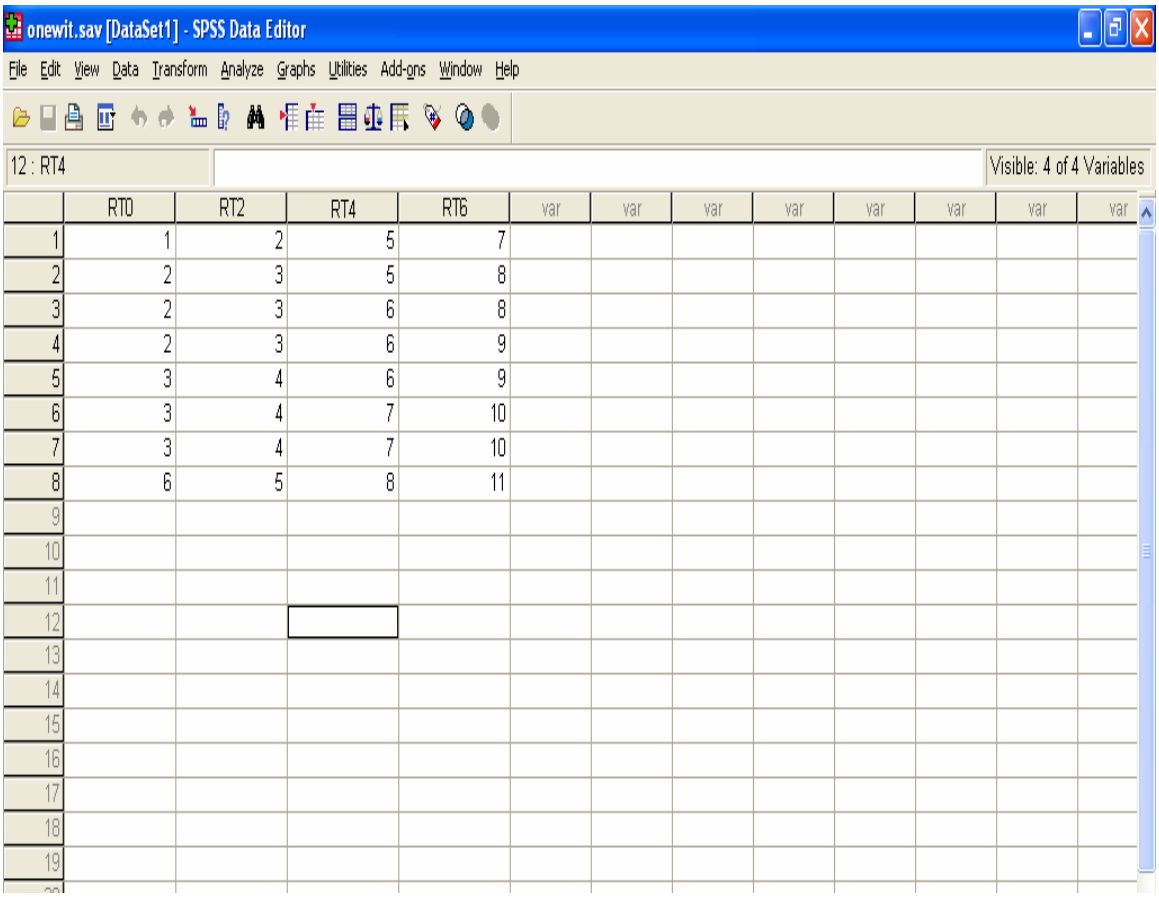
One-Way Within-Subjects ANOVA

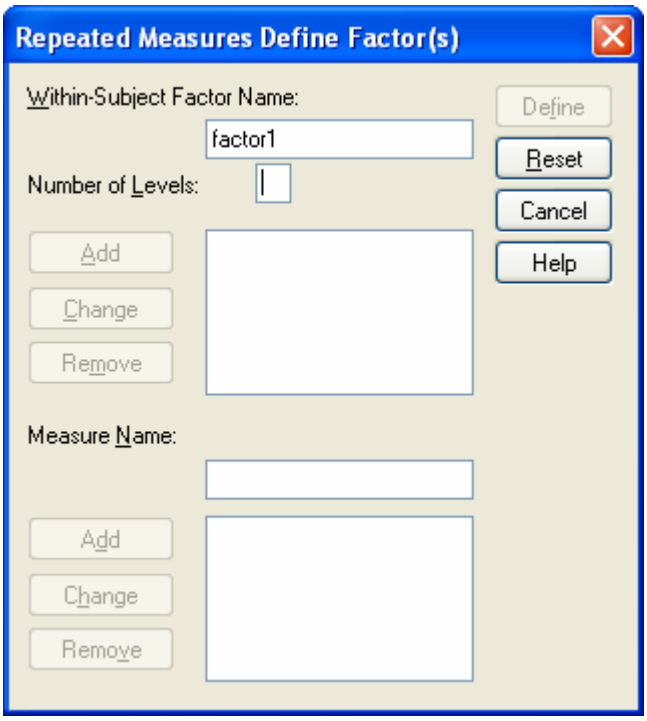
To study the relationship between alcohol consumption and reaction time, reaction time was measured under each of four conditions. Conditions were defined in terms of the amount of alcohol consumed 30 minutes prior to measuring reaction time. Four levels of alcohol were used: 0, 2, 4, and 6 ounces of alcohol. Each of eight subjects took part in each treatment. Treatments were administered one week apart. For each subject the order of the treatments was randomly selected from the 24 possible orders. These data are used to illustrate ANOVA for a design with one within-subjects factor;

Following the procedures for the dependent samples *t* test input the data. There will be four variables. These are labeled RT1, RT2, RT4, and RT6 and are the reaction times under the four levels of alcohol consumption.

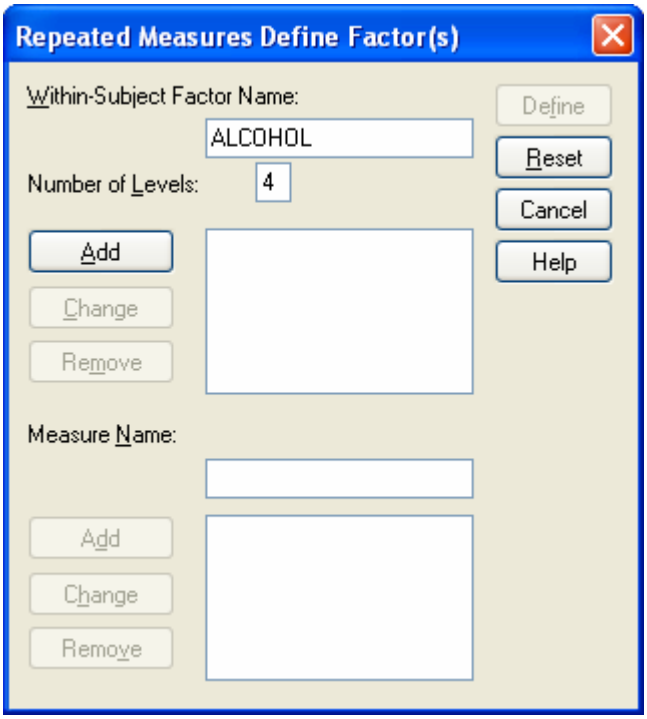


	RT0	RT2	RT4	RT6	var	var	var	var	var	var	var	var
1	1	2	5	7								
2	2	3	5	8								
3	2	3	6	8								
4	2	3	6	9								
5	3	4	6	9								
6	3	4	7	10								
7	3	4	7	10								
8	6	5	8	11								
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												

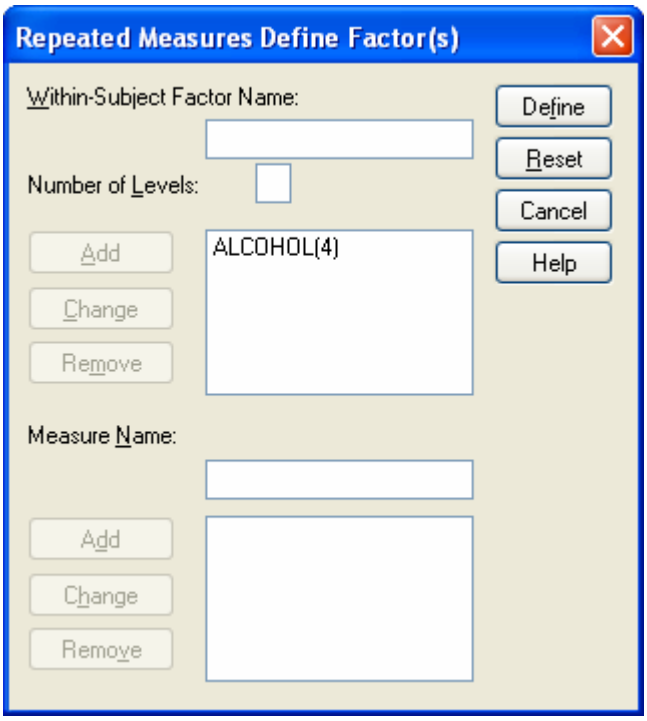
Click Analyze → General Linear Model → Repeated Measures. The following screen is displayed:



Change the text in the Within-Subject Factor Name: slot to ALCOHOL. In the Number of Levels: slot type 4:

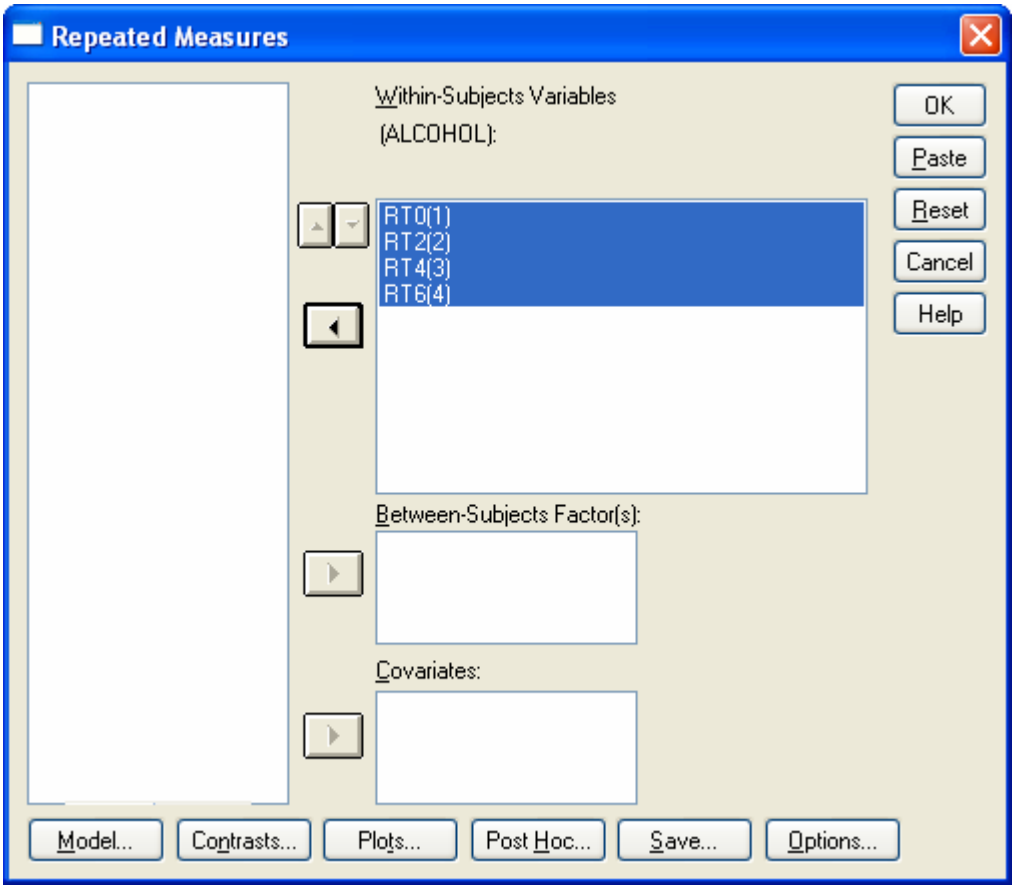


Click Add:

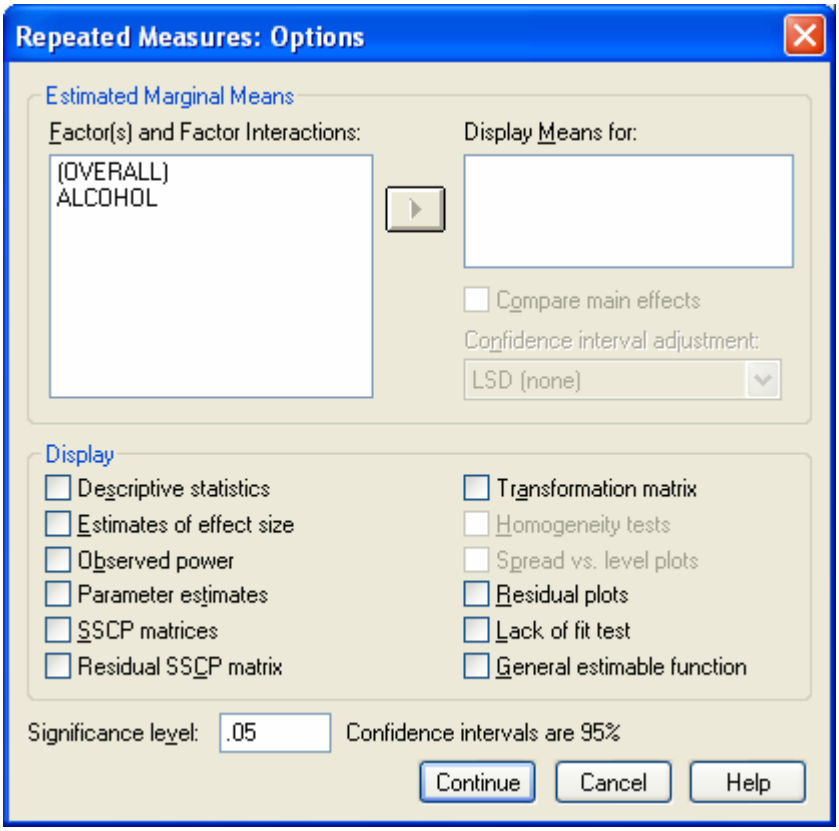


Click Define

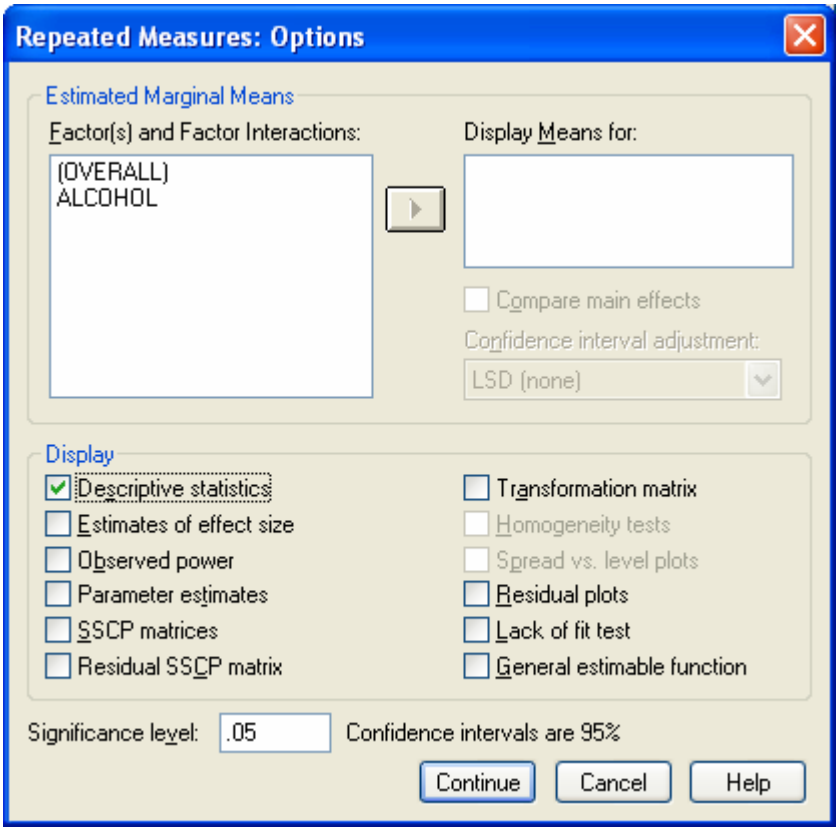
Move RT0, RT2, RT4, and RT6 to the Within-Subjects Variables slot:



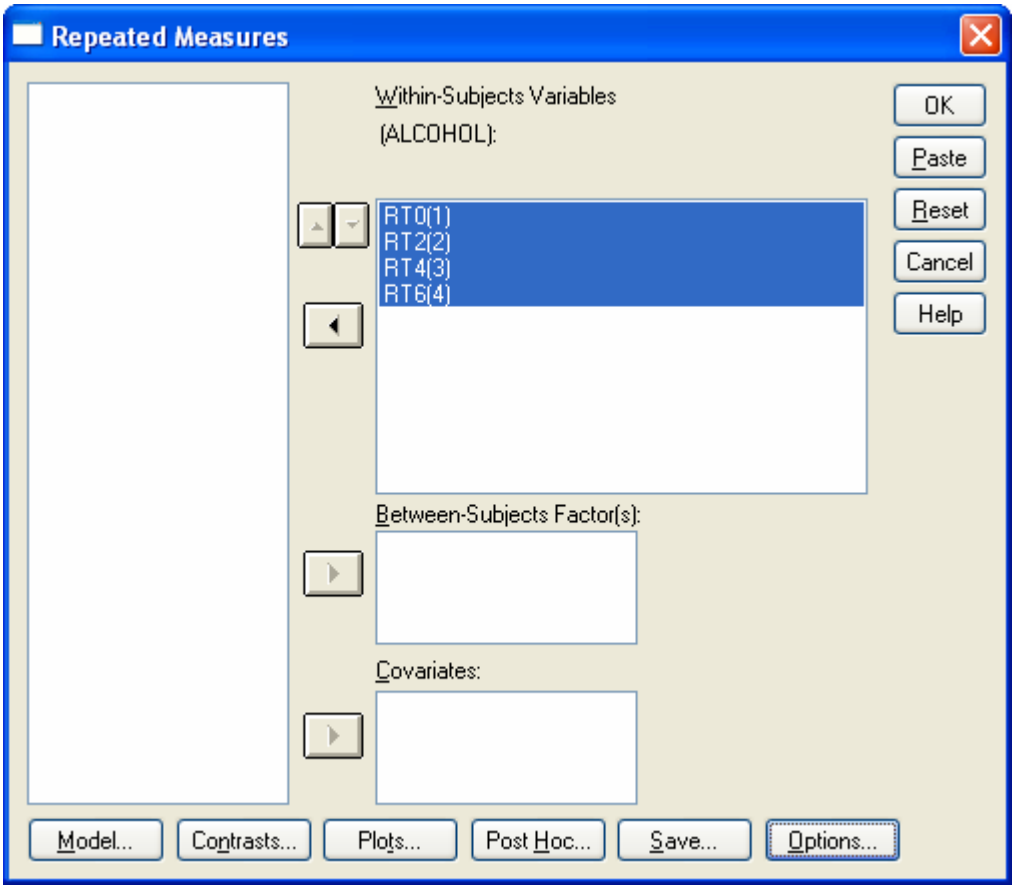
Click Options:



Check Descriptive Statistics:



Click Continue:



Click OK. You can ignore the following results:

1. Multivariate tests.
2. Mauchley's Test of Sphericity (except for epsilon).
3. Tests of Within-Subjects Contrasts.
4. Tests of Between-Subjects Effects.

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

ALCOHOL	Dependent Variable
1	RT0
2	RT2
3	RT4
4	RT6

Descriptive Statistics

	Mean	Std. Deviation	N
RT0	2.75	1.488	8
RT2	3.50	.926	8
RT4	6.25	1.035	8
RT6	9.00	1.309	8

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
ALCOHOL	Pillai's Trace	.994	256.111[a]	3.000	5.000	.000
	Wilks' Lambda	.006	256.111[a]	3.000	5.000	.000
	Hotelling's Trace	153.667	256.111[a]	3.000	5.000	.000
	Roy's Largest Root	153.667	256.111[a]	3.000	5.000	.000

a. Exact statistic

b.

Design: Intercept
Within Subjects Design: ALCOHOL

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
ALCOHOL	.633	2.618	5	.762	.762	1.000	.333

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: ALCOHOL

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
ALCOHOL	Sphericity Assumed	194.500	3	64.833	340.375	.000
	Greenhouse-Geisser	194.500	2.286	85.094	340.375	.000
	Huynh-Feldt	194.500	3.000	64.833	340.375	.000
	Lower-bound	194.500	1.000	194.500	340.375	.000
Error(ALCOHOL)	Sphericity Assumed	4.000	21	.190		
	Greenhouse-Geisser	4.000	16.000	.250		
	Huynh-Feldt	4.000	21.000	.190		
	Lower-bound	4.000	7.000	.571		

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	ALCOHOL	Type III Sum of Squares	df	Mean Square	F	Sig.
ALCOHOL	Linear	184.900	1	184.900	719.056	.000
	Quadratic	8.000	1	8.000	37.333	.000
	Cubic	1.600	1	1.600	16.000	.005
Error(ALCOHOL)	Linear	1.800	7	.257		
	Quadratic	1.500	7	.214		
	Cubic	.700	7	.100		

Tests of Between-Subjects Effects

Measure: MEASURE_1

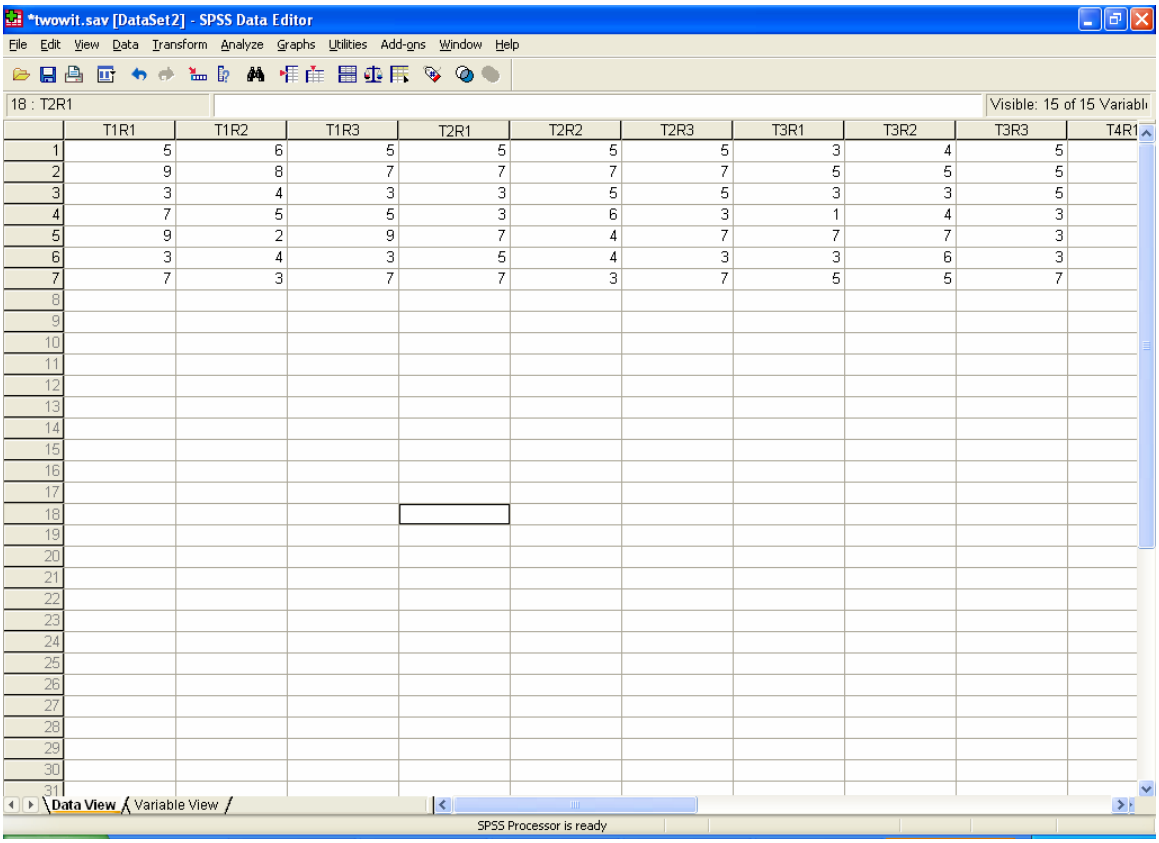
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	924.500	1	924.500	174.905	.000
Error	37.000	7	5.286		

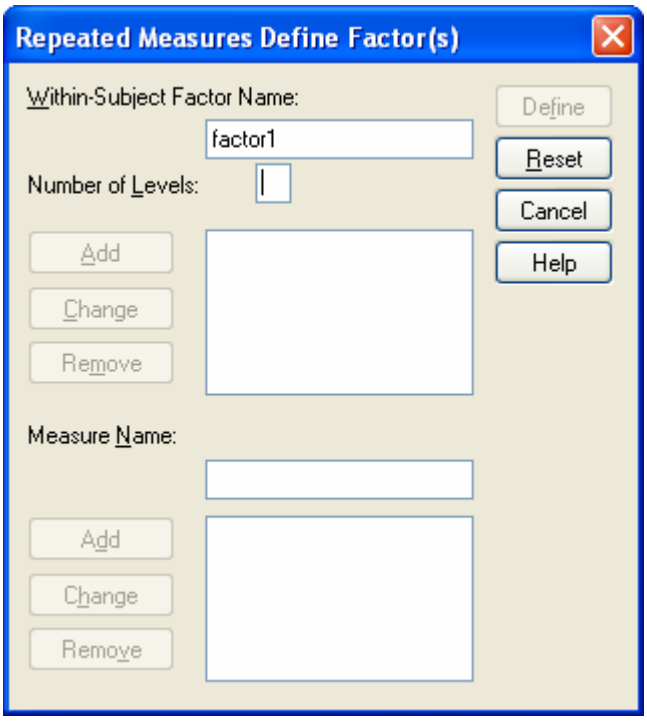
Two-Way Within-Subjects ANOVA

Data are available for seven scientists in an organization, The data are ratings by three raters on five traits thought to be related to scientific success. Because each scientist has a score for each combination of trait and rate, both the trait and rater factprs are within-subjects.

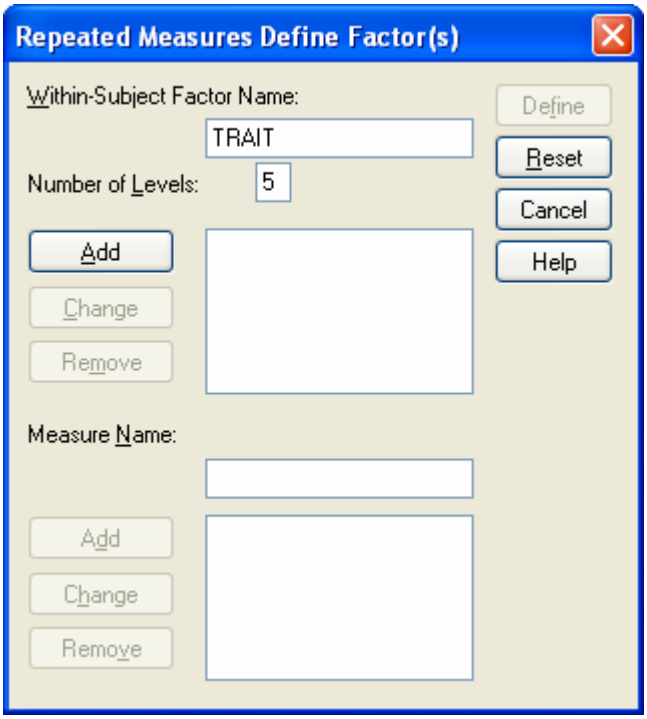
Following the procedures for the dependent samples *t* test, input the data. There will be 15 variables. These are labeled T1R1, T1R2, … , T5R3 and are the ratings on the five trait by the three raters. Note that in the SPSS data Editor, in the list of variables trait changes slowly and rater change quickly. For example the first six variable labels are T1R1, T1R2, T1R3, T2R1, T2R2, T1R3. The variables should be entered either with trait changing most slowly and rater changing most quickly or with rater changing most slowly and trait changing most quickly. Either order will be OK.



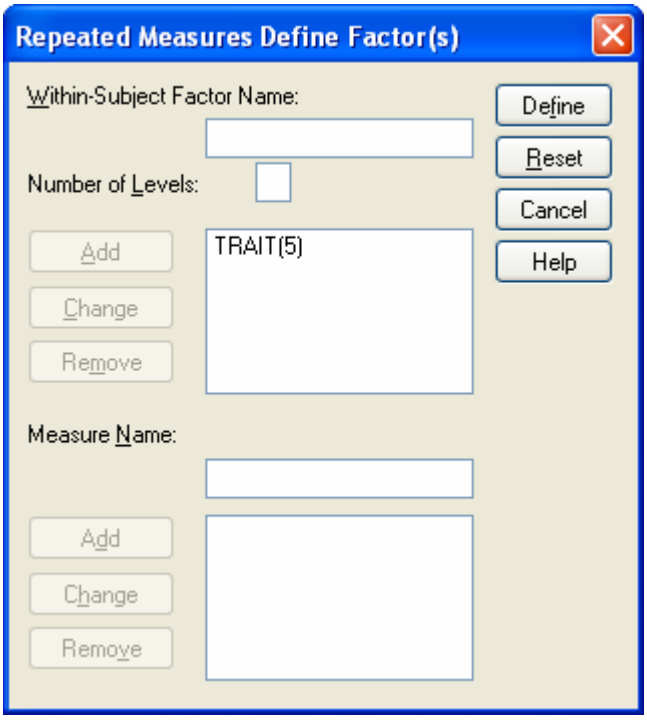
Click Analyze → General Linear Model → Repeated Measures. The following screen is displayed:



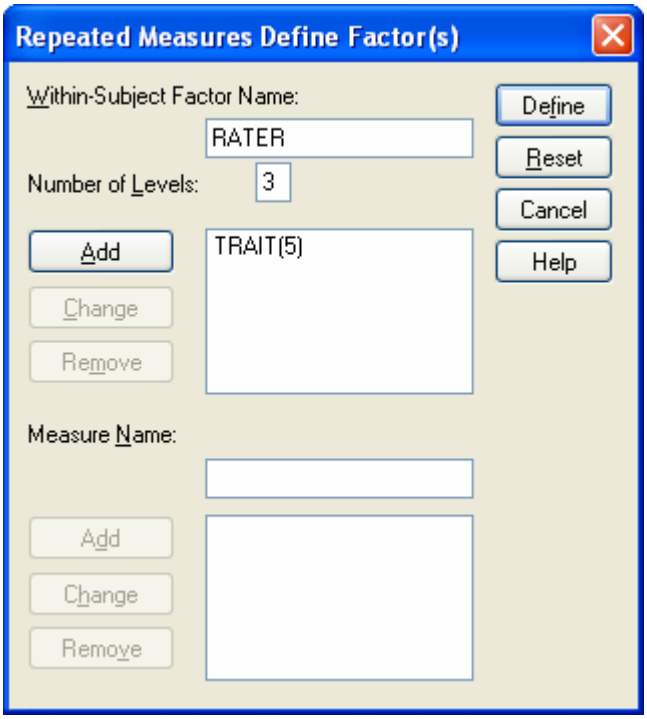
Change the text in the Within-Subject Factor Name: slot to TRAIT. (Recall that in the list of variables trait was changing most slowly.) In the Number of Levels: slot type 5:



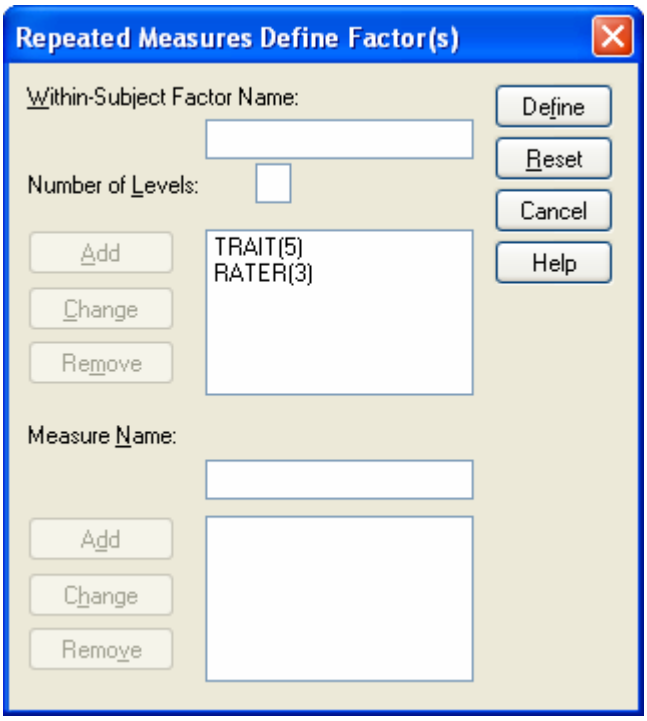
Click Add:



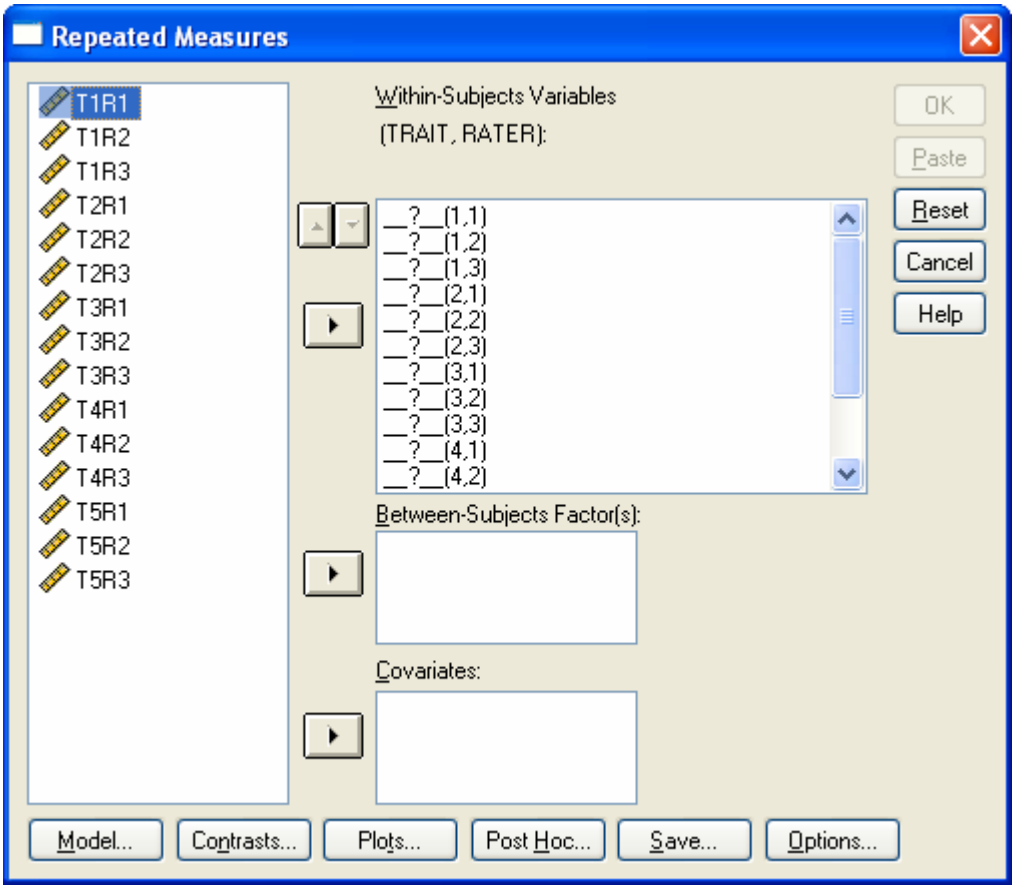
In the Within-Subject Factor Name: type RATER. In the Number of Levels: slot type 3:



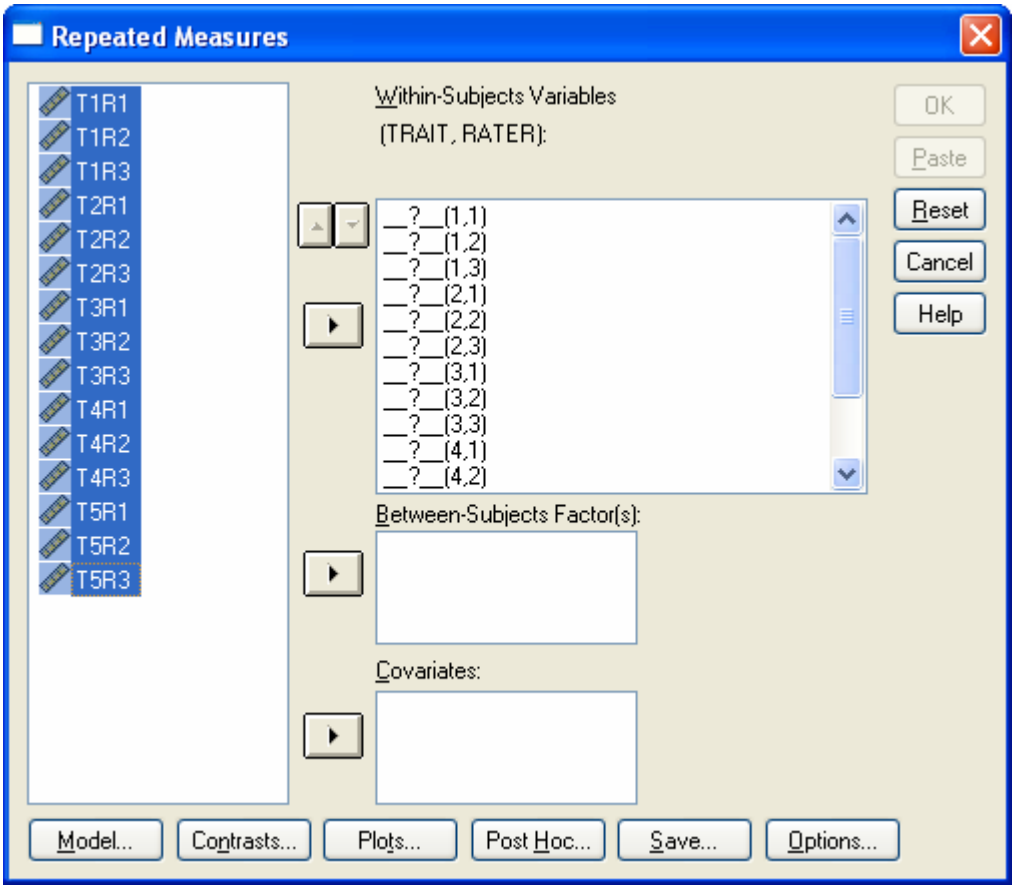
Click Add:



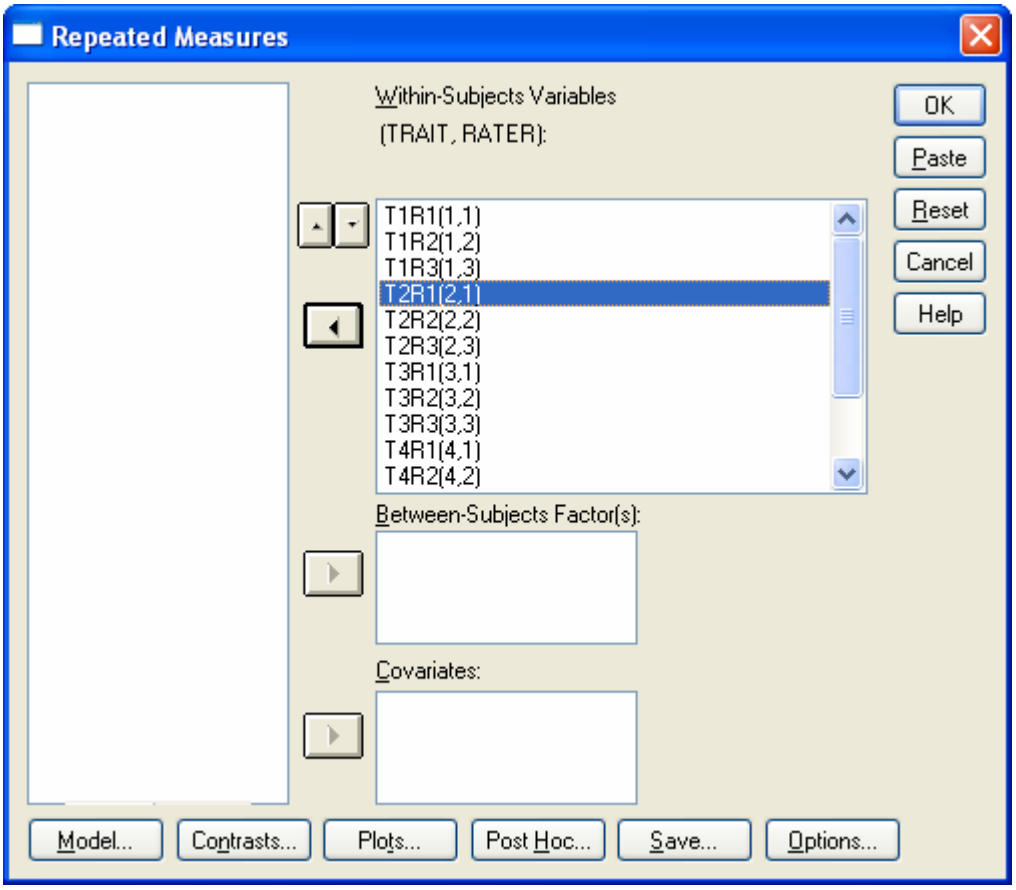
Click Define



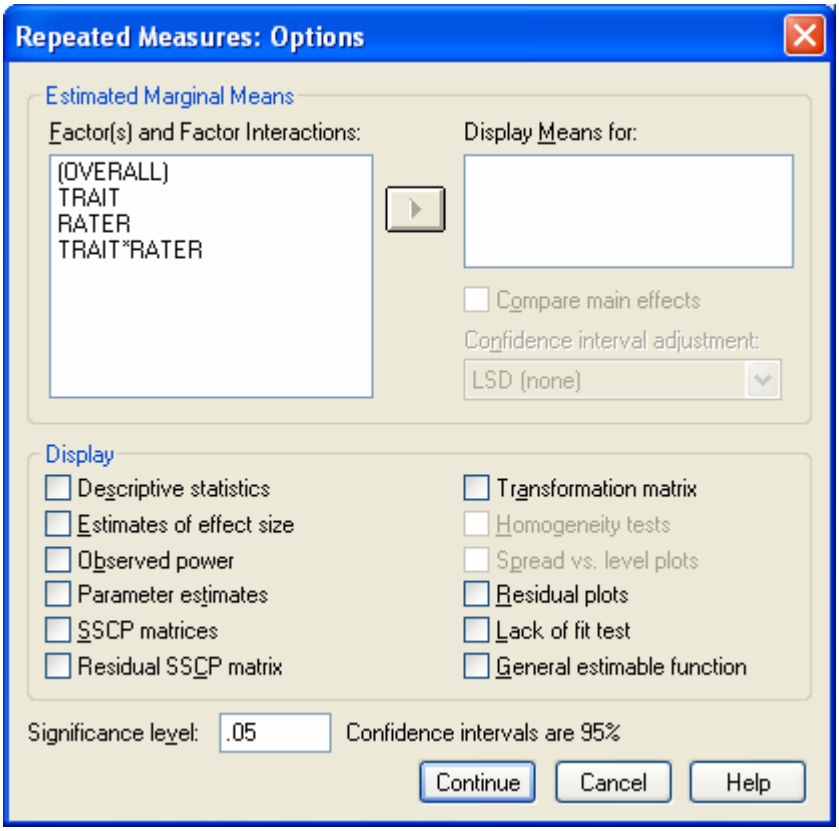
Hold down the shift key and move the courser down the list of variables to highlight all of the variables:



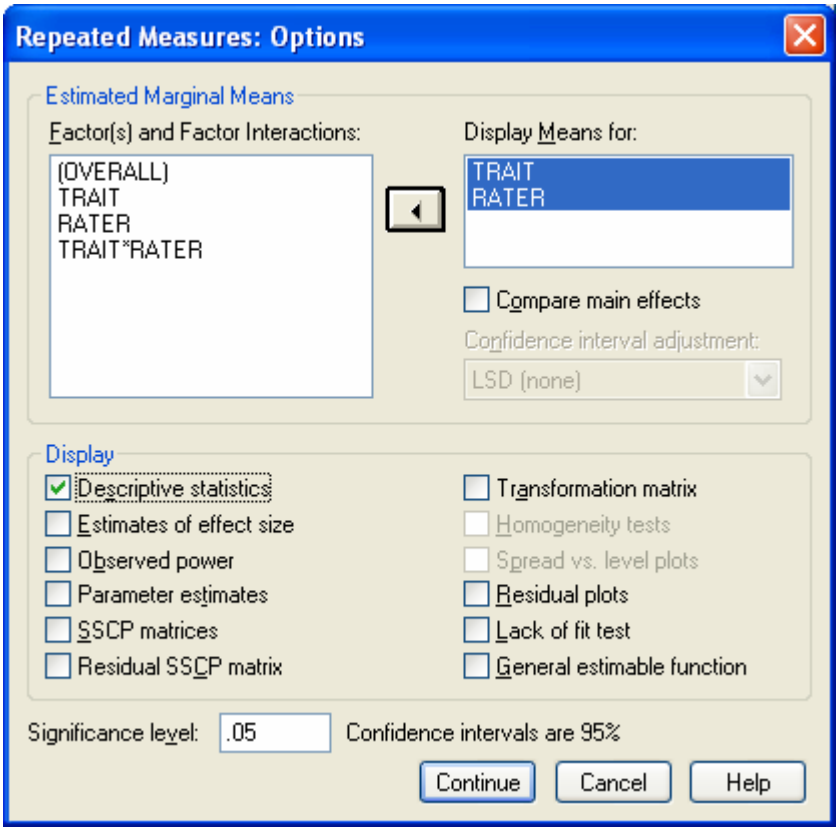
Move the list to the Within-Subjects Variables slot:



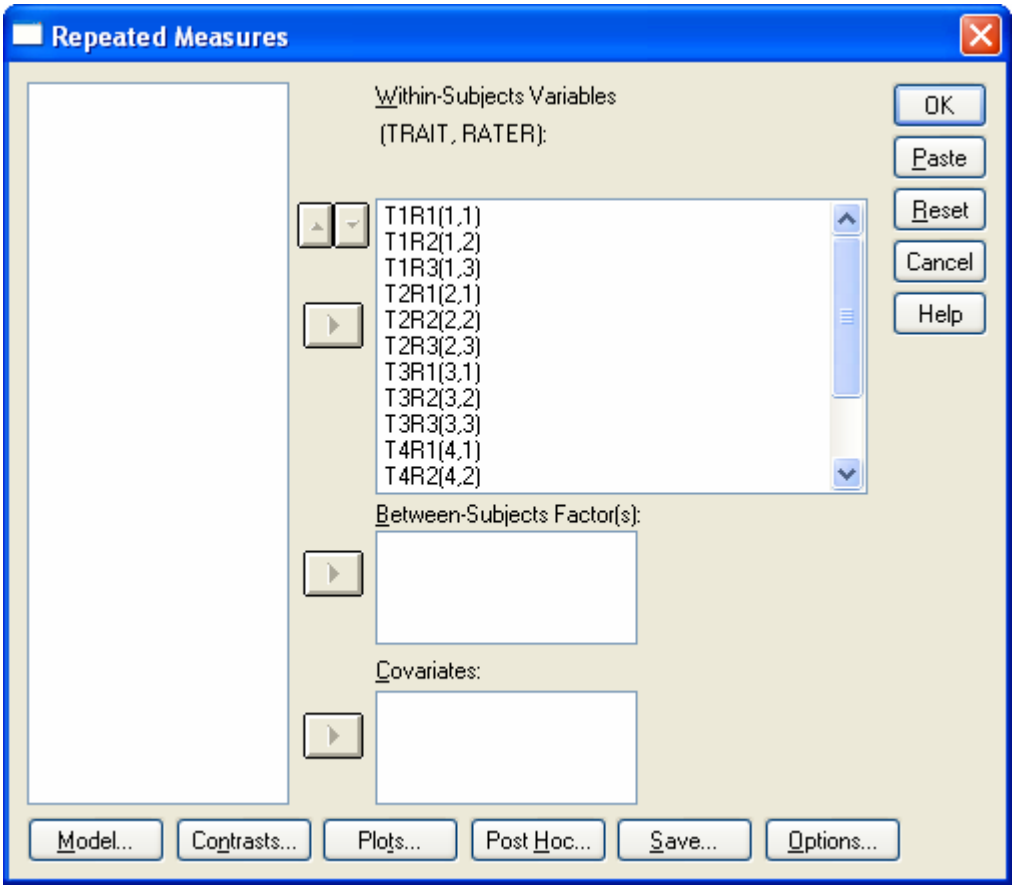
Make sure the list of variables is in the following orders: trait changing most slowly and rater changing most quickly. Click Options:



Move TRAIT and RATER to the Display Means for: slot and check Descriptive Statistics:



Click Continue:



Click OK. You can ignore the following results:

5. Multivariate tests.
6. Mauchley's Test of Sphericity (except for epsilon).
7. Tests of Within-Subjects Contrasts.
8. Tests of Between-Subjects Effects.

Within-Subjects Factors

Measure: MEASURE_1

TRAIT	RATER	Dependent Variable
1	1	T1R1
	2	T1R2
	3	T1R3
2	1	T2R1
	2	T2R2
	3	T2R3
3	1	T3R1
	2	T3R2
	3	T3R3
4	1	T4R1
	2	T4R2
	3	T4R3
5	1	T5R1
	2	T5R2
	3	T5R3

Descriptive Statistics

	Mean	Std. Deviation	N
T1R1	6.14	2.545	7
T1R2	4.57	1.988	7
T1R3	5.57	2.225	7
T2R1	5.29	1.799	7
T2R2	4.86	1.345	7
T2R3	5.29	1.799	7
T3R1	3.86	1.952	7
T3R2	4.86	1.345	7
T3R3	4.43	1.512	7
T4R1	5.86	1.864	7
T4R2	5.00	1.633	7
T4R3	5.57	1.512	7
T5R1	3.29	1.799	7
T5R2	3.57	1.512	7
T5R3	4.43	2.225	7

Multivariate Tests[c]

Effect		Value	F	Hypothesis df	Error df	Sig.
TRAIT	Pillai's Trace	.719	1.920[a]	4.000	3.000	.309
	Wilks' Lambda	.281	1.920[a]	4.000	3.000	.309
	Hotelling's Trace	2.560	1.920[a]	4.000	3.000	.309
	Roy's Largest Root	2.560	1.920[a]	4.000	3.000	.309
RATER	Pillai's Trace	.127	.364[a]	2.000	5.000	.712
	Wilks' Lambda	.873	.364[a]	2.000	5.000	.712
	Hotelling's Trace	.146	.364[a]	2.000	5.000	.712
	Roy's Largest Root	.146	.364[a]	2.000	5.000	.712
TRAIT * RATER	Pillai's Trace	.[b]	.	.	.	.
	Wilks' Lambda	.[b]	.	.	.	.
	Hotelling's Trace	.[b]	.	.	.	.
	Roy's Largest Root	.[b]	.	.	.	.

a. Exact statistic

b. Cannot produce multivariate test statistics because of insufficient residual degrees of freedom.

c.

Design: Intercept
Within Subjects Design: TRAIT+RATER+TRAIT*RATER

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
TRAIT	.020	17.326	9	.057	.601	1.000	.250
RATER	.396	4.631	2	.099	.623	.708	.500
TRAIT * RATER	.000	.	35	.	.416	.999	.125

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: TRAIT+RATER+TRAIT*RATER

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
TRAIT	Sphericity Assumed	46.533	4	11.633	5.425	.003
	Greenhouse-Geisser	46.533	2.404	19.359	5.425	.014
	Huynh-Feldt	46.533	4.000	11.633	5.425	.003
	Lower-bound	46.533	1.000	46.533	5.425	.059
Error(TRAIT)	Sphericity Assumed	51.467	24	2.144		
	Greenhouse-Geisser	51.467	14.422	3.569		
	Huynh-Feldt	51.467	24.000	2.144		
	Lower-bound	51.467	6.000	8.578		
RATER	Sphericity Assumed	4.248	2	2.124	.349	.713
	Greenhouse-Geisser	4.248	1.247	3.406	.349	.619
	Huynh-Feldt	4.248	1.416	3.000	.349	.644
	Lower-bound	4.248	1.000	4.248	.349	.576
Error(RATER)	Sphericity Assumed	73.086	12	6.090		
	Greenhouse-Geisser	73.086	7.482	9.769		
	Huynh-Feldt	73.086	8.494	8.605		
	Lower-bound	73.086	6.000	12.181		
TRAIT * RATER	Sphericity Assumed	16.610	8	2.076	1.195	.322
	Greenhouse-Geisser	16.610	3.332	4.985	1.195	.340
	Huynh-Feldt	16.610	7.992	2.078	1.195	.322
	Lower-bound	16.610	1.000	16.610	1.195	.316
Error(TRAIT*RATER)	Sphericity Assumed	83.390	48	1.737		
	Greenhouse-Geisser	83.390	19.991	4.171		
	Huynh-Feldt	83.390	47.951	1.739		
	Lower-bound	83.390	6.000	13.898		

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	TRAIT	RATER	Type III Sum of Squares	df	Mean Square	F	Sig.
TRAIT	Linear		18.900	1	18.900	5.435	.059
	Quadratic		1.500	1	1.500	.673	.444
	Cubic		11.433	1	11.433	10.088	.019
	Order 4		14.700	1	14.700	8.465	.027
Error(TRAIT)	Linear		20.867	6	3.478		
	Quadratic		13.381	6	2.230		
	Cubic		6.800	6	1.133		
	Order 4		10.419	6	1.737		
RATER		Linear	.514	1	.514	.364	.569
		Quadratic	3.733	1	3.733	.347	.577
Error(RATER)		Linear	8.486	6	1.414		
		Quadratic	64.600	6	10.767		
TRAIT * RATER	Linear	Linear	3.457	1	3.457	19.890	.004
		Quadratic	1.371	1	1.371	.660	.447
	Quadratic	Linear	.020	1	.020	.008	.930
		Quadratic	3.918	1	3.918	1.439	.276
	Cubic	Linear	1.829	1	1.829	1.343	.291
		Quadratic	1.152	1	1.152	.658	.448
	Order 4	Linear	1.322	1	1.322	1.434	.276
		Quadratic	3.539	1	3.539	1.444	.275
Error(TRAIT*RATER)	Linear	Linear	1.043	6	.174		
		Quadratic	12.462	6	2.077		
	Quadratic	Linear	14.622	6	2.437		
		Quadratic	16.344	6	2.724		
	Cubic	Linear	8.171	6	1.362		
		Quadratic	10.514	6	1.752		
	Order 4	Linear	5.535	6	.922		
		Quadratic	14.699	6	2.450		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	2457.752	1	2457.752	155.367	.000
Error	94.914	6	15.819		

Estimated Marginal Means

1. TRAIT

Measure: MEASURE_1

TRAIT	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	5.429	.637	3.870	6.987
2	5.143	.429	4.092	6.194
3	4.381	.421	3.352	5.410
4	5.476	.442	4.396	6.557
5	3.762	.447	2.669	4.855

2. RATER

Measure: MEASURE_1

RATER	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	4.886	.635	3.331	6.440
2	4.571	.284	3.876	5.267
3	5.057	.562	3.682	6.432

.