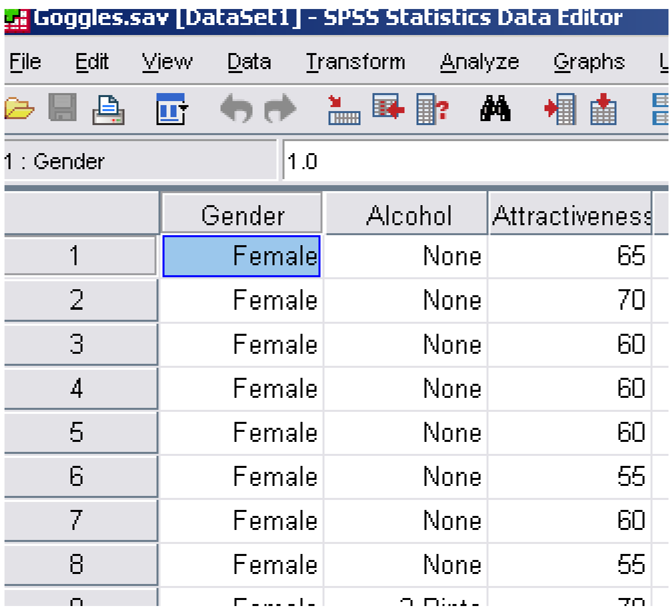
More complex ANOVAs: Factorial ANOVA

Factorial ANOVA's are used when you have 2 or more independent variables. Variables are often called factors in ANOVA (hence the name factorial ANOVA). There are three models of ANOVA: Between Measures, Repeated Measures and Mixed Factorial ANOVA.

BETWEEN MEASURES FACTORIAL ANOVA



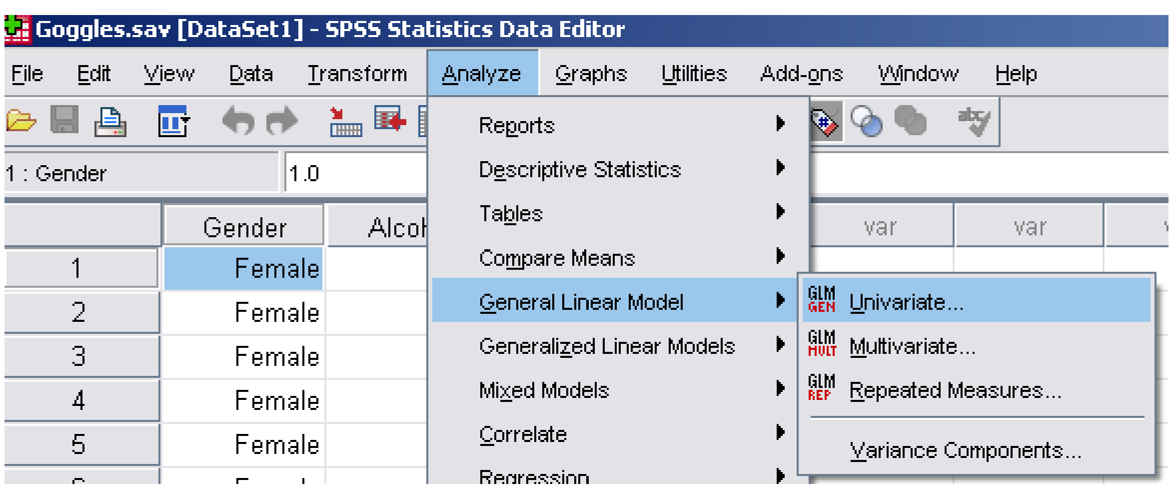
This study is looking at the 'beer goggle' effect i.e. do assessments of attractiveness become more inaccurate when one has had more to drink? Does this effect differ for men and women?

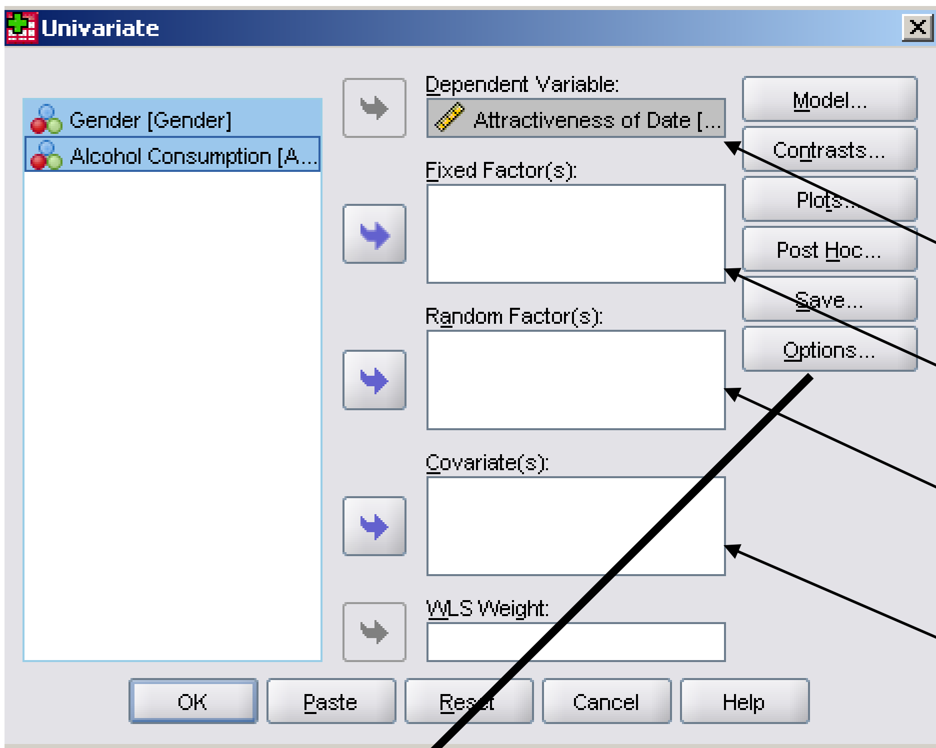
One IV is gender (male / female) the second IV is Alcohol levels (none/ 2 pints/ 4 pints); DV = Attractiveness (of potential 'mate' rated independently

2 x 3 Between Measures Factorial ANOVA

ANALYSIS:

Analyze > General Linear Model > Univariate





This is the main Univariate dialogue box.

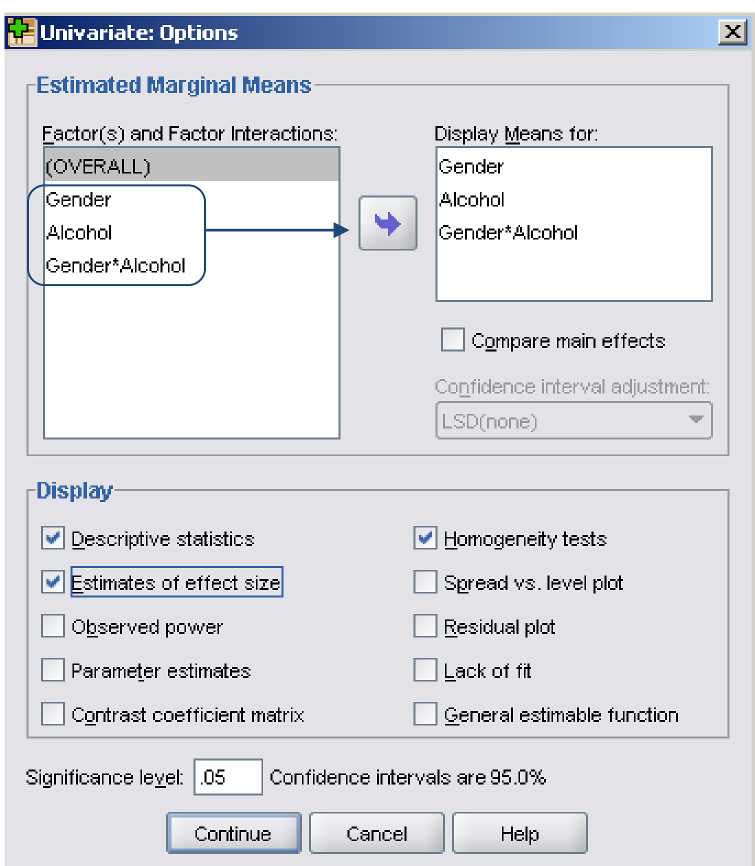
Within this window you will need to:

Place your DV into the *'Dependent Variable'* box

Place your IV's (both) into *'Fixed Factor(s)'*

'Random Factor' ANOVA is complex (refer to Jackson & Brashers, 1994)

'Covariate(s)' allows you to place a control variable that may have a direct effect on your results



Within the OPTIONS dialogue window you need to:

Highlight all the variables and move them across to

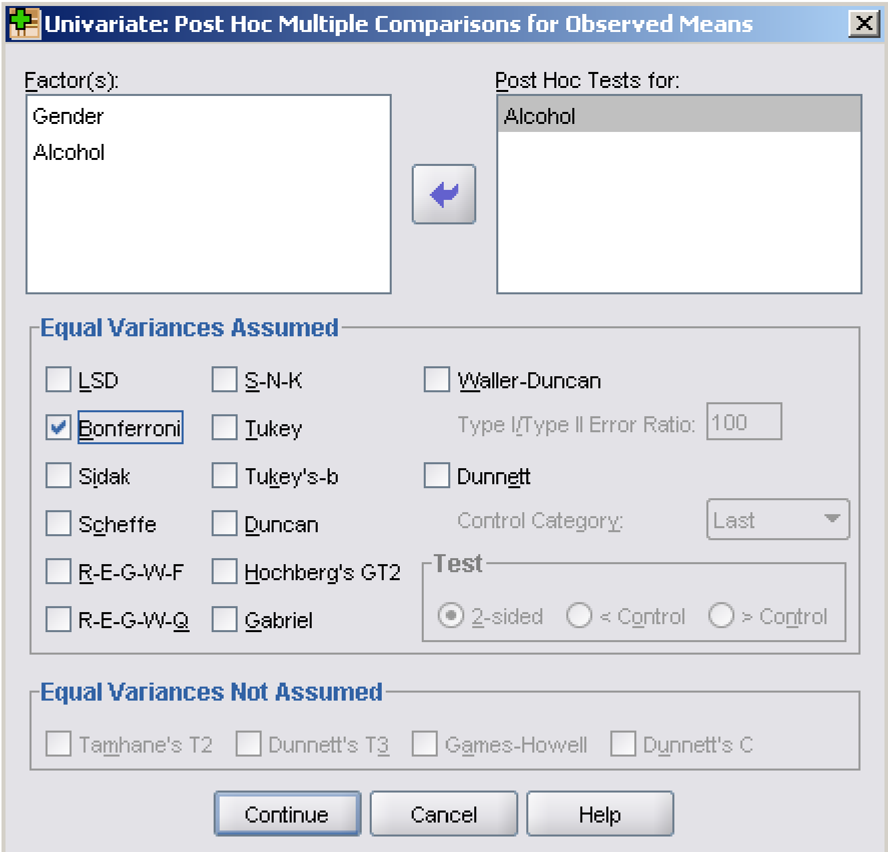
'Display Means for'

In this display box tick:

'Descriptive statistics'- Although you would have got most of this from 'EXPLORE' analysis this will also provide the interaction effect.

'Estimates of effect size' – This will tell you the magnitude of effect for the model

'Homogeneity tests' – Test your parametric assumption of homogeneity of variances



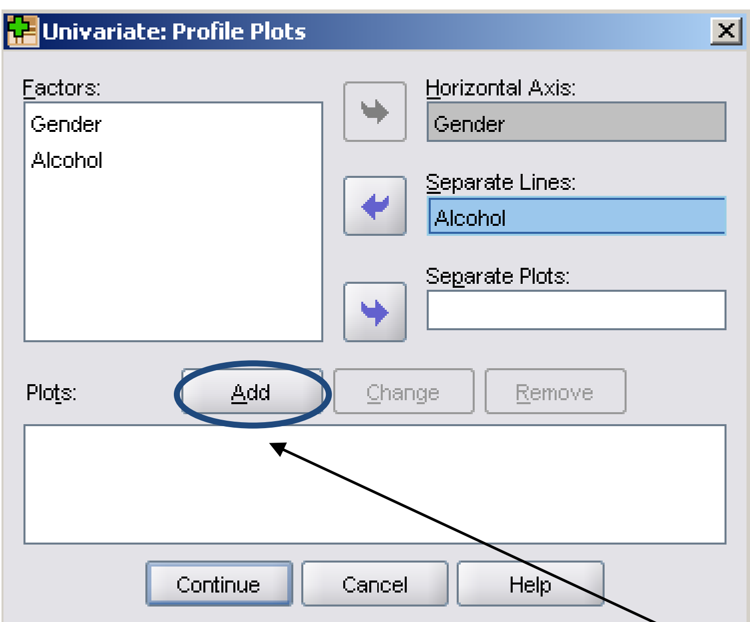
The ANOVA m,odel only tells you where there is an overall effect. If this is significant you will need to assess where that difference is via post hoc analysis.

There are several options for post hoc with many texts giving contradictory information on 'best tests'

Most texts recommend Bonferroni or Tukey.

Bonferroni is conservative but maintains power when testing a small number of multiple comparisons

Tukey is similar to Bonferroni but is better in large number of comparisons



You should produce and report the interaction figure.

This dialogue window can help you produce a line graph of the interaction.

You will be able to adjust it etc in 'Chart Editor' once it has been produced

General rule of thumb – more levels to the IV goes on the 'separate lines' however, sometimes the graph is easier to interpret when the opposite is provided.

Don't forget to select ADD before CONTINUE

THE OUTPUT

Univariate Analysis of Variance

```
[DataSet1] E:\northampton PG stats teaching\Goggles.sav
```

Between-Subjects Factors

		Value Label	N
Gender	0	Male	24
	1	Female	24
Alcohol Consumption	1	None	16
	2	2 Pints	16
	3	4 Pints	16

This just tells you how many participants you have for each group.

Descriptive Statistics

Dependent Variable:Attractiveness of Date

Gender	Alcohol Consumption	Mean	Std. Deviation	N
Male	None	66.88	10.329	8
	2 Pints	66.87	12.518	8
	4 Pints	35.63	10.836	8
	Total	56.46	18.503	24
Female	None	60.62	4.955	8
	2 Pints	62.50	6.547	8
	4 Pints	57.50	7.071	8
	Total	60.21	6.338	24
Total	None	63.75	8.466	16
	2 Pints	64.69	9.911	16
	4 Pints	46.56	14.343	16
	Total	58.33	13.812	48

This is your interactive means.

This tells you the means of each level of one IV whilst the levels of the other IV is held constant.

Levene's Test of Equality of Error Variances[a]

Dependent Variable:Attractiveness of Date

F	df1	df2	Sig.
1.527	5	42	.202

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Gender + Alcohol + Gender * Alcohol

This box is testing your Homogeniety of variances assumption.

Levenes test compares the 2 variances much the same way as a t-test works. If this is significant then you have violated this assumption and thus your variances are very different.

This test can be overly sensitive in large samples and a general rule of thumb is:

Largest variance 3x the size of smallest variable = a problem

Tests of Between-Subjects Effects

Dependent Variable:Attractiveness of Date

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5479.167[a]	5	1095.833	13.197	.000	.611
Intercept	163333.333	1	163333.333	1967.025	.000	.979
Gender	168.750	1	168.750	2.032	.161	.046
Alcohol	3332.292	2	1666.146	20.065	.000	.489
Gender * Alcohol	1978.125	2	989.062	11.911	.000	.362
Error	3487.500	42	83.036			
Total	172300.000	48				
Corrected Total	8966.667	47				

a. R Squared = .611 (Adjusted R Squared = .565)

Test of Between Subjects Effect display data for:
Main effect of Gender
Main effect of Alcohol
Interaction between gender and alcohol

Estimated Marginal Means

1. Gender

Dependent Variable:Attractiveness of Date

Gender	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Male	56.458	1.860	52.705	60.212
Female	60.208	1.860	56.455	63.962

The following aspects of the output are all the descriptive statistics for both main effects and the interaction effect.

2. Alcohol Consumption

Dependent Variable:Attractiveness of Date

Alcohol Consumption	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
None	63.750	2.278	59.153	68.347
2 Pints	64.688	2.278	60.090	69.285
4 Pints	46.563	2.278	41.965	51.160

3. Gender * Alcohol Consumption

Dependent Variable:Attractiveness of Date

Gender	Alcohol Consumption	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Male	None	66.875	3.222	60.373	73.377
	2 Pints	66.875	3.222	60.373	73.377
	4 Pints	35.625	3.222	29.123	42.127
Female	None	60.625	3.222	54.123	67.127
	2 Pints	62.500	3.222	55.998	69.002
	4 Pints	57.500	3.222	50.998	64.002

Post Hoc Tests

Alcohol Consumption

Multiple Comparisons

Dependent Variable:Attractiveness of Date

	(I) Alcohol Consumption	(J) Alcohol Consumption	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Bonferroni	None	2 Pints	-.94	3.222	1.000	-8.97	7.10
		4 Pints	17.19*	3.222	.000	9.15	25.22
	2 Pints	None	.94	3.222	1.000	-7.10	8.97
		4 Pints	18.13*	3.222	.000	10.09	26.16
	4 Pints	None	-17.19*	3.222	.000	-25.22	-9.15
		2 Pints	-18.13*	3.222	.000	-26.16	-10.09

Based on observed means.
The error term is Mean Square(Error) = 83.036.

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

Attractiveness of Date

	Alcohol Consumption	N	Subset 1	2
Student-Newman-Keuls[a,,b]	4 Pints	16	46.56	
	None	16		63.75
	2 Pints	16		64.69
	Sig.		1.000	.772

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = 83.036.

a. Uses Harmonic Mean Sample Size = 16.000.

These output boxes inform you of post hoc tests. This highlights where the significant differences are in your over all model.

POST HOC TESTS

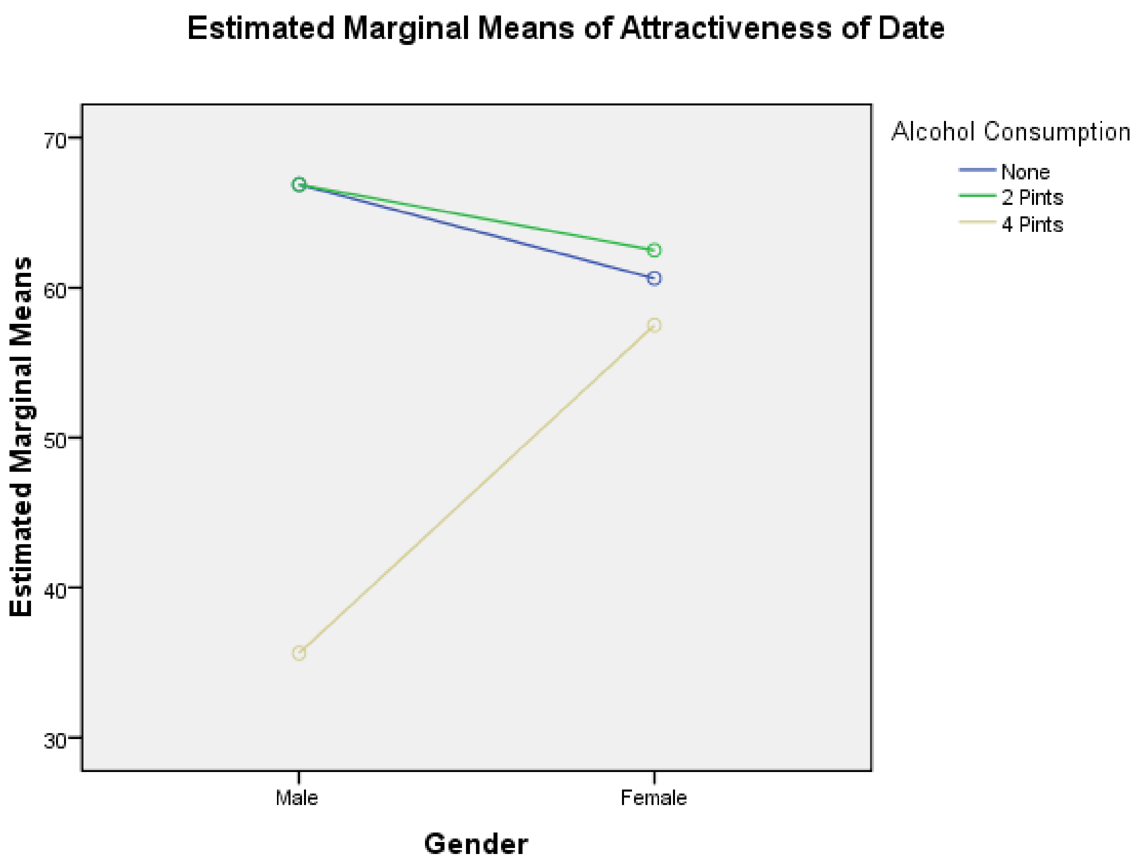
* indicates a significant effect. ‘Difference I-J’ tells you the difference in means (magnitude of effect) for that particular line. For example the first line is: I is ‘none’ and J is ‘2 Pints’. The magnitude of effect is -.94 and the significance is ‘Not Significant’ p = 1.000.

HOMOGENEOUS SUBSETS

This shows you how the levels relate to one another. In this case ‘none’ and ‘2 pints’ can be considered the same and thus homogeneous, whereas 4 pints is separate from these two groups.

You could therefore run a planned contrast between groups 1 & 2 v 3.

Profile Plots



WRITE UP:

2 x 3 factorial ANOVA indicated no significant main effect of Gender: $F(1, 42) = 2.032$, $p = .161$, $p\eta^2 = .046$. There was, however, a significant main effect of alcohol: $F(2, 42) = 20.065$, $p < .001$, $p\eta^2$ .489. post hoc analysis (Bonferroni) indicates these differences to be between '4 pints' and 'none' ($p < .001$), '4 pints' and '2 pints' ($p < .001$), however, there was no significant difference between 'none' and '2 pints' ($p = 1.000$). Analysis also revealed a significant interaction between gender and alcohol: $F(2, 42) = 11.911$, $p < .001$, $p\eta^2 = .362$ (refer them to the figure). It appears that the 'beer goggle effect' only appears within Males. (you then confirm this using simple effects analysis- see next screen shots).

SIMPLE EFFECTS ANALYSIS:

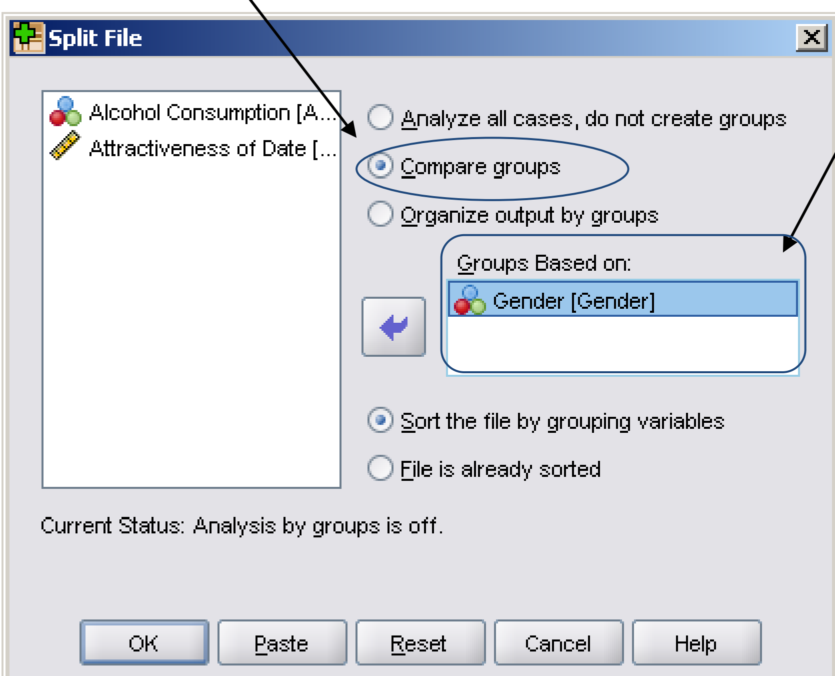
Follow up for significant interaction

Split file by one IV and run one way ANOVA with the other IV

To split file:

Data> Split file> select the IV you would like to 'hold constant' and place in 'Groups Based on' and tick 'Compare Groups'

Don't forget to select 'Analyze all cases' once completed



Then run a one way ANOVA with the other IV and the DV

In this case the one way ANOVA would assess differences in Alcohol on levels of attractiveness. The output (see below) will be produced for males and females separately so you can see exactly how they interact.

Oneway

```
[DataSet1] E:\northampton PG stats teaching\Goggles.sav
```

ANOVA

Attractiveness of Date

Gender		Sum of Squares	df	Mean Square	F	Sig.
Male	Between Groups	5208.333	2	2604.167	20.516	.000
	Within Groups	2665.625	21	126.935		
	Total	7873.958	23			
Female	Between Groups	102.083	2	51.042	1.304	.292
	Within Groups	821.875	21	39.137		
	Total	923.958	23			

Post Hoc Tests

Multiple Comparisons

Attractiveness of Date
Bonferroni

Gender	(I) Alcohol Consumption	(J) Alcohol Consumption	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Male	None	2 Pints	.000	5.633	1.000	-14.65	14.65
		4 Pints	31.250*	5.633	.000	16.60	45.90
	2 Pints	None	.000	5.633	1.000	-14.65	14.65
		4 Pints	31.250*	5.633	.000	16.60	45.90
	4 Pints	None	-31.250*	5.633	.000	-45.90	-16.60
		2 Pints	-31.250*	5.633	.000	-45.90	-16.60
Female	None	2 Pints	-1.875	3.128	1.000	-10.01	6.26
		4 Pints	3.125	3.128	.987	-5.01	11.26
	2 Pints	None	1.875	3.128	1.000	-6.26	10.01
		4 Pints	5.000	3.128	.375	-3.14	13.14
	4 Pints	None	-3.125	3.128	.987	-11.26	5.01
		2 Pints	-5.000	3.128	.375	-13.14	3.14

*. The mean difference is significant at the 0.05 level.

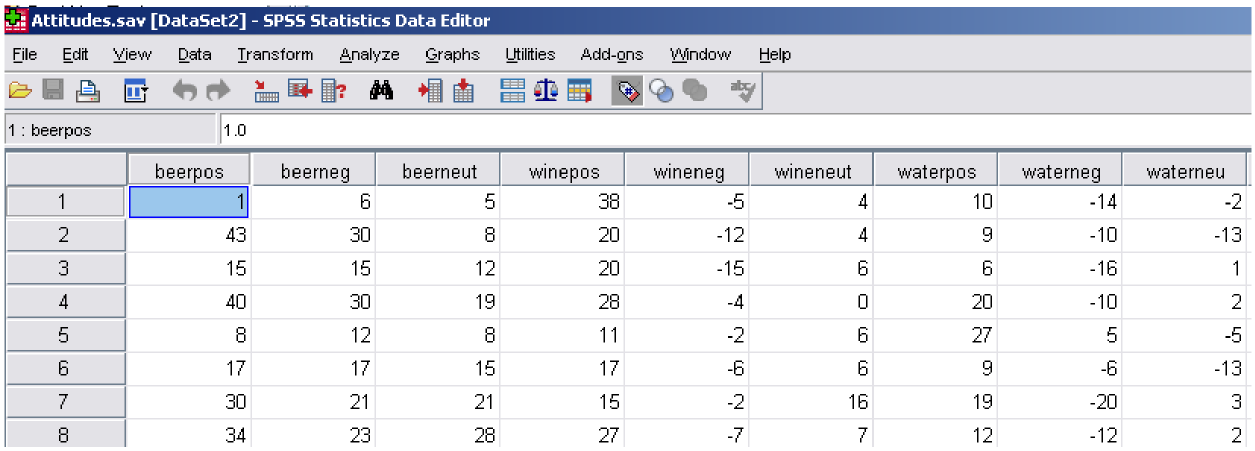
As can be seen by this output there is a significant difference between the alcohol groups in levels of attractiveness for males ($F(2, 21) = 20.515$, $p < .001$) but not for females ($F(2, 21) = 1.304$, $p = .292$).

Post hoc analysis indicates the differences in males is between '4 pints' and 'none' ($p < .001$), '4 pints' and '2 pints' ($p < .001$), but not between 'none' and '2 pints' ($p = 1.000$).

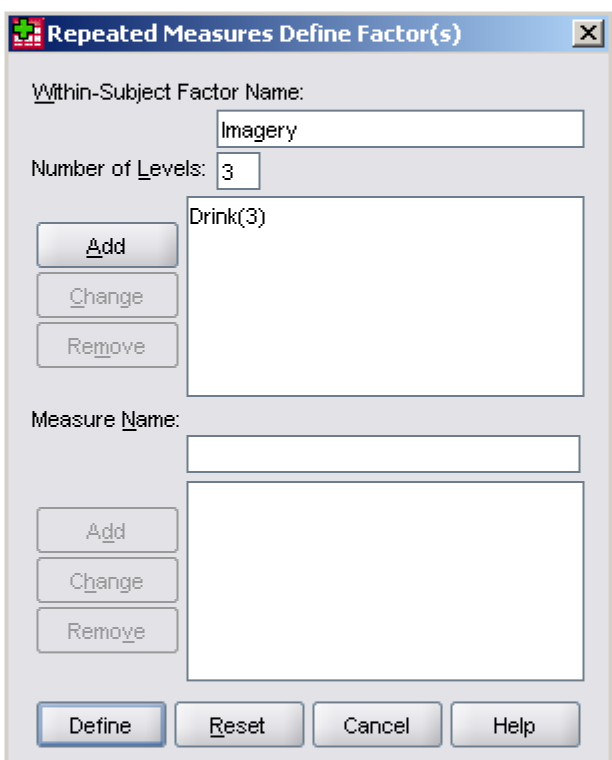
This confirms what was seen within the profile plot.

REPEATED MEASURES FACTORIAL ANOVA

This study is looking at ratings of 'mock' adverts. Participants all viewed nine adverts over the space of 3 weeks and thus the study is completely repeated measures. The two IVs are: drink (beer, wine, water) and imagery (positive, neutral and negative). The DV is rating of liking on a scale of -100 (dislike very much) through 0 (neutral) to 100 (like very much).



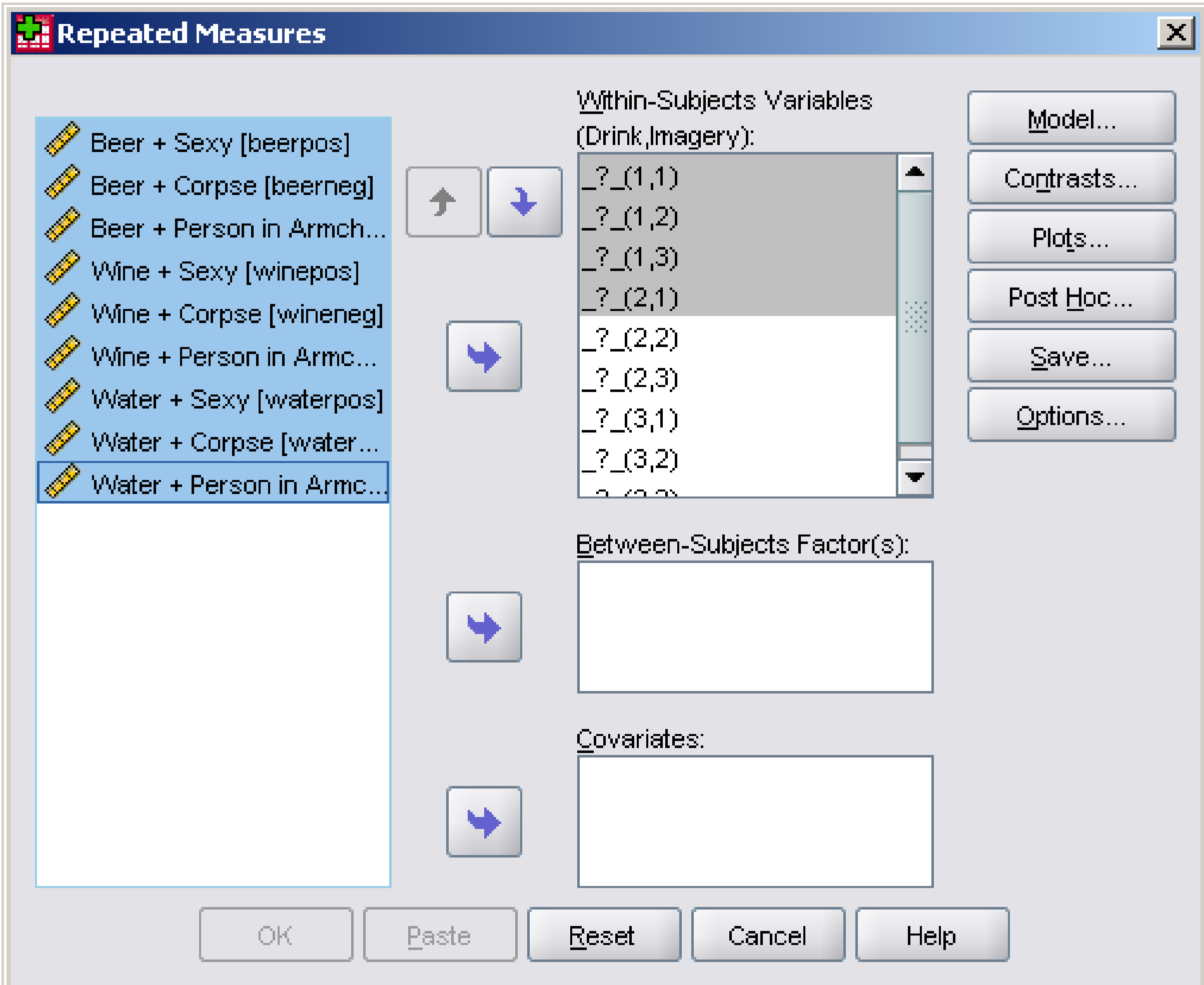
	beerpos	beerneg	beerneut	winepos	wineneg	wineneut	waterpos	waterneg	waterneu
1	1	6	5	38	-5	4	10	-14	-2
2	43	30	8	20	-12	4	9	-10	-13
3	15	15	12	20	-15	6	6	-16	1
4	40	30	19	28	-4	0	20	-10	2
5	8	12	8	11	-2	6	27	5	-5
6	17	17	15	17	-6	6	9	-6	-13
7	30	21	21	15	-2	16	19	-20	3
8	34	23	28	27	-7	7	12	-12	2



For repeated measures factorial ANOVA (just as one way ANOVA) the first step is the 'define dialogue'

You will need to define both IV's and provide the number of levels it has.

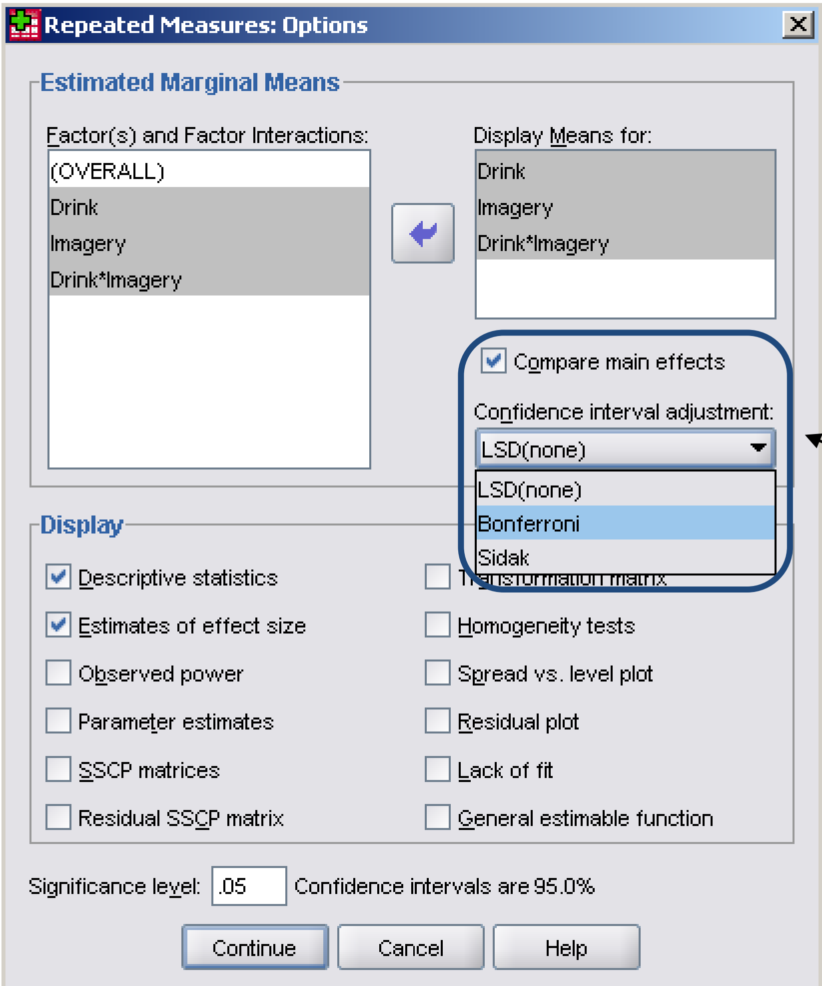
In this case both drink and imagery have 3 levels.



Within the main dialogue window you need to place the 2 IV's and all the levels across to the 'Within-Subjects Variables.

Within this main dialogue box you could also have a Between Subjects Factor (for mixed factorial design (see later)

Additionally you can add a covariate



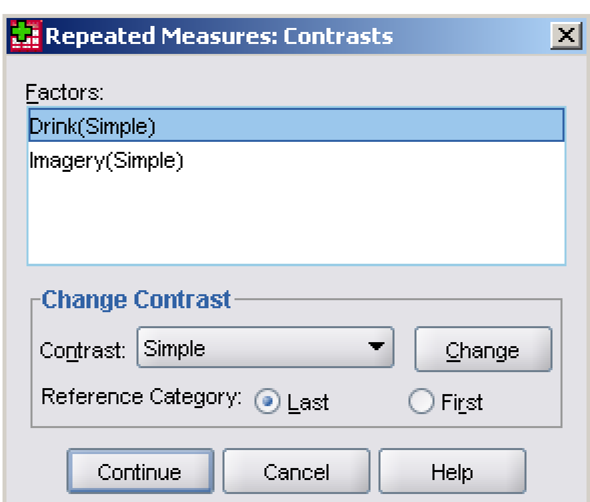
Repeated Measures Options:

As before select all the IV's and the interaction effect and place into display means.

Tick descriptive and estimates of effect size (homogeneity of variance as this is within)

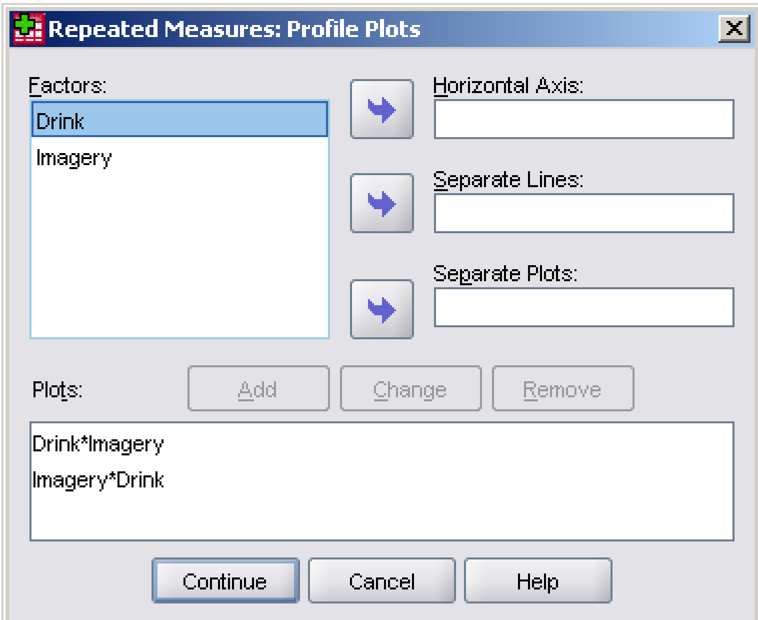
For within factors post hoc tests are asked for here instead. There are a lot less options. Books recommend Bonferroni or Sidak. LSD has very little control over family wise error

.



This box is your contrasts dialogue box. In this case it would be interesting to use water and neutral as our base line categories so we tick 'last' as our reference category.

You should select simple for each IV for this contrast.


Repeated Measures: Profile Plots
Factors:
Drink
Imagery
Horizontal Axis:
Separate Lines:
Separate Plots:
Plots:
Add
Change
Remove
Drink*Imagery
Imagery*Drink
Continue
Cancel
Help

AS BEFORE

REPEATED MEASURES FACTORIAL ANOVA OUTPUT

General Linear Model

```
[DataSet2] E:\northampton PG stats teaching\Attitudes.sav
```

Within-Subjects Factors

Measure:MEASURE_1

Drink	Imagery	Dependent Variable
1	1	beerpos
	2	beerneg
	3	beerneut
2	1	winepos
	2	wineneg
	3	wineneut
3	1	waterpos
	2	waterneg
	3	waterneu

This box just tells you all the levels in the study.

In this study we have

3 drinks: Beer, Wine, and Water

And 3 Images: Positive, Neutral, and negative.

Descriptive Statistics

	Mean	Std. Deviation	N
Beer + Sexy	21.05	13.008	20
Beer + Corpse	4.45	17.304	20
Beer + Person in Armchair	10.00	10.296	20
Wine + Sexy	25.35	6.738	20
Wine + Corpse	-12.00	6.181	20
Wine + Person in Armchair	11.65	6.243	20
Water + Sexy	17.40	7.074	20
Water + Corpse	-9.20	6.802	20
Water + Person in Armchair	2.35	6.839	20

Interactive descriptive statistics

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Drink	Pillai's Trace	.495	8.817[a]	2.000	18.000	.002	.495
	Wilks' Lambda	.505	8.817[a]	2.000	18.000	.002	.495
	Hotelling's Trace	.980	8.817[a]	2.000	18.000	.002	.495
	Roy's Largest Root	.980	8.817[a]	2.000	18.000	.002	.495
Imagery	Pillai's Trace	.936	130.909[a]	2.000	18.000	.000	.936
	Wilks' Lambda	.064	130.909[a]	2.000	18.000	.000	.936
	Hotelling's Trace	14.545	130.909[a]	2.000	18.000	.000	.936
	Roy's Largest Root	14.545	130.909[a]	2.000	18.000	.000	.936
Drink * Imagery	Pillai's Trace	.884	30.437[a]	4.000	16.000	.000	.884
	Wilks' Lambda	.116	30.437[a]	4.000	16.000	.000	.884
	Hotelling's Trace	7.609	30.437[a]	4.000	16.000	.000	.884
	Roy's Largest Root	7.609	30.437[a]	4.000	16.000	.000	.884

a. Exact statistic

b. Design: Intercept
Within Subjects Design: Drink + Imagery + Drink * Imagery

This box is not really needed

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
Drink	.267	23.753	2	.000	.577	.591	.500
Imagery	.662	7.422	2	.024	.747	.797	.500
Drink * Imagery	.595	9.041	9	.436	.798	.979	.250

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: Drink + Imagery + Drink * Imagery

Mauchly's test of sphericity: we are now aware that the Homogeneity of variances is important within between group statistics many people assume this isn't an issue in repeated measures. This is not the case therefore the assumption of sphericity can be likened to the assumption of homogeneity of variance. Sphericity is more a general condition of compound symmetry which holds true when both variances across conditions are equal and the covariance's between pairs of conditions are equal. Sphericity thus refers to the equality of variances of the differences between treatment levels. So if you take each pair of treatment levels, and calculate the differences between each pair of scores, then it is necessary that these differences have equal variances. **You need to have at least 3 conditions for sphericity to e an issue.**

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Drink	Sphericity Assumed	2092.344	2	1046.172	5.106	.011	.212
	Greenhouse-Geisser	2092.344	1.154	1812.764	5.106	.030	.212
	Huynh-Feldt	2092.344	1.181	1770.939	5.106	.029	.212
	Lower-bound	2092.344	1.000	2092.344	5.106	.036	.212
Error(Drink)	Sphericity Assumed	7785.878	38	204.892			
	Greenhouse-Geisser	7785.878	21.930	355.028			
	Huynh-Feldt	7785.878	22.448	346.836			
	Lower-bound	7785.878	19.000	409.783			
Imagery	Sphericity Assumed	21628.678	2	10814.339	122.565	.000	.866
	Greenhouse-Geisser	21628.678	1.495	14468.490	122.565	.000	.866
	Huynh-Feldt	21628.678	1.594	13571.496	122.565	.000	.866
	Lower-bound	21628.678	1.000	21628.678	122.565	.000	.866
Error(Imagery)	Sphericity Assumed	3352.878	38	88.234			
	Greenhouse-Geisser	3352.878	28.403	118.048			
	Huynh-Feldt	3352.878	30.280	110.729			
	Lower-bound	3352.878	19.000	176.467			
Drink * Imagery	Sphericity Assumed	2624.422	4	656.106	17.155	.000	.474
	Greenhouse-Geisser	2624.422	3.194	821.778	17.155	.000	.474
	Huynh-Feldt	2624.422	3.914	670.462	17.155	.000	.474
	Lower-bound	2624.422	1.000	2624.422	17.155	.001	.474
Error(Drink*Imagery)	Sphericity Assumed	2906.689	76	38.246			
	Greenhouse-Geisser	2906.689	60.678	47.903			
	Huynh-Feldt	2906.689	74.373	39.083			
	Lower-bound	2906.689	19.000	152.984			

This is the output box of interest.

Although you can read the sphericity assumed line when you have not violated sphericity text books now recommend that you always read Greenhouse – Geisser.

You need to report three things:
Main effect of variable 1 (drink)
Main effect of variable 2 (imagery)
Interaction effect
For each of these you will need to report the error df.
Thus:

A 3 X 3 repeated measures ANOVA indicated a significant main effect of Drink: F (2, 38) = 5.106, p = .030, pη^2 = .212; a significant main effect of imagery: F(2, 38) = 122.565, p < .001, pη^2 = .866; and a significant interaction: F (4, 76) = 12.155, p < .001, pη^2= .474

Tests of Within-Subjects Contrasts

Measure:MEASURE_1

Source	D ...	Imagery	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Drink	Level 1 vs. Level 3		1383.339	1	1383.339	6.218	.022	.247
	Level 2 vs. Level 3		464.006	1	464.006	18.613	.000	.495
Error(Drink)	Level 1 vs. Level 3		4226.772	19	222.462			
	Level 2 vs. Level 3		473.661	19	24.930			
Imagery		Level 1 vs. Level 3	3520.089	1	3520.089	142.194	.000	.882
		Level 2 vs. Level 3	3690.139	1	3690.139	47.070	.000	.712
Error(Imagery)		Level 1 vs. Level 3	470.356	19	24.756			
		Level 2 vs. Level 3	1489.528	19	78.396			
Drink * Imagery	Level 1 vs. Level 3	Level 1 vs. Level 3	320.000	1	320.000	1.576	.225	.077
		Level 2 vs. Level 3	720.000	1	720.000	6.752	.018	.262
	Level 2 vs. Level 3	Level 1 vs. Level 3	36.450	1	36.450	.235	.633	.012
		Level 2 vs. Level 3	2928.200	1	2928.200	26.906	.000	.586
Error(Drink*Imagery)	Level 1 vs. Level 3	Level 1 vs. Level 3	3858.000	19	203.053			
		Level 2 vs. Level 3	2026.000	19	106.632			
	Level 2 vs. Level 3	Level 1 vs. Level 3	2946.550	19	155.082			
		Level 2 vs. Level 3	2067.800	19	108.832			

Simple contrasts were requested for both drink (for which water was used as a control) and for imagery (for which neutral was used as a control). This table is the summary table for these results. The table is split into main effects and interaction effects, and each effect is split up into components of the contrast. So for the main effect of drink the first contrast compares level 1 (beer) against the base category (the last category: water). The result is significant but contradicts what was found in the post hoc tests. For the interaction contrasts the first contrast looks at level 1 of drink (beer) compared to level 3 (water), when positive imagery (level 1) is used compared to neutral (level 3). This contrast tells us that the increased liking found when positive imagery is used (in comparison to neutral) is the same for both beer and water. It is probably best to graph these and have a look.

Tests of Between-Subjects Effects

Measure:MEASURE_1
Transformed Variable:Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	1246.445	1	1246.445	111.005	.000	.854
Error	213.345	19	11.229			

This box can be ignored unless you have a between subjects variable in a mixed design.

Estimated Marginal Means

1. Drink

Estimates

Measure:MEASURE_1

Drink	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	11.833	2.621	6.348	17.319
2	8.333	.574	7.131	9.535
3	3.517	1.147	1.116	5.918

Post hoc tests for 'Drink'

They reveal a significant difference between 2 & 3 only

Pairwise Comparisons

Measure:MEASURE_1

(I) Drink	(J) Drink	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	95% Confidence Interval for Difference[a] Upper Bound
1	2	3.500	2.849	.703	-3.980	10.980
	3	8.317	3.335	.066	-.438	17.072
2	1	-3.500	2.849	.703	-10.980	3.980
	3	4.817*	1.116	.001	1.886	7.747
3	1	-8.317	3.335	.066	-17.072	.438
	2	-4.817*	1.116	.001	-7.747	-1.886

Based on estimated marginal means

a. Adjustment for multiple comparisons: Bonferroni.

*. The mean difference is significant at the .05 level.

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.495	8.817[a]	2.000	18.000	.002	.495
Wilks' lambda	.505	8.817[a]	2.000	18.000	.002	.495
Hotelling's trace	.980	8.817[a]	2.000	18.000	.002	.495
Roy's largest root	.980	8.817[a]	2.000	18.000	.002	.495

Each F tests the multivariate effect of Drink. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

2. Imagery

Estimates

Measure:MEASURE_1

Imagery	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	21.267	.977	19.222	23.312
2	-5.583	1.653	-9.043	-2.124
3	8.000	.969	5.972	10.028

Post hoc tests for 'imagery'

They reveal significant differences between all conditions

Pairwise Comparisons

Measure:MEASURE_1

(I) Imagery	(J) Imagery	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	95% Confidence Interval for Difference[a] Upper Bound
1	2	26.850*	1.915	.000	21.824	31.876
	3	13.267*	1.113	.000	10.346	16.187
2	1	-26.850*	1.915	.000	-31.876	-21.824
	3	-13.583*	1.980	.000	-18.781	-8.386
3	1	-13.267*	1.113	.000	-16.187	-10.346
	2	13.583*	1.980	.000	8.386	18.781

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Bonferroni.

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.936	130.909[a]	2.000	18.000	.000	.936
Wilks' lambda	.064	130.909[a]	2.000	18.000	.000	.936
Hotelling's trace	14.545	130.909[a]	2.000	18.000	.000	.936
Roy's largest root	14.545	130.909[a]	2.000	18.000	.000	.936

Each F tests the multivariate effect of Imagery. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

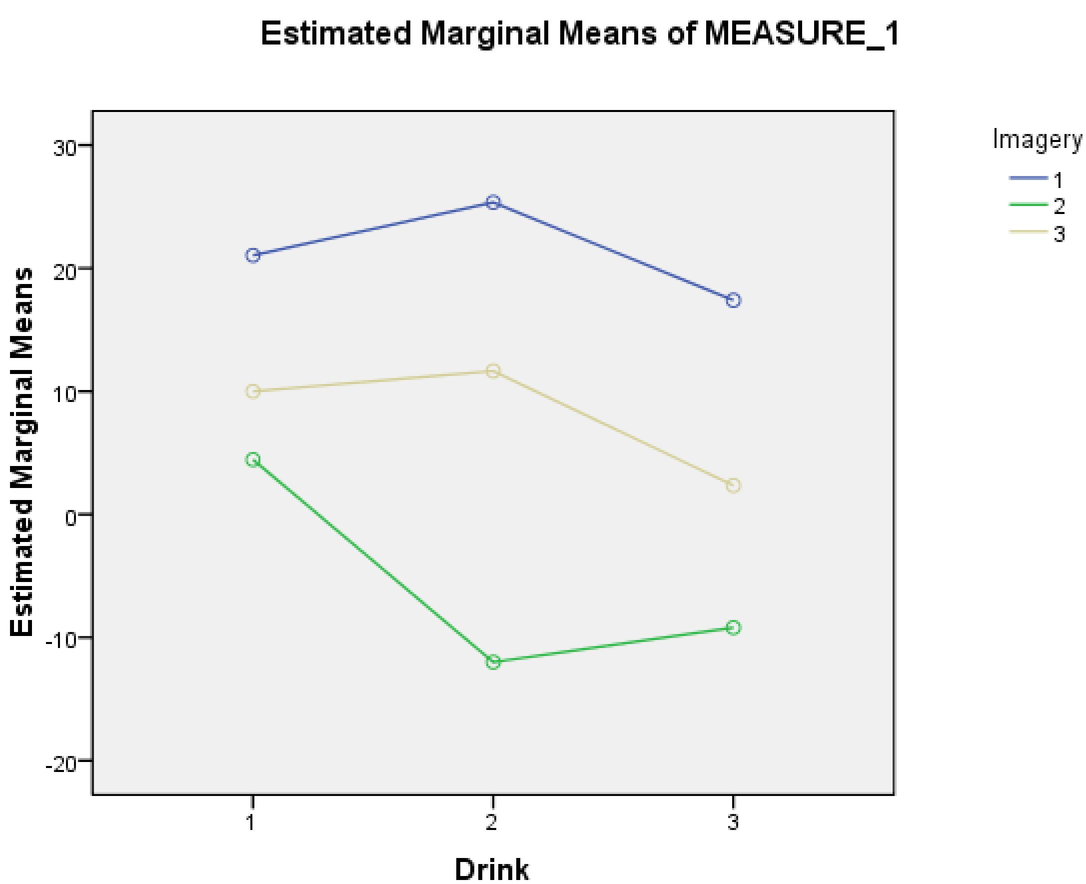
a. Exact statistic

3. Drink * Imagery

Measure:MEASURE_1

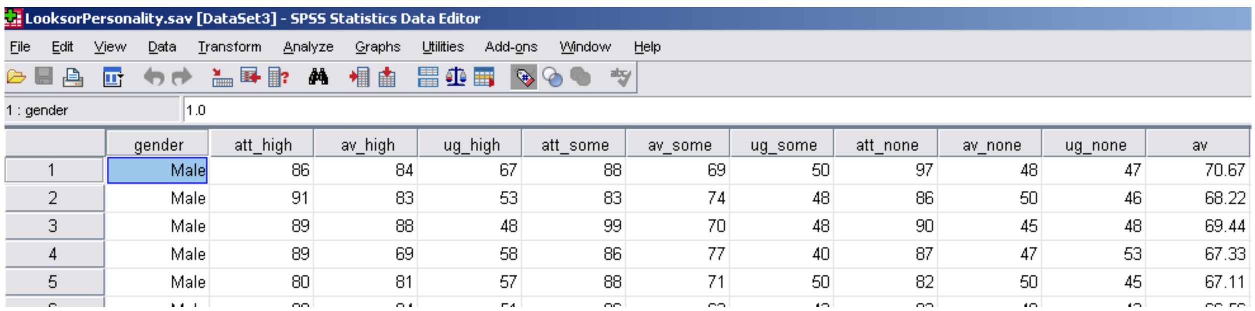
Drink	Imagery	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
1	1	21.050	2.909	14.962	27.138
	2	4.450	3.869	-3.648	12.548
	3	10.000	2.302	5.181	14.819
2	1	25.350	1.507	22.197	28.503
	2	-12.000	1.382	-14.893	-9.107
	3	11.650	1.396	8.728	14.572
3	1	17.400	1.582	14.089	20.711
	2	-9.200	1.521	-12.384	-6.016
	3	2.350	1.529	-.851	5.551

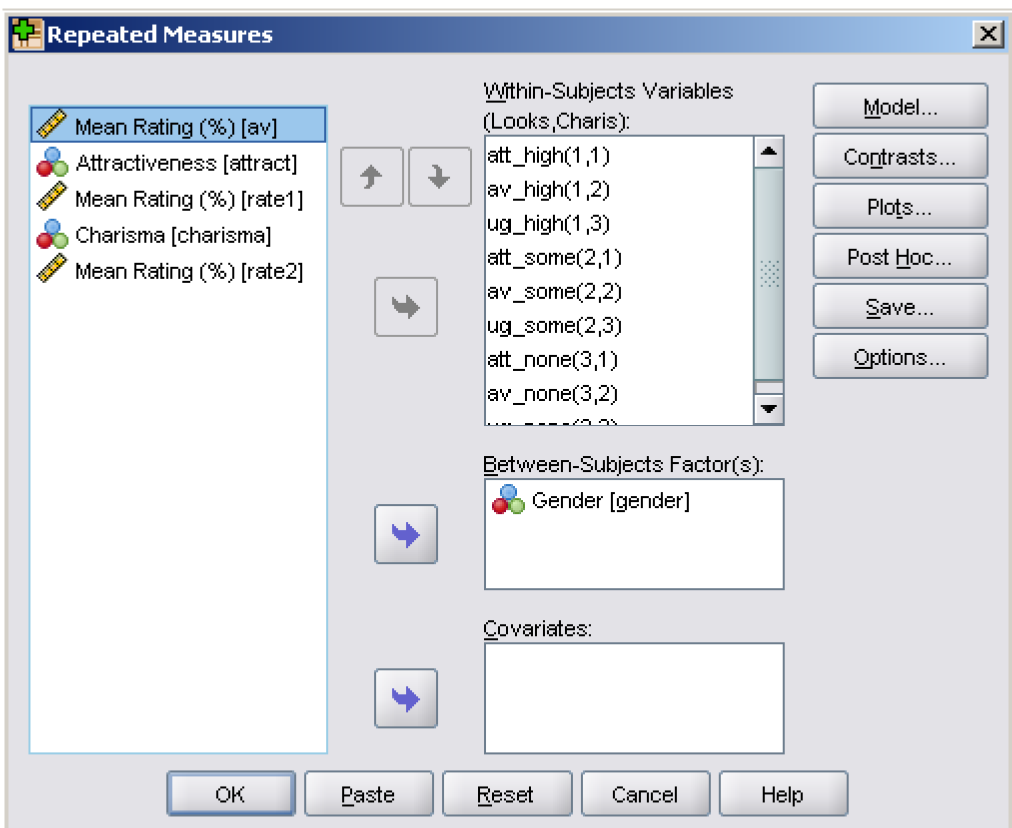
Profile Plots

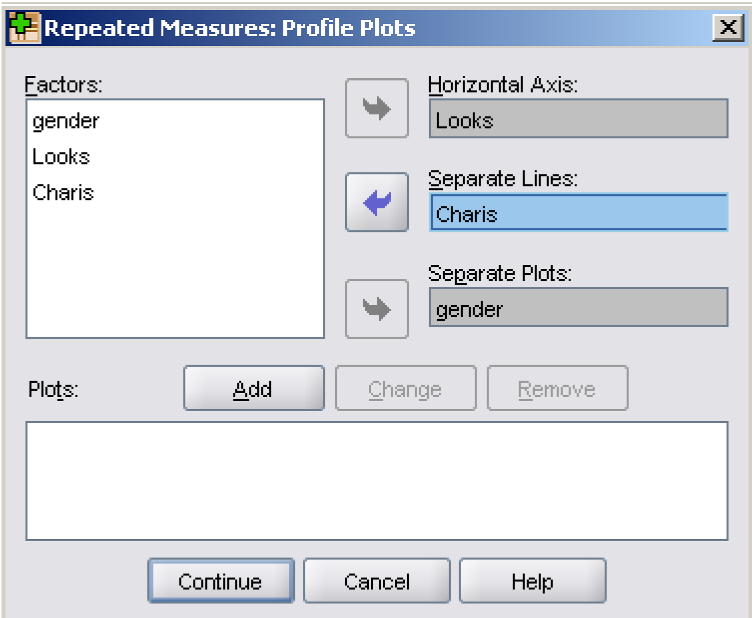


MIXED FACTORIAL ANOVA

This study was focusing on whether looks or personality were more important during a speed dating process. Additionally the researcher wanted to know if there was a difference between genders as well. Therefore in this 3 X 3 X 2 mixed factorial ANOVA there were 2 within IVs both with 3 levels: looks (attractive, average and ugly) and charisma (high, average, and none); and one between measures IV: Gender. The DV was the rating of 'how much you like to go on a proper date' from 0% - 100%.







OUTPUT: The important boxes only

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
Looks	.929	1.246	2	.536	.934	1.000	.500
Charis	.960	.690	2	.708	.962	1.000	.500
Looks * Charis	.613	8.025	9	.534	.799	1.000	.250

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 + gender
Within Subjects Design: Looks + Charis + Looks * Charis

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Looks	Sphericity Assumed	23233.600	2	11616.800	328.250	.000	.948
	Greenhouse-Geisser	23233.600	1.868	12437.761	328.250	.000	.948
	Huynh-Feldt	23233.600	2.000	11616.800	328.250	.000	.948
	Lower-bound	23233.600	1.000	23233.600	328.250	.000	.948
Looks * gender	Sphericity Assumed	4420.133	2	2210.067	62.449	.000	.776
	Greenhouse-Geisser	4420.133	1.868	2366.252	62.449	.000	.776
	Huynh-Feldt	4420.133	2.000	2210.067	62.449	.000	.776
	Lower-bound	4420.133	1.000	4420.133	62.449	.000	.776
Error(Looks)	Sphericity Assumed	1274.044	36	35.390			
	Greenhouse-Geisser	1274.044	33.624	37.891			
	Huynh-Feldt	1274.044	36.000	35.390			
	Lower-bound	1274.044	18.000	70.780			
Charis	Sphericity Assumed	20779.633	2	10389.817	423.733	.000	.959
	Greenhouse-Geisser	20779.633	1.923	10803.275	423.733	.000	.959
	Huynh-Feldt	20779.633	2.000	10389.817	423.733	.000	.959
	Lower-bound	20779.633	1.000	20779.633	423.733	.000	.959
Charis * gender	Sphericity Assumed	3944.100	2	1972.050	80.427	.000	.817
	Greenhouse-Geisser	3944.100	1.923	2050.527	80.427	.000	.817
	Huynh-Feldt	3944.100	2.000	1972.050	80.427	.000	.817
	Lower-bound	3944.100	1.000	3944.100	80.427	.000	.817
Error(Charis)	Sphericity Assumed	882.711	36	24.520			
	Greenhouse-Geisser	882.711	34.622	25.496			
	Huynh-Feldt	882.711	36.000	24.520			
	Lower-bound	882.711	18.000	49.040			
Looks * Charis	Sphericity Assumed	4055.267	4	1013.817	36.633	.000	.671
	Greenhouse-Geisser	4055.267	3.197	1268.295	36.633	.000	.671
	Huynh-Feldt	4055.267	4.000	1013.817	36.633	.000	.671
	Lower-bound	4055.267	1.000	4055.267	36.633	.000	.671
Looks * Charis * gender	Sphericity Assumed	2669.667	4	667.417	24.116	.000	.573
	Greenhouse-Geisser	2669.667	3.197	834.945	24.116	.000	.573
	Huynh-Feldt	2669.667	4.000	667.417	24.116	.000	.573
	Lower-bound	2669.667	1.000	2669.667	24.116	.000	.573
Error(Looks*Charis)	Sphericity Assumed	1992.622	72	27.675			
	Greenhouse-Geisser	1992.622	57.554	34.622			
	Huynh-Feldt	1992.622	72.000	27.675			
	Lower-bound	1992.622	18.000	110.701			

Write up for the following design:
Main effect of Looks
Main effect Charisma
Main effect of Gender (you get this form the between subjects box further down)
Interaction terms for Looks * Gender
Interaction term for Charisma * Gender
Interaction term for Looks * Charisma
3 way interaction term for Looks*Charisma*Gender

Tests of Within-Subjects Contrasts

Measure:MEASURE_1

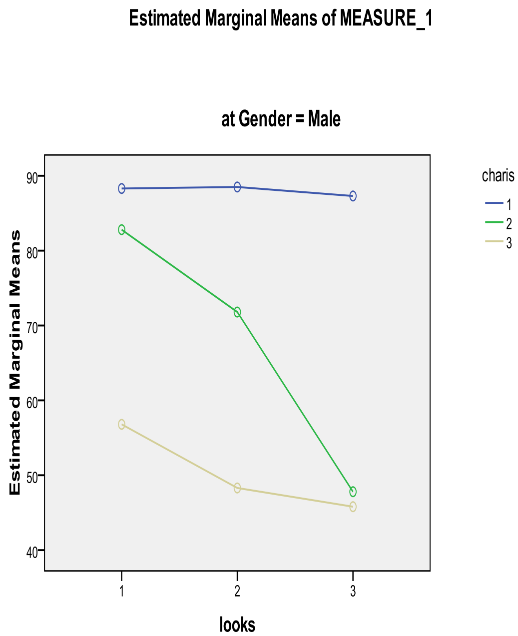
Source	L...	Charis	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Looks	Level 1 vs. Level 3		15456.800	1	15456.800	727.992	.000	.976
	Level 2 vs. Level 3		4500.000	1	4500.000	227.941	.000	.927
Looks * gender	Level 1 vs. Level 3		2944.356	1	2944.356	138.675	.000	.885
	Level 2 vs. Level 3		665.089	1	665.089	33.689	.000	.652
Error(Looks)	Level 1 vs. Level 3		382.178	18	21.232			
	Level 2 vs. Level 3		355.356	18	19.742			
Charis		Level 1 vs. Level 3	13816.272	1	13816.272	1055.722	.000	.983
		Level 2 vs. Level 3	2864.022	1	2864.022	160.067	.000	.899
Charis * gender		Level 1 vs. Level 3	2622.050	1	2622.050	200.355	.000	.918
		Level 2 vs. Level 3	540.800	1	540.800	30.225	.000	.627
Error(Charis)		Level 1 vs. Level 3	235.567	18	13.087			
		Level 2 vs. Level 3	322.067	18	17.893			
Looks * Charis	Level 1 vs. Level 3	Level 1 vs. Level 3	819.200	1	819.200	8.176	.010	.312
		Level 2 vs. Level 3	3075.200	1	3075.200	39.493	.000	.687
	Level 2 vs. Level 3	Level 1 vs. Level 3	4176.050	1	4176.050	58.104	.000	.763
		Level 2 vs. Level 3	7334.450	1	7334.450	88.598	.000	.831
Looks * Charis * gender	Level 1 vs. Level 3	Level 1 vs. Level 3	259.200	1	259.200	2.587	.125	.126
		Level 2 vs. Level 3	2691.200	1	2691.200	34.562	.000	.658
	Level 2 vs. Level 3	Level 1 vs. Level 3	4961.250	1	4961.250	69.029	.000	.793
		Level 2 vs. Level 3	110.450	1	110.450	1.334	.263	.069
Error(Looks*Charis)	Level 1 vs. Level 3	Level 1 vs. Level 3	1803.600	18	100.200			
		Level 2 vs. Level 3	1401.600	18	77.867			
	Level 2 vs. Level 3	Level 1 vs. Level 3	1293.700	18	71.872			
		Level 2 vs. Level 3	1490.100	18	82.783			

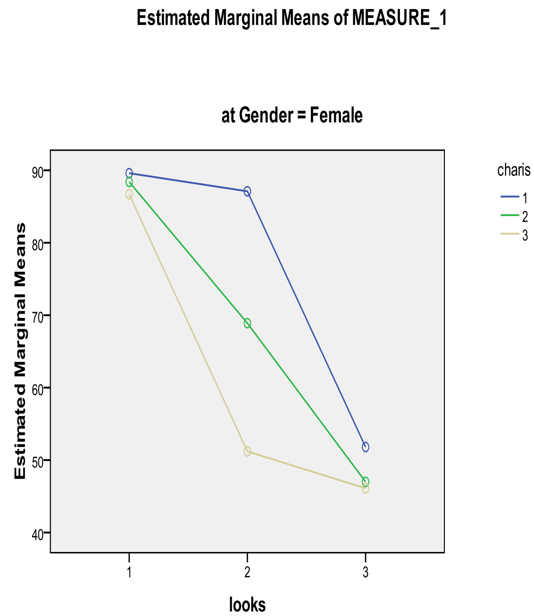
Tests of Between-Subjects Effects

Measure:MEASURE_1
Transformed Variable:Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	94027.756	1	94027.756	20036.900	.000	.999
gender	.022	1	.022	.005	.946	.000
Error	84.469	18	4.693			

This box provides the inferential results for the between subjects variable of Gender.





Profile plots for the 3 way interaction