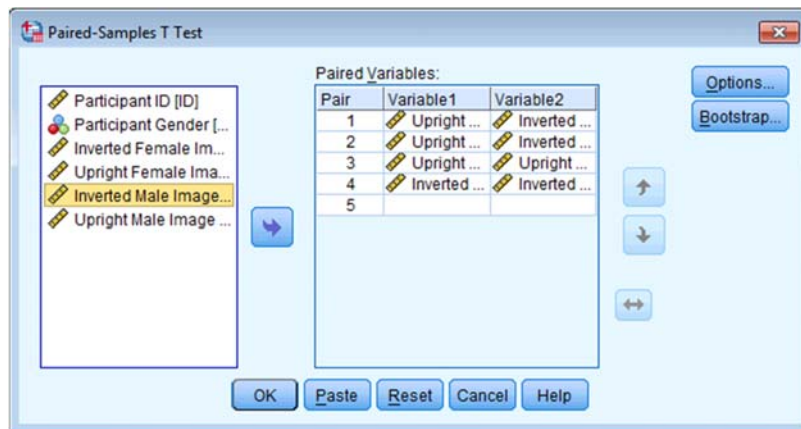


Figure 6

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	UprightWomen	.8568	78	.15885	.01799
	InvertedWomen	.8355	78	.15661	.01773
Pair 2	UprightMen	.8494	78	.16616	.01881
	InvertedMen	.7297	78	.16677	.01888
Pair 3	UprightWomen	.8568	78	.15885	.01799
	UprightMen	.8494	78	.16616	.01881
Pair 4	InvertedWomen	.8355	78	.15661	.01773
	InvertedMen	.7297	78	.16677	.01888

Output 5

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	UprightWomen & InvertedWomen	78	.625	.000
Pair 2	UprightMen & InvertedMen	78	.490	.000
Pair 3	UprightWomen & UprightMen	78	.720	.000
Pair 4	InvertedWomen & InvertedMen	78	.433	.000

Output 6

Paired Samples Test

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	UprightWomen - InvertedWomen	.02137	.13659	.01547	-.00943	.05216	1.382	77	.171
Pair 2	UprightMen - InvertedMen	.11966	.16806	.01903	.08177	.15755	6.288	77	.000
Pair 3	UprightWomen - UprightMen	.00748	.12176	.01379	-.01997	.03493	.542	77	.589
Pair 4	InvertedWomen - InvertedMen	.10577	.17235	.01951	.06691	.14463	5.420	77	.000

Output 7

Output 7 shows the results of the paired samples *t*-tests. The results show that people recognized upright males ($M = 0.85$, $SD = 0.17$) significantly better than inverted males ($M = 0.73$, $SD = 0.17$), $t(77) = 6.29$, $p < .001$, but this pattern did not emerge for females, $t(77) = 1.38$, $p = .171$. Additionally, participants recognized inverted females ($M = 0.83$, $SD = 0.16$) significantly better than inverted males ($M = 0.73$, $SD = 0.17$), $t(77) = 5.42$, $p < .001$. This effect was not found for upright males and females, $t(77) = 0.54$, $p = .59$. Note: the sign of the *t*-statistic will depend on which way round you entered the variables in the *Paired-Samples T Test* dialog box.

Consistent with the authors' hypothesis, the results showed that the inversion effect emerged only when participants saw sexualized males. This suggests that, at a basic cognitive

level, sexualized men were perceived as persons, whereas sexualized women were perceived as objects.

