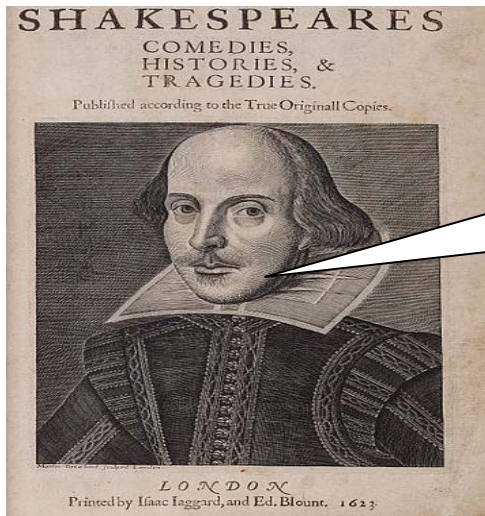


MANOVA / MANCOVA
 Ben Gifford
 James Hayes
 COM 631--Multivariate Analysis
 Spring 2011



To **C**ovariate, or not to **C**ovariate,
 that is the question.

Dependent variables

- 53. I liked the way the film looked
- 47. The film was appealing to look at
- 49. The quality of the film footage was superb
- 39. The film was more realistic than I expected

All of the above question used a Likert scale 1 (strongly disagree) to 7 (strongly agree)

Independent Variables

Race with three categories (recoded)

1. African-American
2. Caucasian
3. Other

108. Condition the participant experienced

1. Color
2. Black and White

Covariates (for later use with MANCOVA)

65. Femaleness, or gender (0 = male 1 = female)

63. Blknwhite, whether or not a viewer expected the film to be in black and white (higher score = greater expectation of B&W)

Item 63 (Blknwhite) used a Likert scale 1 (strongly disagree) to 7 (strongly agree)

Model:

Main Effects

Race

Condition

Interaction Effects

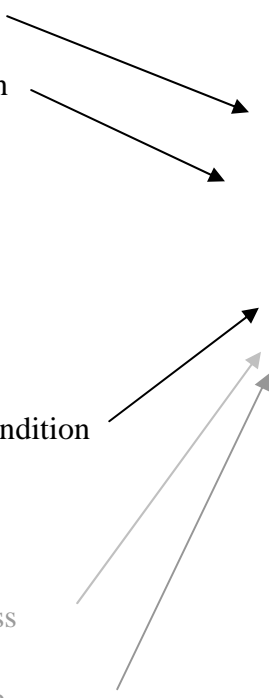
Race x Condition

Covariates

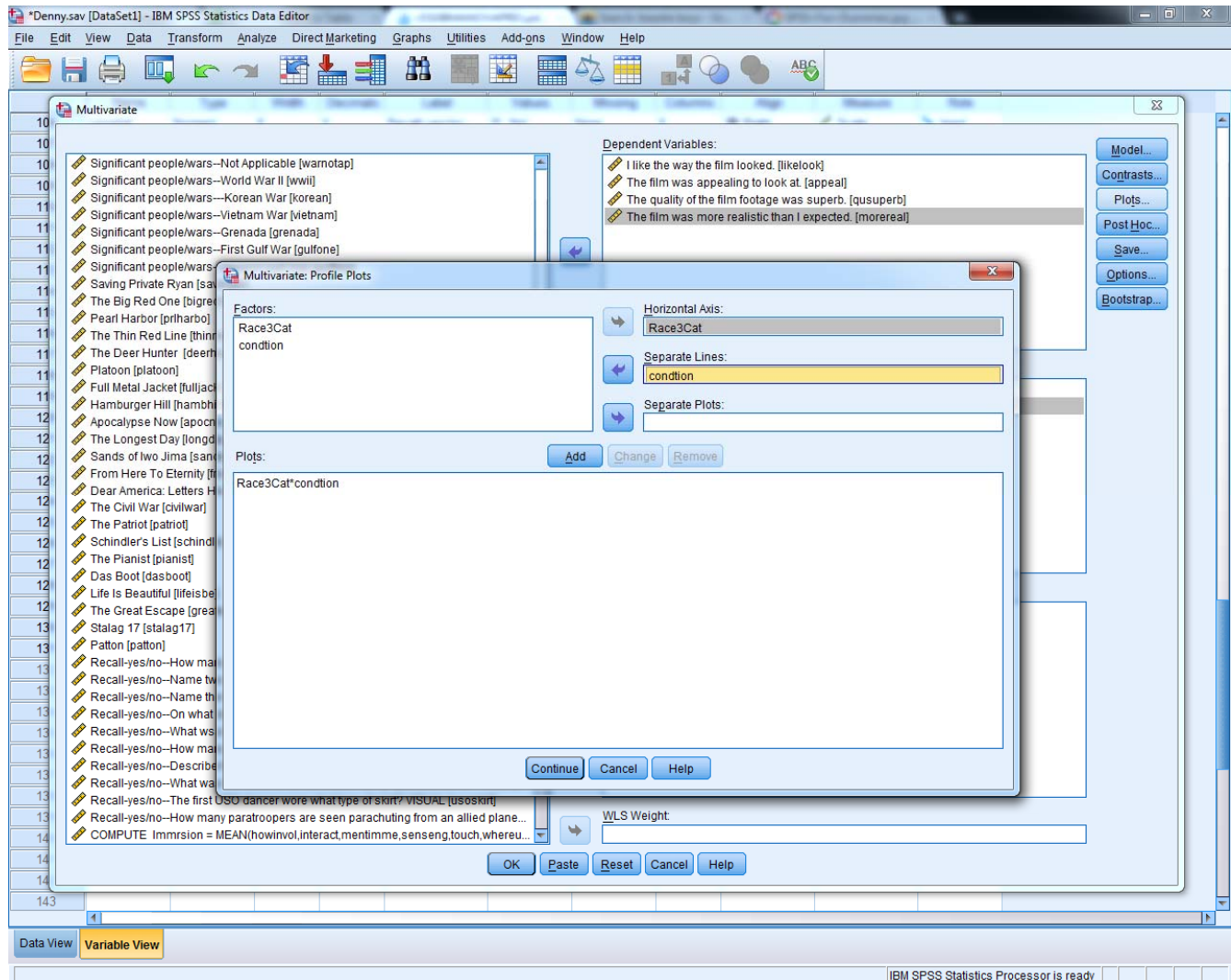
Femaleness

Blknwhite

DV-1 I liked the way the film looked
DV-2 The film was appealing to look at
DV-3 The quality of the film footage was superb
DV-4 The film was more realistic than I expected



Select Plots from the same list on the right
(skipping contrasts)



Move Race3Cat to Horizontal Axis with arrow

Move condition to Separate Lines with arrow

Click Add > Click Continue to exit

Analyze > General Linear Model > Multivariate

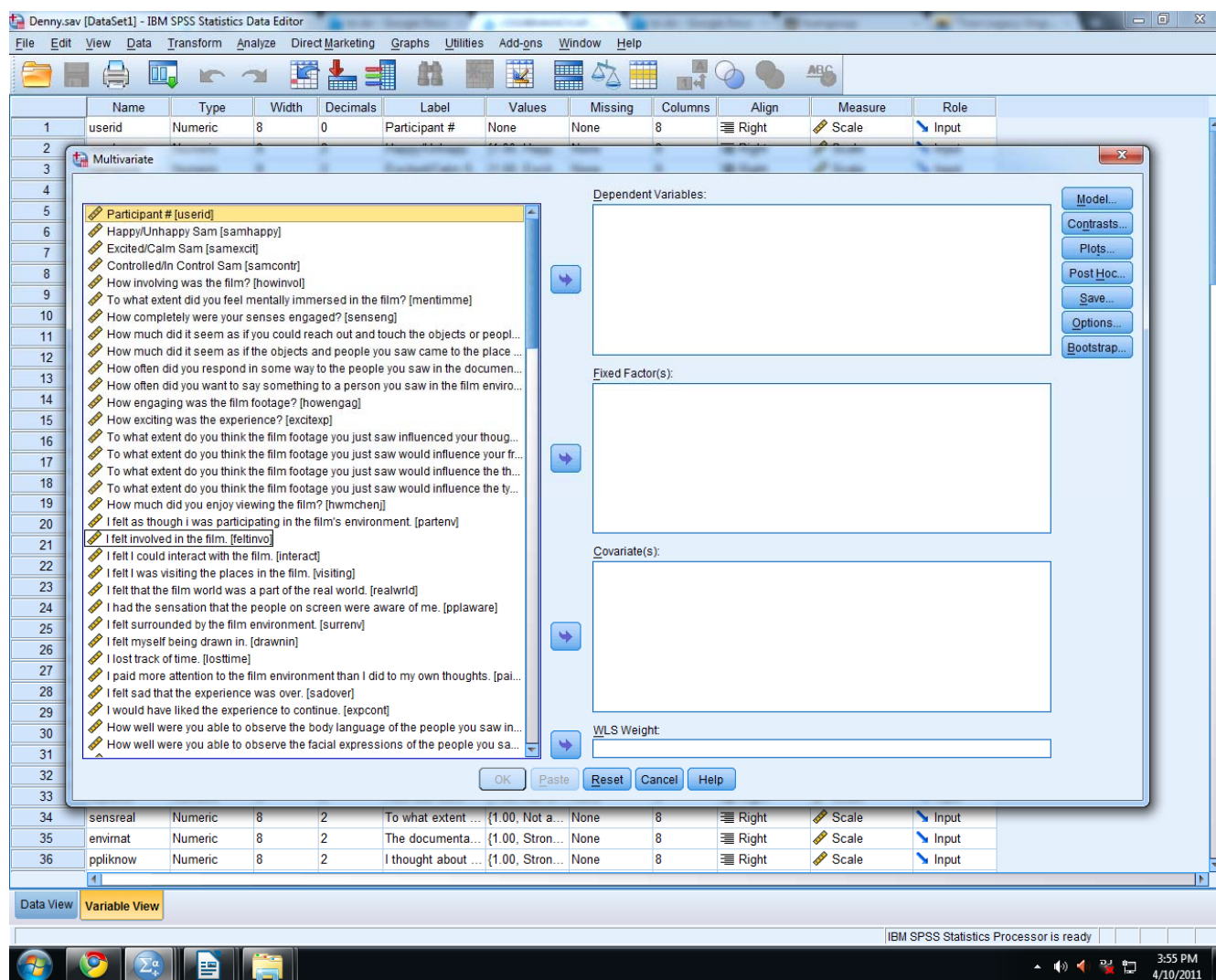
The screenshot displays the IBM SPSS Statistics Data Editor interface. The 'Analyze' menu is open, and the path 'General Linear Model > Multivariate...' is selected. The 'Variable View' tab is active, showing a list of variables with their properties.

Name	Type	Label	Values	Missing	Columns	Align	Measure	Role			
1	userid	Numeric			8	Right	Scale	Input			
2	samhappy	Numeric			8	Right	Scale	Input			
3	samexcit	Numeric			8	Right	Scale	Input			
4	samcontr	Numeric			8	Right	Scale	Input			
5	howinvol	Numeric			8	Right	Scale	Input			
6	mentimme	Numeric			8	Right	Scale	Input			
7	senseng	Numeric			8	Right	Scale	Input			
8	touch	Numeric			8	Right	Scale	Input			
9	whereuwr	Numeric			8	Right	Scale	Input			
10	respond	Numeric			8	Right	Scale	Input			
11	want2say	Numeric			8	Right	Scale	Input			
12	howengag	Numeric			8	Right	Scale	Input			
13	excitexp	Numeric			8	Right	Scale	Input			
14	influyou	Numeric			8	Right	Scale	Input			
15	infrnds	Numeric			8	Right	Scale	Input			
16	infrmost	Numeric			8	Right	Scale	Input			
17	influcus	Numeric			8	Right	Scale	Input			
18	hwmchenj	Numeric			8	Right	Scale	Input			
19	partenv	Numeric			8	Right	Scale	Input			
20	feltinv	Numeric			8	Right	Scale	Input			
21	interact	Numeric			8	Right	Scale	Input			
22	visiting	Numeric			8	Right	Scale	Input			
23	realwrld	Numeric	8	2	I felt that the fil...	{1.00, Stron...	None	8	Right	Scale	Input
24	pplaware	Numeric	8	2	I had the sensa...	{1.00, Stron...	None	8	Right	Scale	Input
25	surrenv	Numeric	8	2	I felt surrounde...	{1.00, Stron...	None	8	Right	Scale	Input
26	drawnin	Numeric	8	2	I felt myself bei...	{1.00, Stron...	None	8	Right	Scale	Input
27	losttime	Numeric	8	2	I lost track of ti...	{1.00, Stron...	None	8	Right	Scale	Input
28	paidatt	Numeric	8	2	I paid more atte...	{1.00, Stron...	None	8	Right	Scale	Input
29	sadover	Numeric	8	2	I felt sad that th...	{1.00, Stron...	None	8	Right	Scale	Input
30	expcont	Numeric	8	2	I would have lik...	{1.00, Stron...	None	8	Right	Scale	Input
31	bodylang	Numeric	8	2	How well were ...	{1.00, Not w...	None	8	Right	Scale	Input
32	facialex	Numeric	8	2	How well were ...	{1.00, Not w...	None	8	Right	Scale	Input
33	styldrss	Numeric	8	2	How well were ...	{1.00, Not w...	None	8	Right	Scale	Input
34	sensreal	Numeric	8	2	To what extent ...	{1.00, Not a...	None	8	Right	Scale	Input
35	enminat	Numeric	8	2	The documenta...	{1.00, Stron...	None	8	Right	Scale	Input
36	ppliknow	Numeric	8	2	I thought about ...	{1.00, Stron...	None	8	Right	Scale	Input

The bottom status bar shows 'IBM SPSS Statistics Processor is ready' and the system clock indicates 2:10 PM on 4/10/2011.

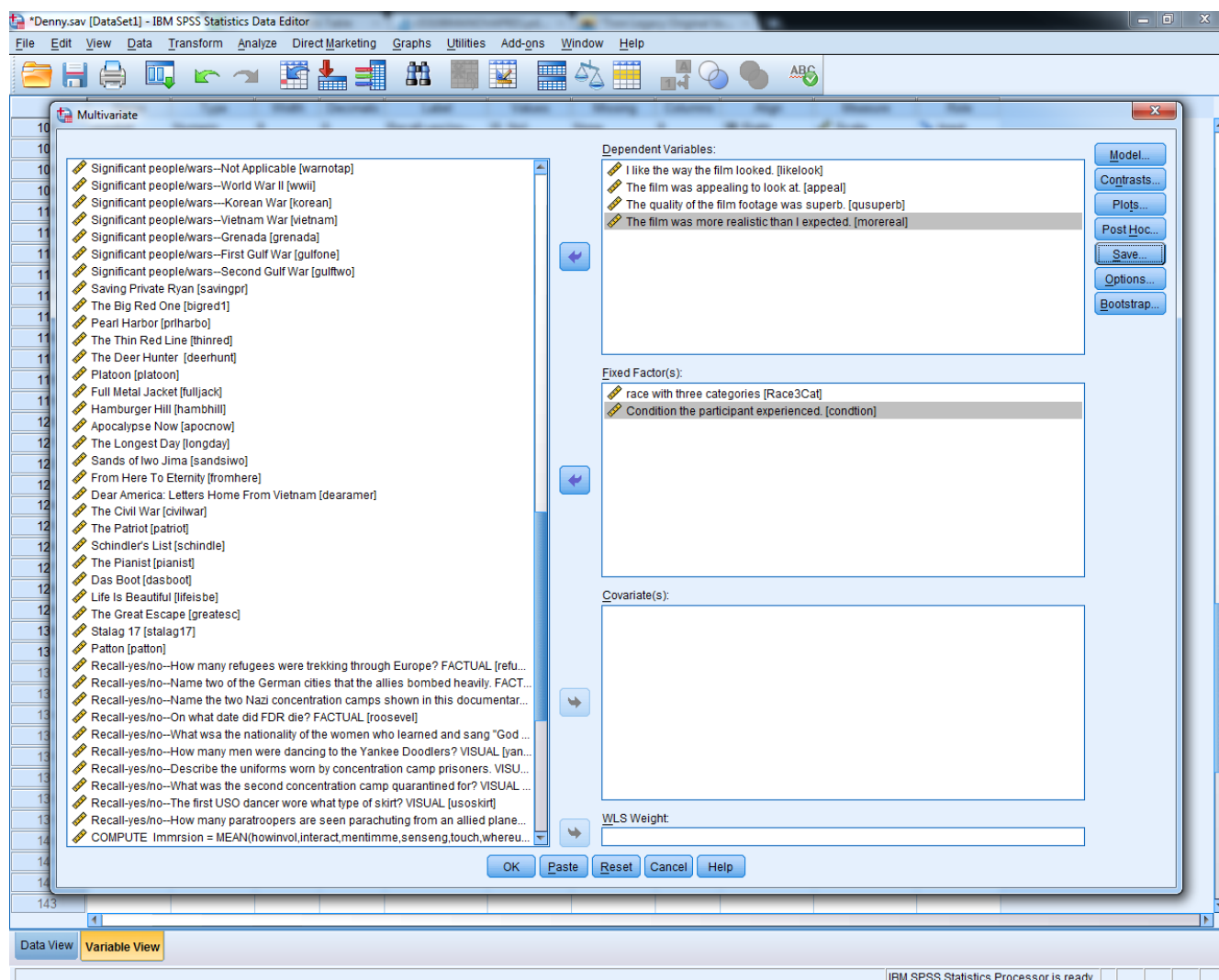
Dependent Variables go in the box labeled
Dependent Variables

Independent variables go in the box labeled Fixed
Factors



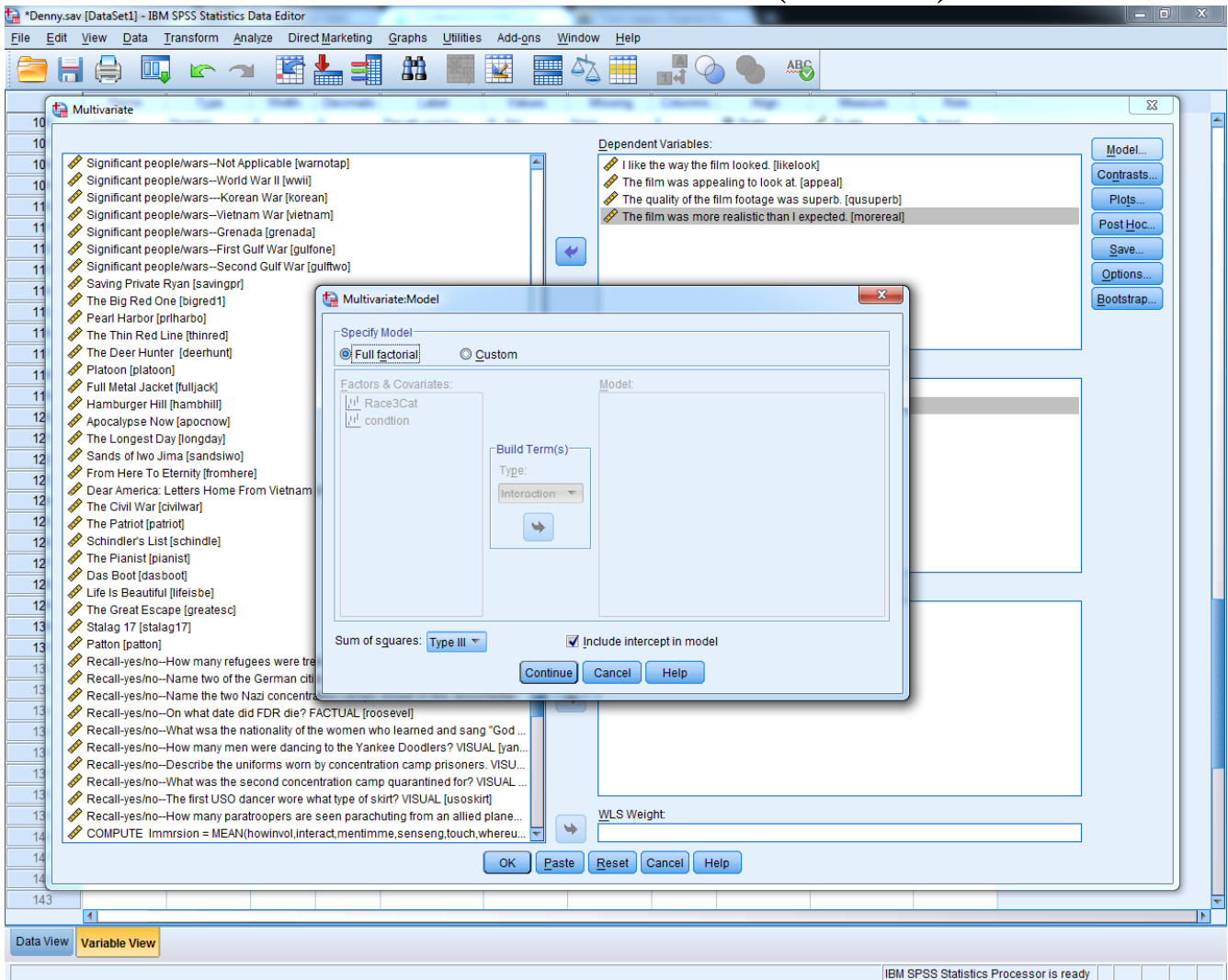
We will mess around with Covariates later

Dependent and Independent Variables added by clicking > arrow

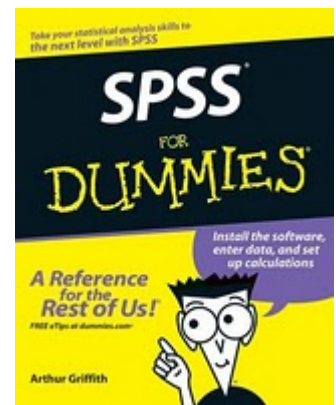


Another useful trick is that you can type the name of the variable while “clicked in” the left box and it will find it for you.

Go to the buttons on the right hand side
>Model>full factorial>continue (to exit)



Full factorial is checked by default,
but it never hurts to make sure.



IF post hoc tests are desired, click on Post Hoc...

The screenshot shows the IBM SPSS Statistics Data Editor with the following data table visible at the bottom:

Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
contlive	Numeric	8	2	It felt like the c...	(1.00, Stron...	None	8	Right	Scale	Input
pplveday	Numeric	8	2	I thought about ...	(1.00, Stron...	None	8	Right	Scale	Input

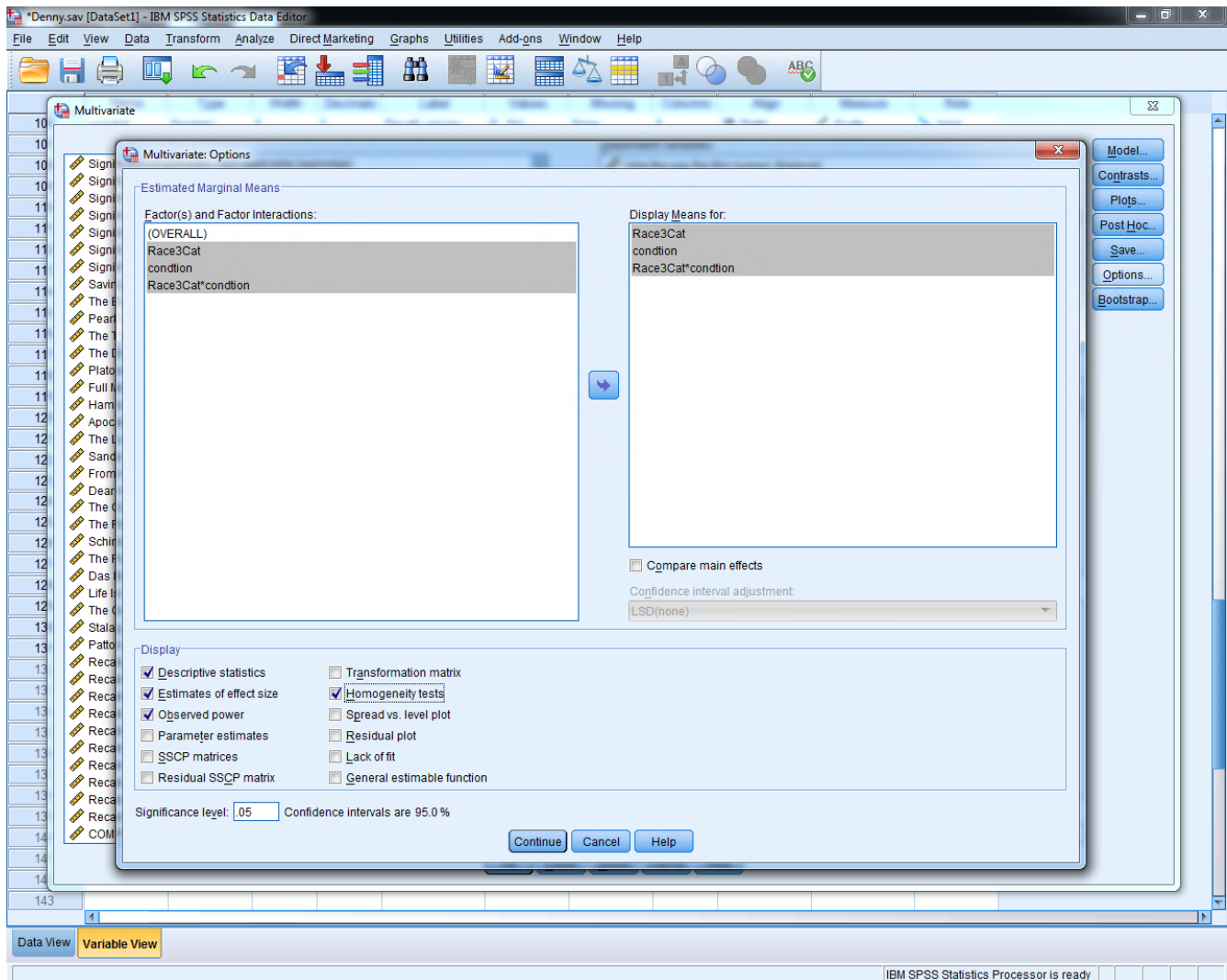
Move over Race3Cat with arrow, Not condition (because it has only two groups)

Select Tukey and Scheffe by checking boxes

Hit continue to exit

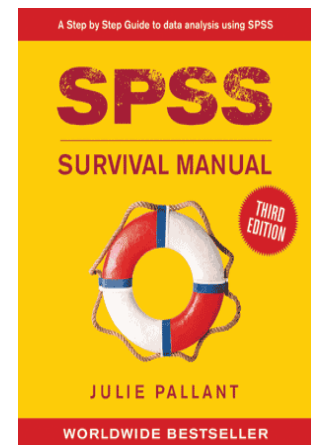
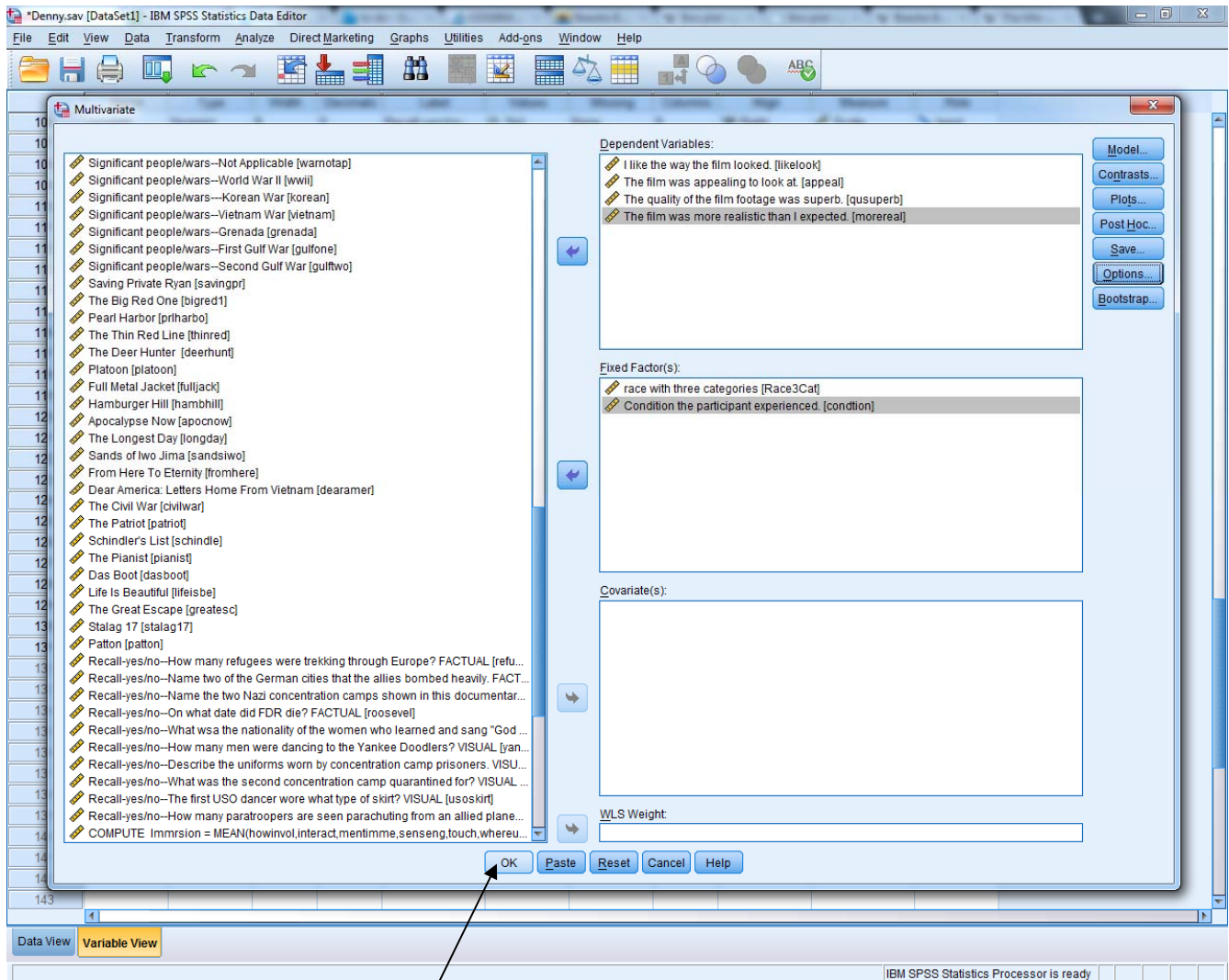
Select Options, highlight all factors in the left box underneath **OVERALL** and click the arrow to move them over. Or arrow them over one at a time.

Check the boxes for Descriptive Statistics, Estimates of effect on effect size, Observed power, and Homogeneity tests



Click continue to save changes and exit

Click OK to run the MANOVA



GET

```

FILE='F:\Com 631\Denny Moded.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
GLM likelook appeal qusuperb morereal BY Race3Cat condtion
/METHOD=SSTYPE(3)
/INTERCEPT=INCLUDE
/POSTHOC=Race3Cat condtion(TUKEY SCHEFFE)
/PLOT=PROFILE(Race3Cat*condtion)
/EMMEANS=TABLES(Race3Cat)
/EMMEANS=TABLES(condtion)
/EMMEANS=TABLES(Race3Cat*condtion)
/PRINT=DESCRIPTIVE ETASQ OPOWER HOMOGENEITY
/CRITERIA=ALPHA(.05)
/DESIGN= Race3Cat condtion Race3Cat*condtion.

```

General Linear Model - MANOVA

Notes

Output Created		06-Apr-2011 20:48:45
Comments		
Input	Data	F:\Com 631\Denny Moded.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	123
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Notes

Syntax	GLM likelook appeal qusuperb moreal BY Race3Cat condtion /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=Race3Cat condtion (TUKEY SCHEFFE) /PLOT=PROFILE (Race3Cat*condtion) /EMMEANS=TABLES(Race3Cat) /EMMEANS=TABLES(condtion) /EMMEANS=TABLES (Race3Cat*condtion) /PRINT=DESCRIPTIVE ETASQ OPOWER HOMOGENEITY /CRITERIA=ALPHA(.05) /DESIGN= Race3Cat condtion Race3Cat*condtion.		
Resources	Processor Time		00:00:04.000
	Elapsed Time		00:00:09.638

[DataSet1] F:\Com 631\Denny Moded.sav

Warnings

Post hoc tests are not performed for Condition the participant experienced. because there are fewer than three groups.

Between-Subjects Factors

		Value Label	N
Race with three categories	1.00	African-American	28
	2.00	Caucasian	66
	3.00	Other	13
Condition the participant experienced.	1	Color footage	48
	2	Black and white footage	59

Descriptive Statistics

	Race with thre...	Condition the particip...	Mean	Std. Deviation	N
I like the way the film looked.	African-American	Color footage	3.7000	2.21359	10
		Black and white footage	2.8333	1.54349	18
		Total	3.1429	1.81994	28
	Caucasian	Color footage	4.2500	1.50269	32
		Black and white footage	4.2059	1.55270	34
		Total	4.2273	1.51704	66
	Other	Color footage	4.6667	1.03280	6
		Black and white footage	3.4286	2.07020	7
		Total	4.0000	1.73205	13
	Total	Color footage	4.1875	1.61977	48
		Black and white footage	3.6949	1.70450	59
		Total	3.9159	1.67738	107
The film was appealing to look at.	African-American	Color footage	4.3000	2.00278	10
		Black and white footage	2.6667	1.68034	18
		Total	3.2500	1.93649	28
	Caucasian	Color footage	2.9063	1.42239	32
		Black and white footage	3.4412	1.70900	34
		Total	3.1818	1.58754	66
	Other	Color footage	5.0000	.89443	6
		Black and white footage	3.4286	1.39728	7
		Total	4.1538	1.40512	13
	Total	Color footage	3.4583	1.68798	48
		Black and white footage	3.2034	1.67928	59
		Total	3.3178	1.68006	107
The quality of the film footage was superb.	African-American	Color footage	3.8000	2.29976	10
		Black and white footage	2.7222	1.36363	18
		Total	3.1071	1.79174	28
	Caucasian	Color footage	3.8437	1.41671	32
		Black and white footage	3.7353	1.56300	34
		Total	3.7879	1.48340	66
	Other	Color footage	4.8333	1.16905	6
		Black and white footage	3.1429	.89974	7
		Total	3.9231	1.32045	13
	Total	Color footage	3.9583	1.61058	48
		Black and white footage	3.3559	1.49439	59
		Total	3.6262	1.56930	107

Descriptive Statistics

	Race with thre...	Condition the particip...	Mean	Std. Deviation	N
The film was more realistic than I expected.	African-American	Color footage	5.4000	2.06559	10
		Black and white footage	3.8333	1.72354	18
		Total	4.3929	1.96901	28
	Caucasian	Color footage	4.5000	1.64611	32
		Black and white footage	4.4412	1.58001	34
		Total	4.4697	1.60019	66
	Other	Color footage	5.3333	1.21106	6
		Black and white footage	5.0000	1.63299	7
		Total	5.1538	1.40512	13
	Total	Color footage	4.7917	1.71301	48
		Black and white footage	4.3220	1.64464	59
		Total	4.5327	1.68410	107

Box's Test of Equality of Covariance Matrices^a

Box's M	77.509
F	1.254
df1	50
df2	2287.505
Sig.	.110

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design:
Intercept +
Race3Cat +
condition +
Race3Cat *
condition

Multivariate Tests^d

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.895	208.783	4.000	98.000	.000	.895
	Wilks' Lambda	.105	208.783	4.000	98.000	.000	.895
	Hotelling's Trace	8.522	208.783	4.000	98.000	.000	.895
	Roy's Largest Root	8.522	208.783	4.000	98.000	.000	.895
Race3Cat	Pillai's Trace	.186	2.534	8.000	198.00	.012	.093
	Wilks' Lambda	.819	2.573 ^a	8.000	196.00	.011	.095
	Hotelling's Trace	.215	2.611	8.000	194.00	.010	.097
	Roy's Largest Root	.184	4.556 ^c	4.000	99.000	.002	.155
condition	Pillai's Trace	.088	2.377 ^a	4.000	98.000	.057	.088
	Wilks' Lambda	.912	2.377 ^a	4.000	98.000	.057	.088
	Hotelling's Trace	.097	2.377 ^a	4.000	98.000	.057	.088
	Roy's Largest Root	.097	2.377 ^a	4.000	98.000	.057	.088
Race3Cat * condition	Pillai's Trace	.139	1.847	8.000	198.00	.070	.069
	Wilks' Lambda	.864	1.863 ^a	8.000	196.00	.068	.071
	Hotelling's Trace	.155	1.878	8.000	194.00	.065	.072
	Roy's Largest Root	.132	3.272 ^c	4.000	99.000	.015	.117

a. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

d. Design: Intercept + Race3Cat + condition + Race3Cat * condition

Multivariate Tests^d

Effect		Noncent Parameter	Observed Power ^b
Intercept	Pillai's Trace	835.132	1.000
	Wilks' Lambda	835.132	1.000
	Hotelling's Trace	835.132	1.000
	Roy's Largest Root	835.132	1.000
Race3Cat	Pillai's Trace	20.273	.907
	Wilks' Lambda	20.584	.912
	Hotelling's Trace	20.886	.917
	Roy's Largest Root	18.225	.935
condtion	Pillai's Trace	9.508	.667
	Wilks' Lambda	9.508	.667
	Hotelling's Trace	9.508	.667
	Roy's Largest Root	9.508	.667
Race3Cat * condtion	Pillai's Trace	14.780	.773
	Wilks' Lambda	14.903	.777
	Hotelling's Trace	15.021	.781
	Roy's Largest Root	13.089	.820

b. Computed using alpha = .05

d. Design: Intercept + Race3Cat + condtion + Race3Cat * condtion

Levene's Test of Equality of Error Variances^a

	F	df1	df2	Sig.
I like the way the film looked.	1.908	5	101	.099
The film was appealing to look at.	1.187	5	101	.321
The quality of the film footage was superb.	1.670	5	101	.149
The film was more realistic than I expected.	.585	5	101	.711

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

a. Design: Intercept + Race3Cat + condition + Race3Cat * condition

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	I like the way the film looked.	33.037 ^a	5	6.607	2.516	.034
	The film was appealing to look at.	40.281 ^c	5	8.056	3.143	.011
	The quality of the film footage was superb.	27.309 ^d	5	5.462	2.360	.045
	The film was more realistic than I expected.	22.020 ^e	5	4.404	1.596	.168
Intercept	I like the way the film looked.	1013.602	1	1013.602	386.01	.000
	The film was appealing to look at.	899.194	1	899.194	350.76	.000
	The quality of the film footage was superb.	927.099	1	927.099	400.60	.000

a. R Squared = .111 (Adjusted R Squared = .067)

c. R Squared = .135 (Adjusted R Squared = .092)

d. R Squared = .105 (Adjusted R Squared = .060)

e. R Squared = .073 (Adjusted R Squared = .027)

Tests of Between-Subjects Effects

Source	Dependent Variable	Partial Eta Square d	Noncent. Parameter	Observed Power ^b
Corrected Model	I like the way the film looked.	.111	12.581	.765
	The film was appealing to look at.	.135	15.713	.863
	The quality of the film footage was superb.	.105	11.800	.734
	The film was more realistic than I expected.	.073	7.982	.537
Intercept	I like the way the film looked.	.793	386.015	1.000
	The film was appealing to look at.	.776	350.766	1.000
	The quality of the film footage was superb.	.799	400.607	1.000

b. Computed using alpha = .05

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	The film was more realistic than I expected.	1545.812	1	1545.812	560.36	.000
Race3Cat	I like the way the film looked.	17.185	2	8.593	3.272	.042
	The film was appealing to look at.	12.075	2	6.038	2.355	.100
	The quality of the film footage was superb.	6.528	2	3.264	1.410	.249
	The film was more realistic than I expected.	5.255	2	2.628	.953	.389
condtion	I like the way the film looked.	8.783	1	8.783	3.345	.070
	The film was appealing to look at.	13.558	1	13.558	5.289	.024
	The quality of the film footage was superb.	15.741	1	15.741	6.802	.010
	The film was more realistic than I expected.	7.298	1	7.298	2.646	.107
Race3Cat * condtion	I like the way the film looked.	5.756	2	2.878	1.096	.338
	The film was appealing to look at.	28.098	2	14.049	5.480	.006
	The quality of the film footage was superb.	9.205	2	4.603	1.989	.142
	The film was more realistic than I expected.	10.578	2	5.289	1.917	.152
Error	I like the way the film looked.	265.206	101	2.626		
	The film was appealing to look at.	258.915	101	2.564		
	The quality of the film footage was superb.	233.738	101	2.314		
	The film was more realistic than I expected.	278.616	101	2.759		

Tests of Between-Subjects Effects

Source	Dependent Variable	Partial Eta Square d	Noncent. Parameter	Observed Power ^b
Intercept	The film was more realistic than I expected.	.847	560.367	1.000
Race3Cat	I like the way the film looked.	.061	6.545	.610
	The film was appealing to look at.	.045	4.710	.467
	The quality of the film footage was superb.	.027	2.821	.296
	The film was more realistic than I expected.	.019	1.905	.211
condition	I like the way the film looked.	.032	3.345	.441
	The film was appealing to look at.	.050	5.289	.625
	The quality of the film footage was superb.	.063	6.802	.733
	The film was more realistic than I expected.	.026	2.646	.364
Race3Cat * condition	I like the way the film looked.	.021	2.192	.238
	The film was appealing to look at.	.098	10.961	.840
	The quality of the film footage was superb.	.038	3.978	.403
	The film was more realistic than I expected.	.037	3.835	.390
Error	I like the way the film looked.			
	The film was appealing to look at.			
	The quality of the film footage was superb.			
	The film was more realistic than I expected.			

b. Computed using alpha = .05

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Total	I like the way the film looked.	1939.000	107			
	The film was appealing to look at.	1477.000	107			
	The quality of the film footage was superb.	1668.000	107			
	The film was more realistic than I expected.	2499.000	107			
Corrected Total	I like the way the film looked.	298.243	106			
	The film was appealing to look at.	299.196	106			
	The quality of the film footage was superb.	261.047	106			
	The film was more realistic than I expected.	300.636	106			

Tests of Between-Subjects Effects

Source	Dependent Variable	Partial Eta Square d	Noncent. Parameter	Observed Power ^b
Total	I like the way the film looked. The film was appealing to look at. The quality of the film footage was superb. The film was more realistic than I expected.			
Corrected Total	I like the way the film looked. The film was appealing to look at. The quality of the film footage was superb. The film was more realistic than I expected.			

b. Computed using alpha = .05

Estimated Marginal Means

1. Race with three categories

Dependent Variable	Race with three categories	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
I like the way the film looked.	African-American	3.267	.320	2.633	3.901
	Caucasian	4.228	.200	3.832	4.624
	Other	4.048	.451	3.153	4.942
The film was appealing to look at.	African-American	3.483	.316	2.857	4.110
	Caucasian	3.174	.197	2.783	3.565
	Other	4.214	.445	3.331	5.098
The quality of the film footage was superb.	African-American	3.261	.300	2.666	3.856
	Caucasian	3.790	.187	3.418	4.161
	Other	3.988	.423	3.149	4.828
The film was more realistic than I expected.	African-American	4.617	.328	3.967	5.266
	Caucasian	4.471	.205	4.065	4.876
	Other	5.167	.462	4.250	6.083

2. Condition the participant experienced.

Dependent Variable	Condition the particip...	Mean	Std. Error
I like the way the film looked.	Color footage	4.206	.295
	Black and white footage	3.489	.258
The film was appealing to look at.	Color footage	4.069	.291
	Black and white footage	3.179	.255
The quality of the film footage was superb.	Color footage	4.159	.277
	Black and white footage	3.200	.242
The film was more realistic than I expected.	Color footage	5.078	.302
	Black and white footage	4.425	.264

2. Condition the participant experienced.

Dependent Variable	Condition the participant experienced.	95% Confidence Interval	
		Lower Bound	Upper Bound
I like the way the film looked.	Color footage	3.621	4.790
	Black and white footage	2.978	4.001
The film was appealing to look at.	Color footage	3.491	4.647
	Black and white footage	2.673	3.684
The quality of the film footage was superb.	Color footage	3.610	4.708
	Black and white footage	2.720	3.680
The film was more realistic than I expected.	Color footage	4.478	5.677
	Black and white footage	3.901	4.949

3. Race with three categories * Condition the participant experienced.

Dependent Variable	Race with three ...	Condition the participant experienced.	Mean	Std. Error
I like the way the film looked.	African-American	Color footage	3.700	.512
		Black and white footage	2.833	.382
	Caucasian	Color footage	4.250	.286
		Black and white footage	4.206	.278
	Other	Color footage	4.667	.662
		Black and white footage	3.429	.612
The film was appealing to look at.	African-American	Color footage	4.300	.506
		Black and white footage	2.667	.377
	Caucasian	Color footage	2.906	.283
		Black and white footage	3.441	.275
	Other	Color footage	5.000	.654
		Black and white footage	3.429	.605
The quality of the film footage was superb.	African-American	Color footage	3.800	.481
		Black and white footage	2.722	.359
	Caucasian	Color footage	3.844	.269
		Black and white footage	3.735	.261
	Other	Color footage	4.833	.621
		Black and white footage	3.143	.575
The film was more realistic than I expected.	African-American	Color footage	5.400	.525
		Black and white footage	3.833	.391
	Caucasian	Color footage	4.500	.294
		Black and white footage	4.441	.285
	Other	Color footage	5.333	.678
		Black and white footage	5.000	.628

3. Race with three categories * Condition the participant experienced.

Dependent Variable	Race with three categories	Condition the participant experienced.	95% Confidence Interval	
			Lower Bound	Upper Bound
I like the way the film looked.	African-American	Color footage	2.683	4.717
		Black and white footage	2.076	3.591
	Caucasian	Color footage	3.682	4.818
		Black and white footage	3.655	4.757
	Other	Color footage	3.354	5.979
		Black and white footage	2.214	4.644
The film was appealing to look at.	African-American	Color footage	3.296	5.304
		Black and white footage	1.918	3.415
	Caucasian	Color footage	2.345	3.468
		Black and white footage	2.896	3.986
	Other	Color footage	3.703	6.297
		Black and white footage	2.228	4.629
The quality of the film footage was superb.	African-American	Color footage	2.846	4.754
		Black and white footage	2.011	3.434
	Caucasian	Color footage	3.310	4.377
		Black and white footage	3.218	4.253
	Other	Color footage	3.601	6.065
		Black and white footage	2.002	4.283
The film was more realistic than I expected.	African-American	Color footage	4.358	6.442
		Black and white footage	3.057	4.610
	Caucasian	Color footage	3.918	5.082
		Black and white footage	3.876	5.006
	Other	Color footage	3.988	6.678
		Black and white footage	3.755	6.245

Post Hoc Tests

Race with three categories

Multiple Comparisons

Dependent Variable		(I) Race with three categories	(J) Race with three categories	Mean Difference (I-J)	Std. Error
I like the way the film looked.	Tukey HSD	African-American	Caucasian	-1.0844	.36546
			Other	-.8571	.54384
		Caucasian	African-American	1.0844	.36546
			Other	.2273	.49170
	Scheffe	African-American	Caucasian	-1.0844	.36546
			Other	-.8571	.54384
		Caucasian	African-American	1.0844	.36546
			Other	.2273	.49170
The film was appealing to look at.	Tukey HSD	African-American	Caucasian	.0682	.36110
			Other	-.9038	.53735
		Caucasian	African-American	-.0682	.36110
			Other	-.9720	.48583
		Other	African-American	.9038	.53735

Based on observed means.

The error term is Mean Square(Error) = 2.759.

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

Multiple Comparisons

Dependent Variable		(I) Race with three categories	(J) Race with three categories	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
I like the way the film looked.	Tukey HSD	African-American	Caucasian	.010	-1.9538	-.2151
			Other	.261	-2.1508	.4365
		Caucasian	African-American	.010	.2151	1.9538
			Other	.889	-.9424	1.3969
		Other	African-American	.261	-.4365	2.1508
			Caucasian	.889	-1.3969	.9424
	Scheffe	African-American	Caucasian	.015	-1.9924	-.1764
			Other	.293	-2.2083	.4940
		Caucasian	African-American	.015	.1764	1.9924
			Other	.899	-.9944	1.4489
		Other	African-American	.293	-.4940	2.2083
			Caucasian	.899	-1.4489	.9944
The film was appealing to look at.	Tukey HSD	African-American	Caucasian	.981	-.7908	.9272
			Other	.217	-2.1821	.3744
		Caucasian	African-American	.981	-.9272	.7908
			Other	.117	-2.1277	.1837
		Other	African-American	.217	-.3744	2.1821

Based on observed means.

The error term is Mean Square(Error) = 2.759.

Multiple Comparisons

Dependent Variable		(I) Race with three categories	(J) Race with three categories	Mean Difference (I-J)	Std. Error
The film was appealing to look at.	Tukey HSD	Other	Caucasian	.9720	.48583
		African-American	Caucasian	.0682	.36110
	Scheffe		Other	-.9038	.53735
		Caucasian	African-American	-.0682	.36110
			Other	-.9720	.48583
		Other	African-American	.9038	.53735
	Caucasian	.9720	.48583		
The quality of the film footage was superb.	Tukey HSD	African-American	Caucasian	-.6807	.34310
			Other	-.8159	.51056
		Caucasian	African-American	.6807	.34310
			Other	-.1352	.46161
		Other	African-American	.8159	.51056
			Caucasian	.1352	.46161
	Scheffe	African-American	Caucasian	-.6807	.34310
			Other	-.8159	.51056
		Caucasian	African-American	.6807	.34310
			Other	-.1352	.46161
		Other	African-American	.8159	.51056
			Caucasian	.1352	.46161
The film was more realistic than I expected.	Tukey HSD	African-American	Caucasian	-.0768	.37459
			Other	-.7610	.55742
		Caucasian	African-American	.0768	.37459
			Other	-.6841	.50398
		Other	African-American	.7610	.55742
			Caucasian	.6841	.50398
	Scheffe	African-American	Caucasian	-.0768	.37459
			Other	-.7610	.55742
		Caucasian	African-American	.0768	.37459
			Other	-.6841	.50398
		Other	African-American	.7610	.55742
			Caucasian	.6841	.50398

Based on observed means.

The error term is Mean Square(Error) = 2.759.

Multiple Comparisons

Dependent Variable		(I) Race with three categories	(J) Race with three categories	Sig.	95% Confidence Interval			
					Lower Bound	Upper Bound		
The film was appealing to look at.	Tukey HSD	Other	Caucasian	.117	-.1837	2.1277		
			Caucasian	.982	-.8290	.9653		
	Scheffe	African-American	Other	.248	-2.2389	.4312		
			Caucasian	.982	-.9653	.8290		
	Scheffe	African-American	Other	.140	-2.1791	.2350		
			Caucasian	.248	-.4312	2.2389		
	Scheffe	African-American	Caucasian	.140	-.2350	2.1791		
			Caucasian	.982	-.9653	.8290		
The quality of the film footage was superb.	Tukey HSD	African-American	Caucasian	.121	-1.4969	.1354		
			Other	.251	-2.0304	.3986		
		Caucasian	African-American	.121	-.1354	1.4969		
			Other	.954	-1.2333	.9629		
		Other	African-American	.251	-.3986	2.0304		
			Caucasian	.954	-.9629	1.2333		
	Scheffe	African-American	Caucasian	.145	-1.5332	.1717		
			Other	.283	-2.0844	.4525		
		Caucasian	African-American	.145	-.1717	1.5332		
			Other	.958	-1.2821	1.0117		
		Other	African-American	.283	-.4525	2.0844		
			Caucasian	.958	-1.0117	1.2821		
		The film was more realistic than I expected.	Tukey HSD	African-American	Caucasian	.977	-.9679	.8142
					Other	.363	-2.0870	.5650
Caucasian	African-American			.977	-.8142	.9679		
	Other			.367	-1.8830	.5147		
Other	African-American			.363	-.5650	2.0870		
	Caucasian			.367	-.5147	1.8830		
Scheffe	African-American		Caucasian	.979	-1.0075	.8538		
			Other	.397	-2.1459	.6239		
	Caucasian		African-American	.979	-.8538	1.0075		
			Other	.401	-1.9363	.5680		
	Other		African-American	.397	-.6239	2.1459		
			Caucasian	.401	-.5680	1.9363		

Based on observed means.
The error term is Mean Square(Error) = 2.759.

Homogeneous Subsets

I like the way the film looked.

	Race with three categories	N	Subset
			1
Tukey HSD ^{a,b}	African-American	28	3.1429
	Other	13	4.0000
	Caucasian	66	4.2273
	Sig.		.061
Scheffe ^{a,b}	African-American	28	3.1429
	Other	13	4.0000
	Caucasian	66	4.2273
	Sig.		.077

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 2.626.

a. Uses Harmonic Mean Sample Size = 23.476.

b. Alpha = .05.

The film was appealing to look at.

	Race with three categories	N	Subset
			1
Tukey HSD ^{a,b}	Caucasian	66	3.1818
	African-American	28	3.2500
	Other	13	4.1538
	Sig.		.099
Scheffe ^{a,b}	Caucasian	66	3.1818
	African-American	28	3.2500
	Other	13	4.1538
	Sig.		.120

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 2.564.

a. Uses Harmonic Mean Sample Size = 23.476.

b. Alpha = .05.

The quality of the film footage was superb.

	Race with three categories	N	Subset
			1
Tukey HSD ^{a,b}	African-American	28	3.1071
	Caucasian	66	3.7879
	Other	13	3.9231
	Sig.		.163
Scheffe ^{a,b}	African-American	28	3.1071
	Caucasian	66	3.7879
	Other	13	3.9231
	Sig.		.190

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 2.314.

a. Uses Harmonic Mean Sample Size = 23.476.

b. Alpha = .05.

The film was more realistic than I expected.

	Race with three categories	N	Subset
			1
Tukey HSD ^{a,b}	African-American	28	4.3929
	Caucasian	66	4.4697
	Other	13	5.1538
	Sig.		.263
Scheffe ^{a,b}	African-American	28	4.3929
	Caucasian	66	4.4697
	Other	13	5.1538
	Sig.		.296

Means for groups in homogeneous subsets are displayed.

Based on observed means.

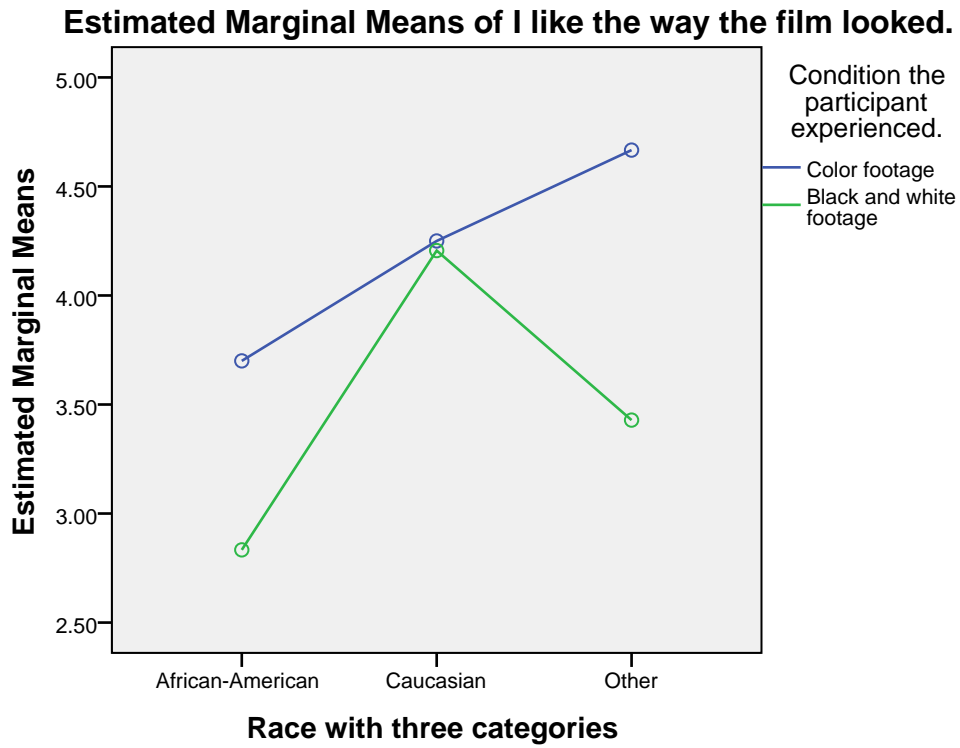
The error term is Mean Square(Error) = 2.759.

a. Uses Harmonic Mean Sample Size = 23.476.

b. Alpha = .05.

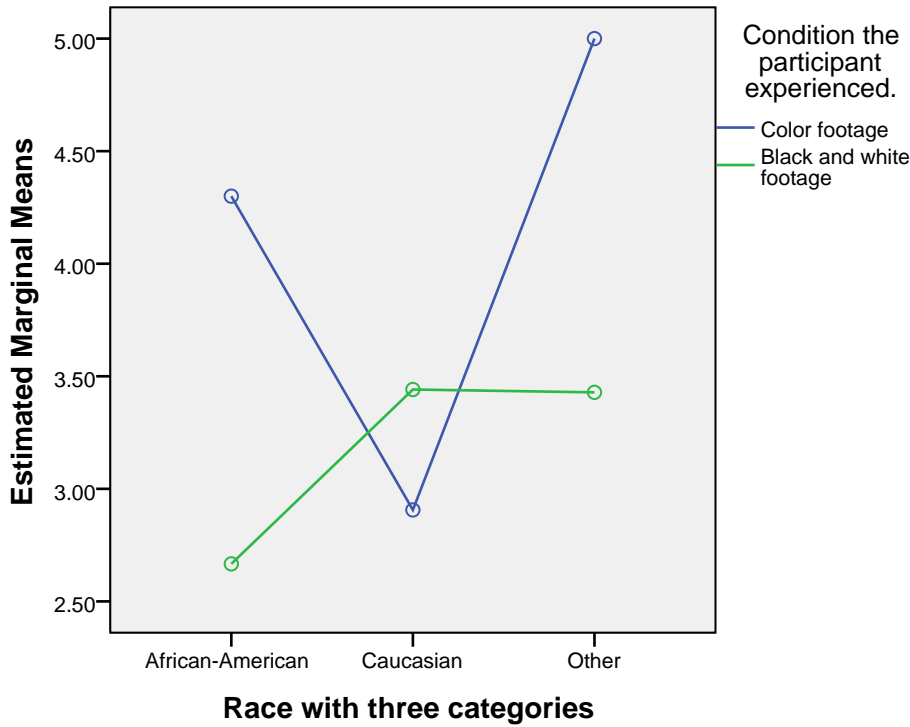
Profile Plots

I like the way the film looked.



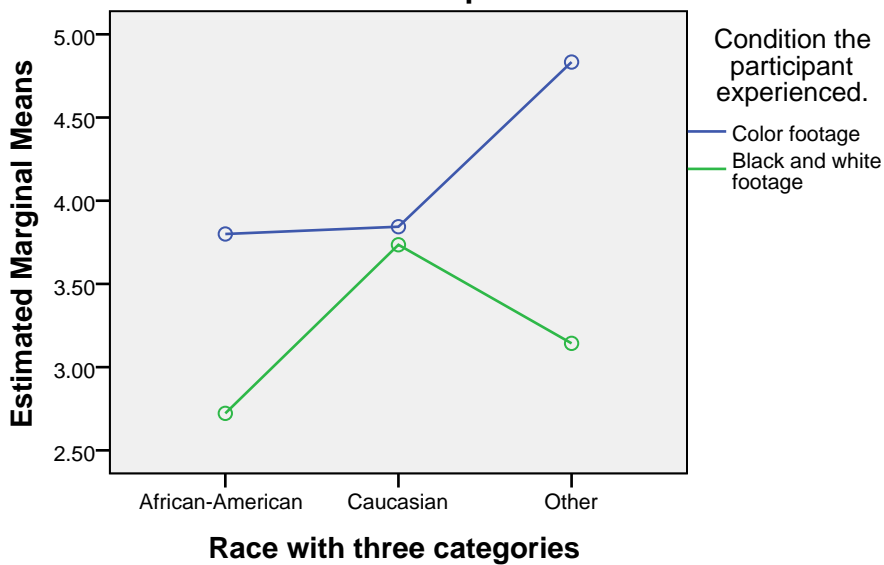
The film was appealing to look at.

Estimated Marginal Means of The film was appealing to look at.



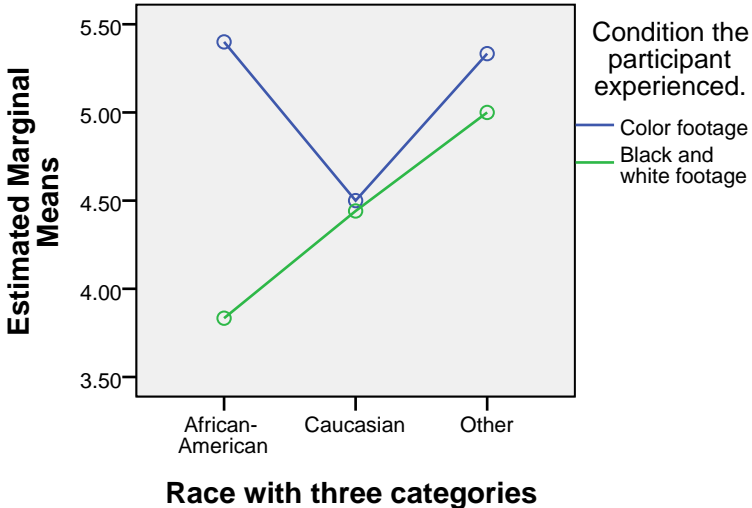
The quality of the film footage was superb.

Estimated Marginal Means of The quality of the film footage was superb.



The film was more realistic than I expected.

Estimated Marginal Means of The film was more realistic than I expected.



What do we have to change to run a MANCOVA instead?

Start back at the beginning same as with MANOVA and add in your covariates

We used Sex or femaleness (0= male, 1=female)

and “I expected the film to be in black and white” (blknwhit, a Likert scale where 1= strongly disagree, 7=strongly agree)

The screenshot shows the IBM SPSS Statistics Data Editor window with a 'Multivariate' dialog box open. The dialog box is used to configure a MANCOVA analysis. The 'Dependent Variables' section contains four items: 'I like the way the film looked. [likelook]', 'The film was appealing to look at. [appeal]', 'The quality of the film footage was superb. [qusuperb]', and 'The film was more realistic than I expected. [morereal]'. The 'Fixed Factor(s)' section contains two items: 'race with three categories [Race3Cat]' and 'Condition the participant experienced. [condition]'. The 'Covariate(s)' section contains two items: 'Sex [femaleness]' and 'I expected the film to be in black-and-white. [blknwhit]'. The 'WLS Weight' section is empty. The background data editor shows a list of variables with their names, types, widths, decimals, labels, and values.

You will then have to repeat what you did in the Model, Plots, and Options, but you cannot do any Post Hoc Tests in MANCOVA.

Sorry Tukey
and Scheffe



GLM likelook appeal qusuperb morereal BY Race3Cat condtion WITH femaleness blk
nwht 36

```
/METHOD=SSTYPE(3)  
/INTERCEPT=INCLUDE  
/PLOT=PROFILE(Race3Cat*condtion)  
/EMMEANS=TABLES(Race3Cat) WITH(femaleness=MEAN blknwht=MEAN)  
/EMMEANS=TABLES(condtion) WITH(femaleness=MEAN blknwht=MEAN)  
/EMMEANS=TABLES(Race3Cat*condtion) WITH(femaleness=MEAN blknwht=MEAN)  
/PRINT=DESCRIPTIVE ETASQ OPOWER HOMOGENEITY  
/CRITERIA=ALPHA(.05)  
/DESIGN=femaleness blknwht Race3Cat condtion Race3Cat*condtion.
```

General Linear Model

- MANCOVA

Notes

Output Created	06-Apr-2011 21:02:38	
Comments		
Input	Data	F:\Com 631\Denny Moded.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	123
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax	<pre> GLM likelook appeal qusuperb moreal BY Race3Cat condition WITH femaleness blkwht /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /PLOT=PROFILE (Race3Cat*condition) /EMMEANS=TABLES(Race3Cat) WITH(femaleness=MEAN blkwht=MEAN) /EMMEANS=TABLES(condition) WITH(femaleness=MEAN blkwht=MEAN) /EMMEANS=TABLES (Race3Cat*condition) WITH (femaleness=MEAN blkwht=MEAN) /PRINT=DESCRIPTIVE ETASQ OPOWER HOMOGENEITY /CRITERIA=ALPHA(.05) /DESIGN=femaleness blkwht Race3Cat condition Race3Cat*condition. </pre>	
Resources	Processor Time	00:00:02.625
	Elapsed Time	00:00:03.281

[DataSet1] F:\Com 631\Denny Moded.sav

Between-Subjects Factors

		Value Label	N
Race with three categories	1.00	African-American	28
	2.00	Caucasian	66
	3.00	Other	13
Condition the participant experienced.	1	Color footage	48
	2	Black and white footage	59

Descriptive Statistics

	Race with three ...	Condition the particip...	Mean	Std. Deviation
I like the way the film looked.	African-American	Color footage	3.7000	2.21359
		Black and white footage	2.8333	1.54349
		Total	3.1429	1.81994
	Caucasian	Color footage	4.2500	1.50269
		Black and white footage	4.2059	1.55270
		Total	4.2273	1.51704
	Other	Color footage	4.6667	1.03280
		Black and white footage	3.4286	2.07020
		Total	4.0000	1.73205
	Total	Color footage	4.1875	1.61977
		Black and white footage	3.6949	1.70450
		Total	3.9159	1.67738
The film was appealing to look at.	African-American	Color footage	4.3000	2.00278
		Black and white footage	2.6667	1.68034
		Total	3.2500	1.93649
	Caucasian	Color footage	2.9063	1.42239
		Black and white footage	3.4412	1.70900
		Total	3.1818	1.58754
	Other	Color footage	5.0000	.89443
		Black and white footage	3.4286	1.39728
		Total	4.1538	1.40512
	Total	Color footage	3.4583	1.68798
		Black and white footage	3.2034	1.67928
		Total	3.3178	1.68006
The quality of the film footage was superb.	African-American	Color footage	3.8000	2.29976
		Black and white footage	2.7222	1.36363
		Total	3.1071	1.79174
	Caucasian	Color footage	3.8437	1.41671
		Black and white footage	3.7353	1.56300
		Total	3.7879	1.48340
	Other	Color footage	4.8333	1.16905
		Black and white footage	3.1429	.89974
		Total	3.9231	1.32045
	Total	Color footage	3.9583	1.61058
		Black and white footage	3.3559	1.49439
		Total	3.6262	1.56930

Descriptive Statistics

	Race with three ...	Condition the particip...	N
I like the way the film looked.	African-American	Color footage	10
		Black and white footage	18
		Total	28
	Caucasian	Color footage	32
		Black and white footage	34
		Total	66
	Other	Color footage	6
		Black and white footage	7
		Total	13
	Total	Color footage	48
		Black and white footage	59
		Total	107
The film was appealing to look at.	African-American	Color footage	10
		Black and white footage	18
		Total	28
	Caucasian	Color footage	32
		Black and white footage	34
		Total	66
	Other	Color footage	6
		Black and white footage	7
		Total	13
	Total	Color footage	48
		Black and white footage	59
		Total	107
The quality of the film footage was superb.	African-American	Color footage	10
		Black and white footage	18
		Total	28
	Caucasian	Color footage	32
		Black and white footage	34
		Total	66
	Other	Color footage	6
		Black and white footage	7
		Total	13
	Total	Color footage	48
		Black and white footage	59
		Total	107

Descriptive Statistics

	Race with three ...	Condition the particip...	Mean	Std. Deviation
The film was more realistic than I expected.	African-American	Color footage	5.4000	2.06559
		Black and white footage	3.8333	1.72354
		Total	4.3929	1.96901
	Caucasian	Color footage	4.5000	1.64611
		Black and white footage	4.4412	1.58001
		Total	4.4697	1.60019
	Other	Color footage	5.3333	1.21106
		Black and white footage	5.0000	1.63299
		Total	5.1538	1.40512
	Total	Color footage	4.7917	1.71301
		Black and white footage	4.3220	1.64464
		Total	4.5327	1.68410

Descriptive Statistics

	Race with three ...	Condition the particip...	N
The film was more realistic than I expected.	African-American	Color footage	10
		Black and white footage	18
		Total	28
	Caucasian	Color footage	32
		Black and white footage	34
		Total	66
	Other	Color footage	6
		Black and white footage	7
		Total	13
	Total	Color footage	48
		Black and white footage	59
		Total	107

**Box's Test of
Equality of
Covariance
Matrices^a**

Box's M	77.509
F	1.254
df1	50
df2	2287.505
Sig.	.110

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design:
Intercept +
femaleness +
blkwhrt +
Race3Cat +
condition +
Race3Cat *
condition

Multivariate Tests^d

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.508	24.737	4.000	96.000	.000	.508
	Wilks' Lambda	.492	24.737	4.000	96.000	.000	.508
	Hotelling's Trace	1.031	24.737	4.000	96.000	.000	.508
	Roy's Largest Root	1.031	24.737	4.000	96.000	.000	.508
femaleness	Pillai's Trace	.031	.756 ^a	4.000	96.000	.557	.031
	Wilks' Lambda	.969	.756 ^a	4.000	96.000	.557	.031
	Hotelling's Trace	.031	.756 ^a	4.000	96.000	.557	.031
	Roy's Largest Root	.031	.756 ^a	4.000	96.000	.557	.031
blkwhrt	Pillai's Trace	.174	5.042 ^a	4.000	96.000	.001	.174
	Wilks' Lambda	.826	5.042 ^a	4.000	96.000	.001	.174
	Hotelling's Trace	.210	5.042 ^a	4.000	96.000	.001	.174
	Roy's Largest Root	.210	5.042 ^a	4.000	96.000	.001	.174

a. Exact statistic

d. Design: Intercept + femaleness + blkwhrt + Race3Cat + condition + Race3Cat * condition

Multivariate Tests^d

Effect		Noncent. Parameter	Observed Power ^b
Intercept	Pillai's Trace	98.948	1.000
	Wilks' Lambda	98.948	1.000
	Hotelling's Trace	98.948	1.000
	Roy's Largest Root	98.948	1.000
femaleness	Pillai's Trace	3.023	.235
	Wilks' Lambda	3.023	.235
	Hotelling's Trace	3.023	.235
	Roy's Largest Root	3.023	.235
blkwht	Pillai's Trace	20.169	.957
	Wilks' Lambda	20.169	.957
	Hotelling's Trace	20.169	.957
	Roy's Largest Root	20.169	.957

b. Computed using alpha = .05

d. Design: Intercept + femaleness + blkwht + Race3Cat + condtion + Race3Cat * condtion

Multivariate Tests^d

Effect		Value	F	Hypothe sis df	Error df	Sig.	Partial Eta Squared
Race3Cat	Pillai's Trace	.205	2.771	8.000	194.00	.006	.103
	Wilks' Lambda	.801	2.823 ^a	8.000	192.00	.006	.105
	Hotelling's Trace	.242	2.873	8.000	190.00	.005	.108
	Roy's Largest Root	.208	5.033 ^c	4.000	97.000	.001	.172
condtion	Pillai's Trace	.112	3.036 ^a	4.000	96.000	.021	.112
	Wilks' Lambda	.888	3.036 ^a	4.000	96.000	.021	.112
	Hotelling's Trace	.126	3.036 ^a	4.000	96.000	.021	.112
	Roy's Largest Root	.126	3.036 ^a	4.000	96.000	.021	.112
Race3Cat * condtion	Pillai's Trace	.123	1.588	8.000	194.00	.130	.061
	Wilks' Lambda	.879	1.595 ^a	8.000	192.00	.128	.062
	Hotelling's Trace	.135	1.601	8.000	190.00	.127	.063
	Roy's Largest Root	.113	2.730 ^c	4.000	97.000	.033	.101

a. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

d. Design: Intercept + femaleness + blkwht + Race3Cat + condtion + Race3Cat * condtion

Multivariate Tests^d

Effect		Noncent. Parameter	Observed Power ^b
Race3Cat	Pillai's Trace	22.170	.934
	Wilks' Lambda	22.582	.939
	Hotelling's Trace	22.983	.943
	Roy's Largest Root	20.132	.956
condtion	Pillai's Trace	12.142	.785
	Wilks' Lambda	12.142	.785
	Hotelling's Trace	12.142	.785
	Roy's Largest Root	12.142	.785
Race3Cat * condtion	Pillai's Trace	12.708	.694
	Wilks' Lambda	12.760	.696
	Hotelling's Trace	12.809	.698
	Roy's Largest Root	10.919	.735

b. Computed using alpha = .05

d. Design: Intercept + femaleness + blkwhwt + Race3Cat + condtion + Race3Cat * condtion

Levene's Test of Equality of Error Variances^a

	F	df1	df2	Sig.
I like the way the film looked.	.955	5	101	.449
The film was appealing to look at.	.843	5	101	.523
The quality of the film footage was superb.	1.058	5	101	.388
The film was more realistic than I expected.	.504	5	101	.773

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

a. Design: Intercept + femaleness + blkwhwt + Race3Cat + condtion + Race3Cat * condtion

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	I like the way the film looked.	75.361 ^a	7	10.766	4.78	.000	.253
	The film was appealing to look at.	48.336 ^c	7	6.905	2.72	.013	.162
	The quality of the film footage was superb.	50.956 ^d	7	7.279	3.43	.003	.195
	The film was more realistic than I expected.	37.106 ^e	7	5.301	1.99	.064	.123
Intercept	I like the way the film looked.	68.286	1	68.286	30.3	.000	.235
	The film was appealing to look at.	114.695	1	114.69	45.2	.000	.314
	The quality of the film footage was superb.	79.609	1	79.609	37.5	.000	.275
	The film was more realistic than I expected.	172.141	1	172.14	64.6	.000	.395
femaleness	I like the way the film looked.	.485	1	.485	.215	.644	.002
	The film was appealing to look at.	.806	1	.806	.318	.574	.003
	The quality of the film footage was superb.	.148	1	.148	.070	.793	.001
	The film was more realistic than I expected.	4.696	1	4.696	1.76	.187	.018
blknwht	I like the way the film looked.	42.016	1	42.016	18.6	.000	.159
	The film was appealing to look at.	7.351	1	7.351	2.90	.092	.028
	The quality of the film footage was superb.	23.569	1	23.569	11.1	.001	.101
	The film was more realistic than I expected.	10.085	1	10.085	3.78	.054	.037

a. R Squared = .253 (Adjusted R Squared = .200)

c. R Squared = .162 (Adjusted R Squared = .102)

d. R Squared = .195 (Adjusted R Squared = .138)

e. R Squared = .123 (Adjusted R Squared = .061)

Tests of Between-Subjects Effects

Source	Dependent Variable	Noncent. Parameter	Observed Power _b
Corrected Model	I like the way the film looked.	33.474	.994
	The film was appealing to look at.	19.076	.890
	The quality of the film footage was superb.	24.012	.955
	The film was more realistic than I expected.	13.940	.751
Intercept	I like the way the film looked.	30.331	1.000
	The film was appealing to look at.	45.264	1.000
	The quality of the film footage was superb.	37.514	1.000
	The film was more realistic than I expected.	64.668	1.000
femaleness	I like the way the film looked.	.215	.075
	The film was appealing to look at.	.318	.086
	The quality of the film footage was superb.	.070	.058
	The film was more realistic than I expected.	1.764	.260
blkwhrt	I like the way the film looked.	18.663	.990
	The film was appealing to look at.	2.901	.392
	The quality of the film footage was superb.	11.106	.910
	The film was more realistic than I expected.	3.789	.487

b. Computed using alpha = .05

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Race3Cat	I like the way the film looked.	21.203	2	10.602	4.70	.011	.087
	The film was appealing to look at.	11.028	2	5.514	2.17	.119	.042
	The quality of the film footage was superb.	7.903	2	3.952	1.86	.161	.036
	The film was more realistic than I expected.	3.351	2	1.675	.629	.535	.013
condition	I like the way the film looked.	12.282	1	12.282	5.45	.022	.052
	The film was appealing to look at.	15.140	1	15.140	5.97	.016	.057
	The quality of the film footage was superb.	19.077	1	19.077	8.98	.003	.083
	The film was more realistic than I expected.	8.968	1	8.968	3.36	.069	.033
Race3Cat * condition	I like the way the film looked.	1.029	2	.515	.229	.796	.005
	The film was appealing to look at.	21.728	2	10.864	4.28	.016	.080
	The quality of the film footage was superb.	3.861	2	1.931	.910	.406	.018
	The film was more realistic than I expected.	8.778	2	4.389	1.64	.198	.032
Error	I like the way the film looked.	222.882	99	2.251			
	The film was appealing to look at.	250.860	99	2.534			
	The quality of the film footage was superb.	210.091	99	2.122			
	The film was more realistic than I expected.	263.529	99	2.662			

Tests of Between-Subjects Effects

Source	Dependent Variable	Noncent. Parameter	Observed Power _b
Race3Cat	I like the way the film looked.	9.418	.777
	The film was appealing to look at.	4.352	.436
	The quality of the film footage was superb.	3.724	.380
	The film was more realistic than I expected.	1.259	.153
condition	I like the way the film looked.	5.455	.638
	The film was appealing to look at.	5.975	.677
	The quality of the film footage was superb.	8.989	.844
	The film was more realistic than I expected.	3.369	.444
Race3Cat * condition	I like the way the film looked.	.457	.085
	The film was appealing to look at.	8.575	.735
	The quality of the film footage was superb.	1.819	.203
	The film was more realistic than I expected.	3.298	.341
Error	I like the way the film looked.		
	The film was appealing to look at.		
	The quality of the film footage was superb.		
	The film was more realistic than I expected.		

b. Computed using alpha = .05

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Total	I like the way the film looked.	1939.000	107				
	The film was appealing to look at.	1477.000	107				
	The quality of the film footage was superb.	1668.000	107				
	The film was more realistic than I expected.	2499.000	107				
Corrected Total	I like the way the film looked.	298.243	106				
	The film was appealing to look at.	299.196	106				
	The quality of the film footage was superb.	261.047	106				
	The film was more realistic than I expected.	300.636	106				

Tests of Between-Subjects Effects

Source	Dependent Variable	Noncent. Parameter	Observed Power _b
Total	I like the way the film looked. The film was appealing to look at. The quality of the film footage was superb. The film was more realistic than I expected.		
Corrected Total	I like the way the film looked. The film was appealing to look at. The quality of the film footage was superb. The film was more realistic than I expected.		

b. Computed using alpha = .05

Estimated Marginal Means

1. Race with three categories

Dependent Variable	Race with three categories	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
I like the way the film looked.	African-American	3.202 ^a	.297	2.613	3.790
	Caucasian	4.280 ^a	.186	3.911	4.649
	Other	3.979 ^a	.419	3.147	4.811
The film was appealing to look at.	African-American	3.462 ^a	.315	2.838	4.087
	Caucasian	3.189 ^a	.197	2.798	3.581
	Other	4.199 ^a	.445	3.317	5.081
The quality of the film footage was superb.	African-American	3.211 ^a	.288	2.639	3.783
	Caucasian	3.830 ^a	.180	3.472	4.188
	Other	3.934 ^a	.407	3.126	4.741
The film was more realistic than I expected.	African-American	4.560 ^a	.323	3.920	5.200
	Caucasian	4.521 ^a	.202	4.120	4.922
	Other	5.077 ^a	.456	4.173	5.981

a. Covariates appearing in the model are evaluated at the following values: Sex = .50, I expected the film to be in black-and-white. = 4.9065.

2. Condition the participant experienced.

Dependent Variable	Condition the participant experienced.	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
I like the way the film looked.	Color footage	4.245 ^a	.273	3.703	4.787
	Black and white footage	3.395 ^a	.240	2.918	3.872
The film was appealing to look at.	Color footage	4.089 ^a	.290	3.514	4.664
	Black and white footage	3.145 ^a	.255	2.639	3.651
The quality of the film footage was superb.	Color footage	4.188 ^a	.265	3.662	4.714
	Black and white footage	3.128 ^a	.233	2.665	3.591
The film was more realistic than I expected.	Color footage	5.082 ^a	.297	4.493	5.672
	Black and white footage	4.356 ^a	.261	3.838	4.874

a. Covariates appearing in the model are evaluated at the following values: Sex = .50, I expected the film to be in black-and-white. = 4.9065.

3. Race with three categories * Condition the participant experienced.

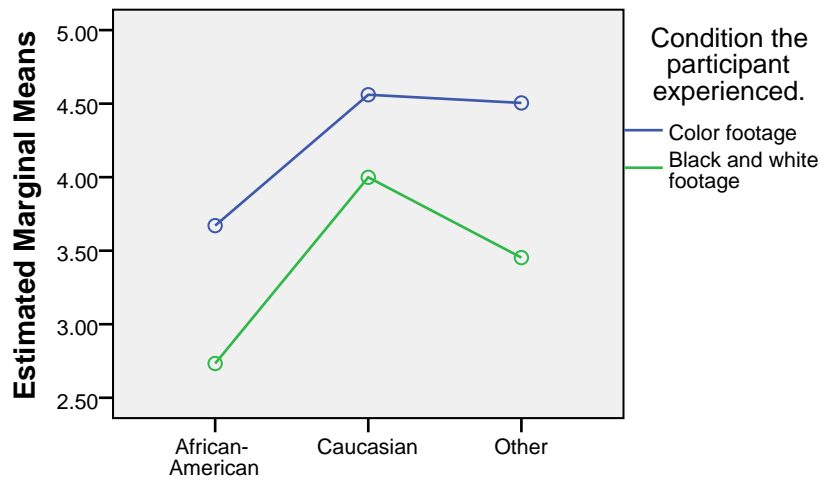
Dependent Variable	Race with three categories	Condition the participant experienced.	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
I like the way the film looked.	African-American	Color footage	3.670 ^a	.475	2.729	4.612
		Black and white footage	2.733 ^a	.356	2.026	3.439
	Caucasian	Color footage	4.560 ^a	.276	4.013	5.108
		Black and white footage	3.999 ^a	.262	3.480	4.519
	Other	Color footage	4.505 ^a	.616	3.283	5.727
		Black and white footage	3.453 ^a	.567	2.327	4.579
The film was appealing to look at.	African-American	Color footage	4.287 ^a	.503	3.288	5.286
		Black and white footage	2.637 ^a	.378	1.888	3.387
	Caucasian	Color footage	3.028 ^a	.293	2.447	3.609
		Black and white footage	3.351 ^a	.278	2.800	3.902
	Other	Color footage	4.952 ^a	.653	3.655	6.248
		Black and white footage	3.447 ^a	.602	2.252	4.641
The quality of the film footage was superb.	African-American	Color footage	3.778 ^a	.461	2.864	4.692
		Black and white footage	2.644 ^a	.346	1.958	3.330
	Caucasian	Color footage	4.078 ^a	.268	3.546	4.610
		Black and white footage	3.581 ^a	.254	3.077	4.086
	Other	Color footage	4.708 ^a	.598	3.521	5.894
		Black and white footage	3.159 ^a	.551	2.066	4.253
The film was more realistic than I expected.	African-American	Color footage	5.388 ^a	.516	4.364	6.412
		Black and white footage	3.732 ^a	.387	2.964	4.500
	Caucasian	Color footage	4.685 ^a	.300	4.090	5.280
		Black and white footage	4.357 ^a	.285	3.792	4.921
	Other	Color footage	5.175 ^a	.670	3.846	6.503
		Black and white footage	4.979 ^a	.617	3.755	6.204

a. Covariates appearing in the model are evaluated at the following values: Sex = .50, I expected the film to be in black-and-white. = 4.9065.

Profile Plots

I like the way the film looked.

Estimated Marginal Means of I like the way the film looked.

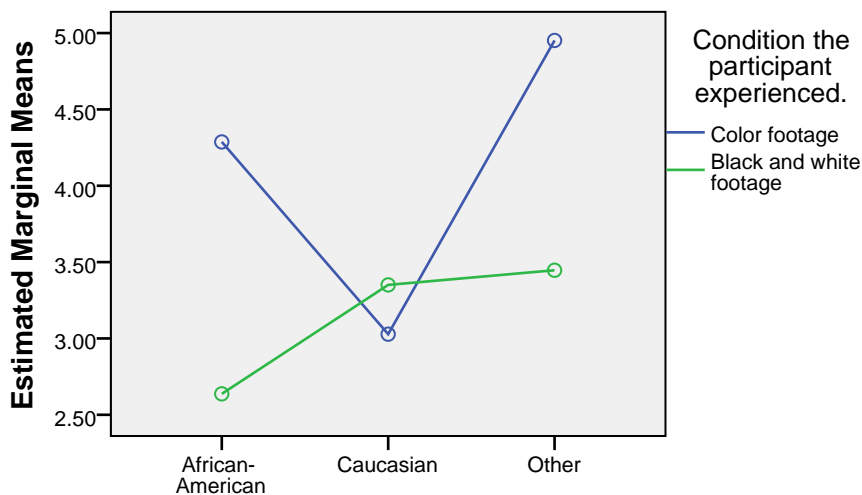


Race with three categories

Covariates appearing in the model are evaluated at the following values: $S_e = .50$, I expected the film to be in black-and-white. = 4.9065

The film was appealing to look at.

Estimated Marginal Means of The film was appealing to look at.

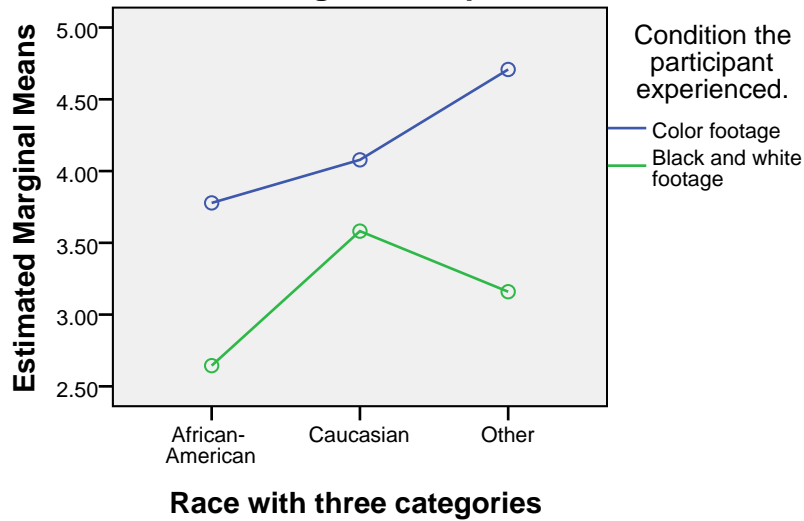


Race with three categories

Covariates appearing in the model are evaluated at the following values: $S_e = .50$, I expected the film to be in black-and-white. = 4.9065

The quality of the film footage was superb.

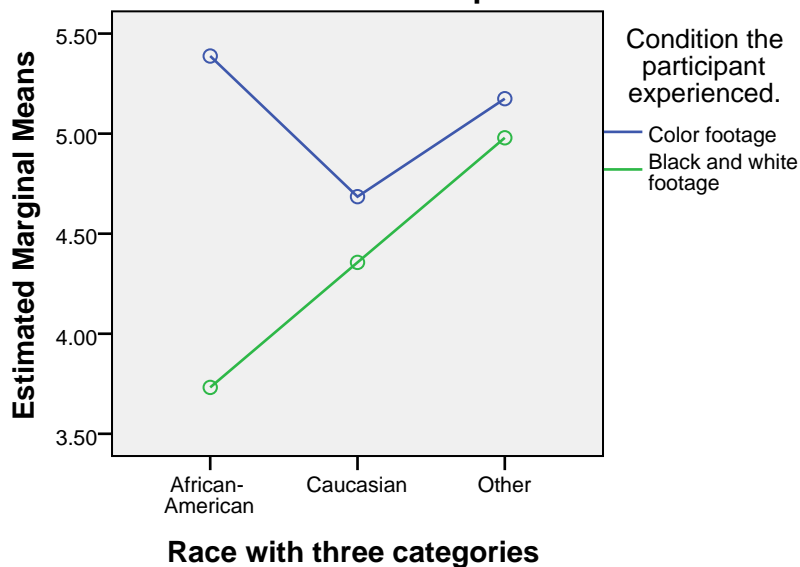
Estimated Marginal Means of The quality of the film footage was superb.



Covariates appearing in the model are evaluated at the following values
Sex = .50, I expected the film to be in black-and-white. = 4.9065

The film was more realistic than I expected.

Estimated Marginal Means of The film was more realistic than I expected.



Covariates appearing in the model are evaluated at the following values:
Sex = .50, I expected the film to be in black-and-white. = 4.9065

Table 1
Multivariate Tests for MANOVA

		Multivariate Tests			
Effect		Value	F-Value	Sig	Observed Power
Race3Cat	Pillai's Trace	.186	2.534	.012	.907
	Wilks' Lambda	.819	2.573	.011	.912
	Hotelling's Trace	.215	2.611	.010	.917
	Roy's Largest Root	.184	4.556	.002	.935
Condition	Pillai's Trace	.088	2.377	.057	.667
	Wilks' Lambda	.912	2.377	.057	.667
	Hotelling's Trace	.097	2.377	.057	.667
	Roy's Largest Root	.097	2.377	.057	.667
Race3Cat*Condition (interaction)	Pillai's Trace	.139	1.847	.070	.773
	Wilks' Lambda	.864	1.863	.068	.777
	Hotelling's Trace	.155	1.878	.065	.781
	Roy's Largest Root	.132	3.272	.015	.820



ANOVA Tables

Table 2

DV1: Q53 – I liked the way the film looked

	Means	Sum of Squares	Df	Mean Squares	F	Sig.	Power
Race3Cat 1=African-American 2=Caucasian 3=Other	a 3.1429 b 4.2273 ab 4.0000	17.185	2	8.593	3.272	.042	.610
Condition 1=Color 2=Black and White	4.1875 3.6949	8.783	1	8.783	3.345	.070	.441
Race3Cat*Condition	-	5.756	2	2.878	1.096	.338	.238
Error	-	265.206	101	2.626	-	-	-

Groups that do not share a superscript varied significantly from one another according to both Tukey and Scheffe post hoc tests

Table 3

DV2: Q47 – The film was appealing to look at

	Means	Sum of Squares	Df	Mean Squares	F	Sig.	Power
Race3Cat 1=African-American 2=Caucasian 3=Other	3.2500 3.1818 4.1538	12.075	2	6.038	2.335	.100	.467
Condition 1=Color 2=Black and White	3.4583 3.2034	13.558	1	13.558	5.289	.024	.625
Race3Cat*Condition	-	28.098	2	14.049	5.480	.006	.840
Error	-	258.915	101	2.564	-	-	-

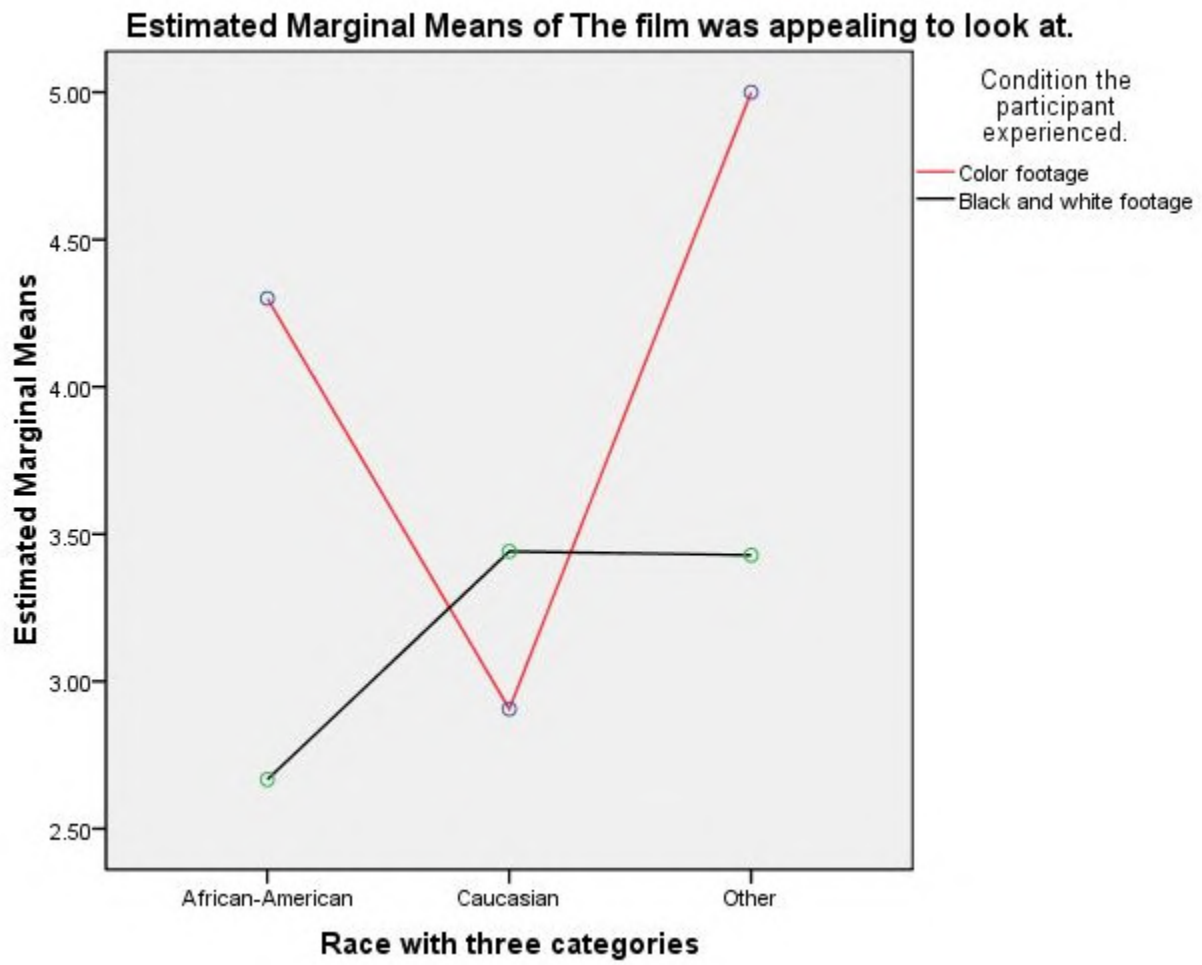
Table 4
DV3: Q49 – The quality of the film footage was superb

	Means	Sum of Squares	Df	Mean Squares	F	Sig.	Power
Race3Cat 1=African-American 2=Caucasian 3=Other	3.1071 3.7879 3.9231	6.528	2	3.264	1.410	.249	.296
Condition 1=Color 2=Black and White	3.9583 3.3559	15.741	1	15.741	6.802	.010	.733
Race3Cat*Condition	-	9.205	2	4.603	1.989	.142	.403
Error	-	233.738	101	2.314	-	-	-

Table 5
DV4: Q39 – The film was more realistic than I expected

	Means	Sum of Squares	Df	Mean Squares	F	Sig.	Power
Race3Cat 1=African-American 2=Caucasian 3=Other	4.3929 4.4697 5.1538	5.255	2	2.628	.953	.389	.211
Condition 1=Color 2=Black and White	4.7917 4.3220	7.298	1	7.298	2.646	.107	.364
Race3Cat*Condition	-	10.578	2	5.289	1.917	.152	.390
Error	-	278.616	101	2.759	-	-	-

Figure 1
Significant Interaction for MANOVA



Race	Condition experienced by participant	Mean
African-American	Color	4.300
	Black and White	2.667
Caucasian	Color	2.906
	Black and White	3.441
Other	Color	5.000
	Black and White	3.429

Writeup for MANOVA:

Four dependent variables were chosen from Denny's Color vs. Black and White Film data set that all had significant correlations at $p < .01$:

2. Q53 - I liked the way the film looked
3. Q47 - The film was appealing to look at
4. Q49 - The quality of the film footage was superb
5. Q39 - The film was more realistic than I expected

Independent variables chosen were race and condition that the participant experienced in terms of either color WWII footage (1) or black and white WWII (2) footage. Because of a lack of a racially diverse experimental group, race was recoded into a three-category variable with African-American (1), Caucasian (2), and other (Asian/Pacific Islander, Latino, Arabic/Middle Eastern, Native American, and Don't Know/Refuse to Answer) (3). This resulted in a two-factor 2x3 design.

Assumptions

Box's M tests for homoscedasticity. In order to reject the null hypothesis, M should be non-significant. For these variables, Box's M test had a significance of .110. This indicates its non-significance (greater than >0.05), allowing for the rejection of the null hypothesis, confirming the homogeneity of the variance/covariances matrices across groups.

Multivariate Tests

The multivariate tests in Table 1 showed that race had a significant effect on the set of dependent variables (Pillai's Trace $p=.012$, Wilks' Lambda $p=.011$, Hotelling's Trace $p=.010$, Roy's Largest Root $p=.002$). Condition experienced had a near significant effect (Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root all $p=.057$). The interaction effect was shown only to have a significant effect with Roy's Largest Root ($p=.015$), but was examined anyway as it can still be argued that the interaction is of importance (and indeed, one of the dependent variables was significantly impacted by the interaction effect). Because of this significance and near significance from the multivariate tests, we

further examined the individual ANOVA tests.

Race significantly affected only one DV, Q53 - I liked the way the film looked ($p=.042$). African Americans liked the way the film looked the least ($m=3.14$), followed by “other” races ($m=4.00$), and finally Caucasians liked the way the film looked the most ($m=4.23$). It should be noted however, that in a post hoc test (using both Tukey's and Scheffe's), African Americans and Caucasians were the only groups that differed significantly on this question.

Condition had a near significant effect ($p=.057$) on all omnibus tests, so it must be examined with caution. It was found to have individual significant effects on two of the dependent variables: Q47 – the film was appealing to look at ($p=.024$) and Q49 – the quality of the film was superb ($p=.01$). The means reported suggest that color film ($m=3.49$) was more appealing to look at than black and white film ($m=3.20$) and that participants thought that color film footage was of a higher quality ($m=3.96$) than black and white footage ($m=3.63$). Again, these results need to be looked at cautiously because the omnibus test was near significant.

Interaction Plot

There was a single significant interaction effect between the independent variables in their impact on Q47 - The Film Was Appealing to Look At ($p=.006$). The mean for African-Americans who experienced color ($m=4.300$) was greater than that of those who viewed black and white footage ($m=2.667$). Other races also found color footage ($m=5.000$) more appealing than black and white footage ($m=3.429$). Caucasians, however, found black and white footage of WWII ($m=3.441$) more appealing to look at than color WWII footage.

“Other” races were not highly represented in this data set ($n=13$), though African Americans ($n=28$) and Caucasians ($n=66$) both were.

Table 6
Multivariate Tests for MANCOVA

		Value	F-Value	Sig	Observed Power
Race3Cat	Pillai's Trace	0.205	2.771	0.006	0.934
	Wilks' Lambda	0.801	2.823	0.006	0.939
	Hotelling's Trace	0.242	2.873	0.005	0.943
	Roy's Largest Root	0.208	5.033	0.001	0.956
Condition	Pillai's Trace	0.112	3.036	0.021	0.785
	Wilks' Lambda	0.888	3.036	0.021	0.785
	Hotelling's Trace	0.126	3.036	0.021	0.785
	Roy's Largest Root	0.126	3.036	0.021	0.785
Race3Cat*Condition (interaction)	Pillai's Trace	0.125	1.588	0.13	0.694
	Wilks' Lambda	0.879	1.595	0.128	0.696
	Hotelling's Trace	0.135	1.601	0.127	0.698
	Roy's Largest Root	0.113	2.73	0.033	0.735
Femaleness	Pillai's Trace	0.031	0.756	0.557	0.235
	Wilks' Lambda	0.969	0.756	0.557	0.235
	Hotelling's Trace	0.031	0.756	0.557	0.235
	Roy's Largest Root	0.031	0.756	0.577	0.235
Blknwhite	Pillai's Trace	0.174	5.042	0.001	0.957
	Wilks' Lambda	0.826	5.042	0.001	0.957
	Hotelling's Trace	0.21	5.042	0.001	0.957
	Roy's Largest Root	0.21	5.042	0.001	0.957

ANCOVA Tables

Table 7

DV1: Q53 – I liked the way the film looked

	Means	Sum of Squares	Df	Mean Squares	F	Sig.	Power
Race3Cat		21.203	2	10.602	4.709	0.011	0.777
1=African-American	3.1429						
2=Caucasian	4.2273						
3=Other	4.0000						
Condition		12.282	1	12.282	5.455	0.022	0.638
1=Color	4.1875						
2=Black and White	3.6949						
Race3Cat*Condition	-	1.029	2	0.512	0.224	.796	0.085
Femaleness	-	0.485	1	0.485	0.215	0.644	0.075
Blknwhite	-	42.016	1	42.016	18.66	0.000	0.990
Error	-	265.206	101	2.626	-	-	-

Table 8

DV2: Q47 – The film was appealing to look at

	Means	Sum of Squares	Df	Mean Squares	F	Sig.	Power
Race3Cat		11.028	2	5.514	2.176	0.119	.476
1=African-American	3.2500						
2=Caucasian	3.1818						
3=Other	4.1538						
Condition		15.140	1	15.140	5.975	0.016	0.677
1=Color	3.4583						
2=Black and White	3.2034						
Race3Cat*Condition	-	21.728	2	10.864	4.287	0.016	0.735
Femaleness	-	0.806	1	0.806	0.318	0.574	0.086
Blknwhite	-	7.351	1	7.351	2.901	0.009	0.392
Error	-	258.915	101	2.564	-	-	-

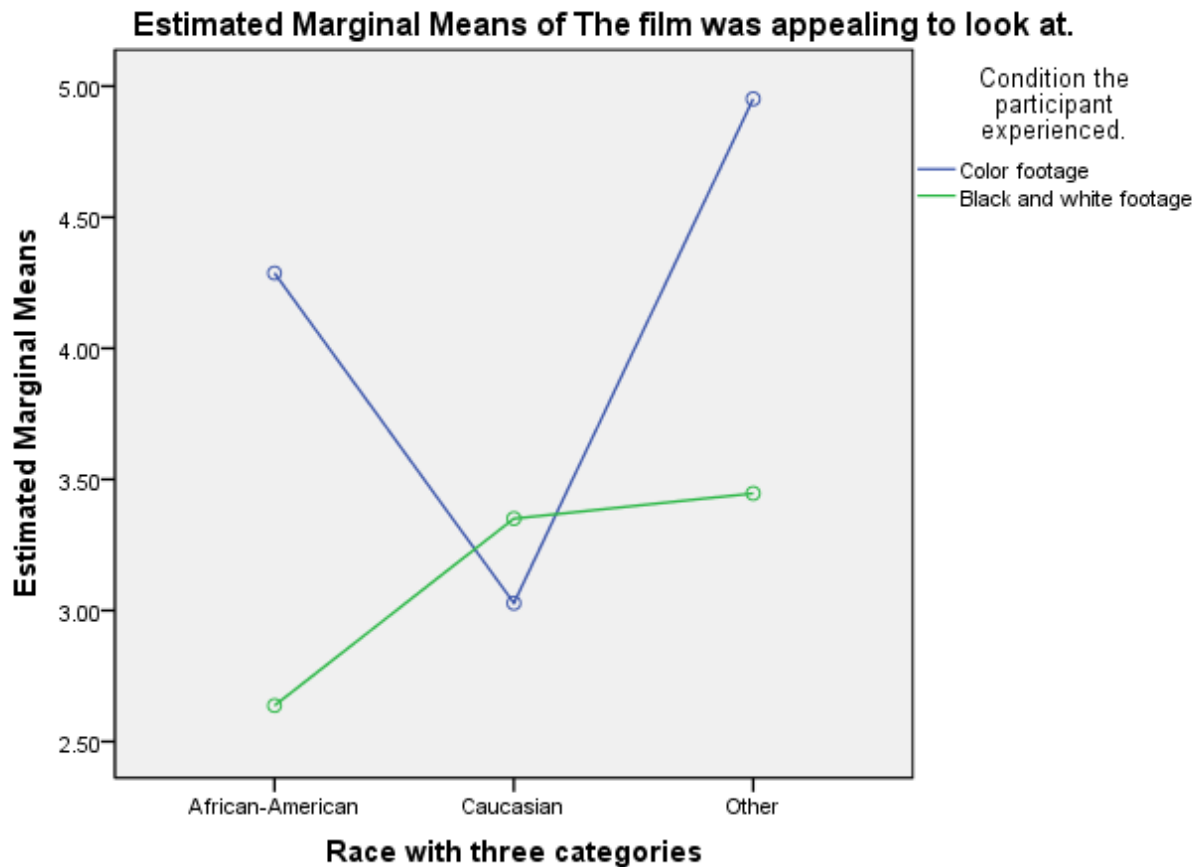
Table 9
DV3: Q49 – The quality of the film footage was superb

	Means	Sum of Squares	Df	Mean Squares	F	Sig.	Power
Race3Cat 1=African-American 2=Caucasian 3=Other	3.1071 3.7879 3.9231	7.903	2	3.952	0.862	0.161	0.380
Condition 1=Color 2=Black and White	3.9583 3.3559	19.077	1	19.077	8.989	0.003	0.844
Race3Cat*Condition	-	3.861	2	1.931	0.910	0.406	0.203
Femaleness	-	0.148	1	0.148	0.070	0.793	0.058
Blknwhite	-	23.569	1	23.569	11.106	0.001	0.910
Error	-	233.738	101	2.314	-	-	-

Table 10
DV4: Q39 – The film was more realistic than I expected

	Means	Sum of Squares	Df	Mean Squares	F	Sig.	Power
Race3Cat 1=African-American 2=Caucasian 3=Other	4.3929 4.4697 5.1538	3.351	2	1.675	0.629	0.535	0.153
Condition 1=Color 2=Black and White	4.7917 4.3220	8.968	1	8.968	3.369	0.069	0.444
Race3Cat*Condition	-	8.778	2	4.389	1.649	0.198	0.341
Femaleness	-	4.696	1	4.696	1.764	0.187	0.260
Blknwhite	-	10.085	1	10.085	3.789	0.054	0.487
Error	-	278.616	101	2.759	-	-	-

Figure 2
Significant Interaction for MANCOVA



Covariates appearing in the model are evaluated at the following values: Sex = .50, I expected the film to be in black-and-white. = 4.9065

Writeup for MANCOVA:

Two covariates, Femaleness (gender) and Blknwhite, how much a person expected the film to be in black and white, were added into the analysis to make the MANOVA a MANCOVA. That is, these two variables will operate as controls for the analysis that was previously conducted. The addition of these two covariates into the analysis changed many things. Notably, the independent variable “condition” moved from being nearly significant in MANOVA ($p = 0.057$ for Pillai’s, Wilk’s, Hotelling, and Roy’s) to significant in MANCOVA ($p = 0.021$ for Pillai’s, Wilk’s, Hotelling, and Roy’s). MANCOVA provides more support for this main effect. The interaction effect of Race x Condition is relatively unchanged compared to MANOVA. Pillai’s, Wilk’s, and Hotellings’s are still not significant while

Roy's indicates a relationship with a significance of $p = 0.033$.

Of the two covariates, *blknwhite* proved to be a stronger predictor of the DV set than did femaleness. People's pre-conceptions about the color of the film are shown to be significant predictors of the four chosen perceptions of the film (liking, appeal, quality, realism), where their gender is not. That is to say people's expectations shaped the way they answered questions about the film much more so than did their sex. To get a better understanding of how this was happening as well as an elaboration of statistics run at the multivariate level several ANCOVAs were completed.

For the first three questions:

53. I liked the way the film looked

47. The film was appealing to look at

49. The quality of the film footage was superb

Blknwhite is significant, people's expectations prior to watching the film were a factor in how they answered these questions. For the final question:

39. The film was more realistic than I expected

Blknwhite has near significance at $p = 0.054$, it can be argued that it is still a determining factor.

Controlling for people's B&W expectations and gender as covariates, it can be concluded:

54. I liked the way the film looked- *Race is significant* ($p = 0.011$), *Condition is significant* ($p = 0.022$)

47. The film was appealing to look at- *Condition is significant* ($p = 0.016$)

49. The quality of the film footage was superb- *Condition is significant* ($p = 0.003$)

39. The film was more realistic than I expected- *Neither is significant, but Condition is closer* ($p = 0.069$)

Interaction Plot

There was still a single significant interaction effect--between the independent variables in their impact on Q47 - The Film Was Appealing to Look At ($p = .016$) when controlling for sex and B&W expectations. The pattern found (see Figure 2) was nearly identical to that found with MANOVA.