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



To C<sub>ovariate</sub>, or not to C<sub>ovariate</sub>, 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:



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

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# 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

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# 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)

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



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

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# 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



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#### GET

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### **General Linear Model**

### - MANOVA

Notes

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#### Warnings

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

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

	Race with thre	Condition the particip	Mean	Std. Deviation	Ν
I like the way	African-American	Color footage	3.7000	2.21359	10
the film looked.		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	African-American	Color footage	4.3000	2.00278	10
look at.		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	African-American	Color footage	3.8000	2.29976	10
the film footage was superb.		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	Ν
The film was	African-American	Color footage	5.4000	2.06559	10
than I expected.		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

#### **Descriptive Statistics**

#### Box's Test of Equality of Covariance Matrices<sup>a</sup>

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 + condtion + Race3Cat \* condtion

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

Multivariate Tests<sup>d</sup>

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 + condtion + Race3Cat \* condtion

Effect		Noncent	Observ
		Paramet er	ed Power <sup>b</sup>
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 *	Pillai's Trace	14.780	.773
condtion	Wilks' Lambda	14.903	.777
	Hotelling's Trace	15.021	.781
	Roy's Largest Root	13.089	.820

Multivariate Tests<sup>d</sup>

b. Computed using alpha = .05

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

Levene's T	lest of	Equality	of	Error	Variances	a
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	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 + condtion + Race3Cat \* condtion

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	I like the way the film looked.	33.037 <sup>a</sup>	5	6.607	2.516	.034
	The film was appealing to look at.	40.281 <sup>c</sup>	5	8.056	3.143	.011
	The quality of the film footage was superb.	27.309 <sup>d</sup>	5	5.462	2.360	.045
	The film was more realistic than I expected.	22.020 <sup>e</sup>	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)

Source	Dependent Variable	Partial Eta Square d	Noncent. Parameter	Observed Power
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

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		

Source	Dependent Variable	Partial		
		Square d	Noncent. Parameter	Observed Power
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
condtion	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 * condtion	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

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
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**

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

1. Race with three categories

# 2. Condition the participant experienced.

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

# 2. Condition the participant experienced.

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

Dependent Variable	Race with three	Condition the participant experienced.	Mean	Std. Error
I like the way the	African-	Color footage	3.700	.512
tilm looked.	American	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	African-	Color footage	4.300	.506
appealing to look	American	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	African-	Color footage	3.800	.481
superb.	American	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	African-	Color footage	5.400	.525
expected.	American	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	Condition the participant experienced.	95% Con Inter	95% Confidence Interval	
	categones		Lower Bound	Upper Bound	
I like the way the	African-	Color footage	2.683	4.717	
nim looked.	American	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	African-	Color footage	3.296	5.304	
appealing to look	American	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	African- American	Color footage	2.846	4.754	
superb.		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	African-	Color footage	4.358	6.442	
expected.	American	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	

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

# **Post Hoc Tests**

Race with three categories

Dependent Variable		(I) Race with three categories	(J) Race with three categories	Mean Difference	Otal Error
				(I-J)	Sta. Error
I like the way the	Tukey HSD	African-American	Caucasian	-1.0844	.36546
min looked.			Other	8571	.54384
		Caucasian	African-American	1.0844	.36546
			Other	.2273	.49170
		Other	African-American	.8571	.54384
			Caucasian	2273	.49170
	Scheffe	African-American	Caucasian	-1.0844	.36546
			Other	8571	.54384
		Caucasian	African-American	1.0844	.36546
			Other	.2273	.49170
		Other	African-American	.8571	.54384
			Caucasian	2273	.49170
The film was	Tukey HSD	African-American	Caucasian	.0682	.36110
look at.			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.

Dependent Variable		(I) Race with three categories	(J) Race with three categories		95% Cor Inte	nfidence rval
				Sig.	Lower Bound	Upper Bound
I like the way the	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	Tukey HSD	African-American	Caucasian	.981	7908	.9272
look at.			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.

Dependent Variable		(I) Race with three categories	(J) Race with three categories	Mean Difference	Std Error
The film was Tukey HSD		Other	Caucasian	(I-J) 9720	J8583
appealing to	Schoffo		Caucasian	.9720	.+0000
IOOK at.	Schelle	American	Othor	.0002	52725
		Caucasian		9030	.00700
		Caucasian	Amcan-American Othor	0002	.30110
		Other		9720	.40303
		Other	Amcan-American	.9030	.03730
The survey little of	Tuluu HOD		Caucasian	.9720	.48583
the film footage	Tukey HSD	African-American	Caucasian	6807	.34310
was superb.			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	Tukey HSD	African-American	Caucasian	0768	.37459
than I expected.			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.

Dependent Variable		(I) Race with three categories	(J) Race with three categories	95% Confid Interva		nfidence rval
				Sig.	Lower Bound	Upper Bound
The film was	Tukey HSD	Other	Caucasian	.117	1837	2.1277
look at.	Scheffe	African-American	Caucasian	.982	8290	.9653
			Other	.248	-2.2389	.4312
		Caucasian	African-American	.982	9653	.8290
			Other	.140	-2.1791	.2350
		Other	African-American	.248	4312	2.2389
			Caucasian	.140	2350	2.1791
The quality of	Tukey HSD	African-American	Caucasian	.121	-1.4969	.1354
was superb.			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	Tukey HSD	African-American	Caucasian	.977	9679	.8142
than I expected.			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		Subset
	categories	Ν	1
Tukey HSD <sup>a,b</sup>	African-American	28	3.1429
	Other	13	4.0000
	Caucasian	66	4.2273
	Sig.		.061
Scheffe <sup>a,b</sup>	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		Subset
	categones	Ν	1
Tukey HSD <sup>a,b</sup>	Caucasian	66	3.1818
	African-American	28	3.2500
	Other	13	4.1538
	Sig.		.099
Scheffe <sup>a,b</sup>	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		Subset
	categones	Ν	1
Tukey HSD <sup>a,b</sup>	African-American	28	3.1071
	Caucasian	66	3.7879
	Other	13	3.9231
	Sig.		.163
Scheffe <sup>a,b</sup>	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		Subset
	categones	Ν	1
Tukey HSD <sup>a,b</sup>	African-American	28	4.3929
	Caucasian	66	4.4697
	Other	13	5.1538
	Sig.		.263
Scheffe <sup>a,b</sup>	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.



Estimated Marginal Means of 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.

Race with three categories

The quality of the film footage was superb.



Estimated Marginal Means of The quality of the film footage

The film was more realistic than I expected.



34

Race with three categories

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" (blknwhite, a Likert scale where 1= strongly disagree, 7=strongly agree)

File Fdit	[DataSe View	et1] - IBM Data	SPSS Statistics	s Data Editor Analyze	Direct Marketin	n Granhs Ullillities Add-ons Window Hein	· Second St.	
				M 🔣				
	Na	ame	Туре	Width	Decimals	Label	Values	
13	excite	хр	Numeric	8	2	How exciting was the experience?	{1.00, Not at all}	N
14	influyo	ou	Numeric	8	2	To what extent do you think the film footage you just saw influenced your thoughts?	{1.00, Not at all}	N
15	inffrnd	s	Numeric	8	2	To what extent do you think the film footage you just saw would influence your friends' thoughts'	{1.00, Not at all}	N
16	inflmo	st	Numeric	8	2	To what extent do you think the film footage you just saw would influence the thoughts of most.	. {1.00, Not at all}	N
17	influce	su	Numeric	8	2	To what extent do you think the film footage you just saw would influence the typical Cleveland	. {1.00, Not at all}	Ne
18	hw t	Multiva	ariate			Nax much dd yns wyny mwng fas Bol?	×	N
19	par							N
20	felt					Dependent Variables:	<u>M</u> odel	N
21	inte	Full	Metal Jacket [f	fulljack]		I like the way the film looked. [likelook]	Contrasts	N
22	visi	Har	nburger Hill [h	ambhill]		The film was appealing to look at. [appeal]	Plots	N
23	rea	The	Longest Day I	apochow]		The quality of the mini toolage was superb. [qusuperb]	110,0	N
24	ppl	San	ds of Iwo Jima	a [sandsiwo]			Post Hoc	N
25	sur	From	m Here To Ete	rnity [fromhe	re]		Save	N
26	dra	Dea	ar America: Let	ters Home F	From Vietnam [	dearamer]	Options	N
27	los	The Civil War (civilwar) Eixed Factor(s): Bootstrap						N
28	pai	The Pathot pathot     A Scholar List Scholar						N
29	sac	J The	Pianist (pianis	st]		Condition the participant experienced. [condtion]		N
30	exp	🖉 Das	Boot (dasboo	t]				N
31	bod	🛷 Life	Is Beautiful [lif	feisbe]				N
32	fac	🛷 The	Great Escape	[greatesc]				N
33	sty	A Patt	on (patton)	4				N
34	ser	🛷 Rec	all-yes/noHo	w many refu	igees were trel	cking through Europe? F Covariate(s):	-	N
35	env	🔗 Rec	all-yes/noNa	ime two of th	ie German citie	s that the allies bombed		N
36	lag	Rec	all-yes/noNa	me the two	Nazi concentra	tion camps shown in this		N
37	cor	A Rec	all-yes/noOn	what date o	lid FDR die? F/	ACTUAL [roosevel]		N
38	ppl	A Rec	all-yes/noHo	w many me	n were dancing	to the Yankee Doodlers		N
39	sol	🔗 Rec	all-yes/noDe	scribe the u	niforms worn b	y concentration camp pri		N
40	dea	Rec	all-yes/noWh	nat was the s	second concer	tration camp quarantine		N
41	pic	Rec	all-yes/noTh	e first USO o	lancer wore wi	hat type of skirt? VISUAL [		N
42	mr	A COL	all-yes/noHo	w many par sion = MEAN	atroopers are s (howinyol inter	act mentimme sensend t		N
43	mo	- COI		AGA - MEAN	(			N
44	mre					OK Paste Reset Cancel Help		N
45	mree	ent	Numeric	8	2	The film fontane seemed more recent than I would have imagined	100 Strongly Disagree	N
46	morei	nt	Numeric	8	2	The film was more interesting than I had expected it to be	{1.00, Strongly Disagree}	N
40	moree	NC NC	Numeric	8	2	For some reason, the film was more exciting than I had expected	[1.00, Strongly Disagree]	N
41	vicance	al.	Numeric	0	2	I found the film featage to be visually unappealing/visually appealing	(1.00, Strongry Disagree)	N
40	visuel	an	Numeric	0	2	The film's visual appearance was of a/n) peer quality/avcellent quality	[1.00, visually unappealing]	
49	dullais	ah	Numeric	0	2	The film feetage leoked dull/wid	(1.00, Poor quanty)	
50	4		Numeric	0	2	me lim loorage looked dull/Wid.	{1.00, Dull}	
Data View	Variabl	e View				(IBM S	SPSS Statistics Processor is ready	

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 more real BY Race3Cat condtion WITH femaleness blk  $$^{36}$$  nwht

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/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	
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Comments		
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	Active Dataset	DataSet1
	Filter	<none></none>
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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		GLM likelook appeal qusuperb morereal BY Race3Cat condtion WITH femaleness blknwht /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.
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	Ν
Race with three categories	1.00	African- American	28
	2.00	Caucasian	66
	3.00	Other	13
Condition the participant	1	Color footage	48
experiencea.	2	Black and white footage	59

	Race with three	Condition the particip	Mean	Std. Deviation
I like the way	African-American	Color footage	3.7000	2.21359
the film looked.		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	African-American	Color footage	4.3000	2.00278
appealing to look at.		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	African-American	Color footage	3.8000	2.29976
the film footage was superb.		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	Ν
I like the way	African-American	Color footage	10
the film looked.		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	African-American	Color footage	10
appealing to look at.		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	African-American	Color footage	10
was superb.		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	African-American	Color footage	5.4000	2.06559
than I		Black and white footage	3.8333	1.72354
expected.		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**

# **Descriptive Statistics**

	Race with three	Condition the particip	Ν
The film was	African-American	Color footage	10
than I		Black and white footage	18
expected.		Total	28
	Caucasian	Color footage	32
Other		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

Equality of Covariance Matrices <sup>a</sup>			
Box's M	77.509		
F	1.254		
df1	50		
df2	2287.505		
Sig.	.110		

Box's Test of

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

a. Design: Intercept + femaleness + blknwht + Race3Cat + condtion + Race3Cat \* condtion

Multivariate Tests <sup>d</sup>								
Effect				Llypotho		(	Partial	
		Value	F	sis df	Error df	Sig.	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 <sup>a</sup>	4.000	96.000	.557	.031	
	Wilks' Lambda	.969	.756 <sup>a</sup>	4.000	96.000	.557	.031	
	Hotelling's Trace	.031	.756 <sup>a</sup>	4.000	96.000	.557	.031	
	Roy's Largest Root	.031	.756 <sup>a</sup>	4.000	96.000	.557	.031	
blknwht	Pillai's Trace	.174	5.042 <sup>a</sup>	4.000	96.000	.001	.174	
	Wilks' Lambda	.826	5.042 <sup>a</sup>	4.000	96.000	.001	.174	
	Hotelling's Trace	.210	5.042 <sup>a</sup>	4.000	96.000	.001	.174	
	Roy's Largest Root	.210	5.042 <sup>a</sup>	4.000	96.000	.001	.174	

# a. Exact statistic

d. Design: Intercept + femaleness + blknwht + Race3Cat + condtion + Race3Cat \* condtion

Effect		Noncent. Parameter	Observed Power
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
blknwht	Pillai's Trace	20.169	.957
	Wilks' Lambda	20.169	.957
	Hotelling's Trace	20.169	.957
	Roy's Largest Root	20.169	.957

Multivariate Tests<sup>d</sup>

b. Computed using alpha = .05

d. Design: Intercept + femaleness + blknwht + Race3Cat + condtion + Race3Cat \* condtion

Effect				Hypothe			Partial Eta
		Value		sis df	Error df	Sig.	Squared
Race3Cat	Pillai's Trace	.205	2.771	8.000	194.00	.006	.103
	Wilks' Lambda	.801	2.823 <sup>a</sup>	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 <sup>c</sup>	4.000	97.000	.001	.172
condtion	Pillai's Trace	.112	3.036 <sup>a</sup>	4.000	96.000	.021	.112
	Wilks' Lambda	.888	3.036 <sup>a</sup>	4.000	96.000	.021	.112
	Hotelling's Trace	.126	3.036 <sup>a</sup>	4.000	96.000	.021	.112
	Roy's Largest Root	.126	3.036 <sup>a</sup>	4.000	96.000	.021	.112
Race3Cat *	Pillai's Trace	.123	1.588	8.000	194.00	.130	.061
condtion	Wilks' Lambda	.879	1.595 <sup>a</sup>	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 <sup>c</sup>	4.000	97.000	.033	.101

# Multivariate Tests<sup>d</sup>

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 + blknwht + Race3Cat + condtion + Race3Cat \* condtion

Effect		Noncent. Parameter	Observed Power
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 *	Pillai's Trace	12.708	.694
condtion	Wilks' Lambda	12.760	.696
	Hotelling's Trace	12.809	.698
	Roy's Largest Root	10.919	.735

Multivariate Tests<sup>d</sup>

b. Computed using alpha = .05

d. Design: Intercept + femaleness + blknwht + Race3Cat + condtion + Race3Cat \* condtion

	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

Levene's Test of Equality of Error Variances<sup>a</sup>

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

a. Design: Intercept + femaleness + blknwht + 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 <sup>a</sup>	7	10.766	4.78	.000	.253
	The film was appealing to look at.	48.336 <sup>c</sup>	7	6.905	2.72	.013	.162
	The quality of the film footage was superb.	50.956 <sup>d</sup>	7	7.279	3.43	.003	.195
	The film was more realistic than I expected.	37.106 <sup>e</sup>	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)

Source	Dependent Variable		Observ
		Noncent. Paramet er	ed 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
blknwht	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
condtion	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 * condtion	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			

Source	Dependent Variable		Observ
		Noncent. Paramet er	ed 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
condtion	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 * condtion	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

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				

Source	Dependent Variable	Noncent. Paramet er	Observ ed 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**

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

#### 1. Race with three categories

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	ble Condition the participant experienced.			95% Coi Inte	nfidence rval
		Mean	Std. Error	Lower Bound	Upper Bound
I like the way the film	Color footage	4.245 <sup>a</sup>	.273	3.703	4.787
looked.	Black and white footage	3.395 <sup>a</sup>	.240	2.918	3.872
The film was appealing to	Color footage	4.089 <sup>a</sup>	.290	3.514	4.664
IOOK at.	Black and white footage	3.145 <sup>a</sup>	.255	2.639	3.651
The quality of the film	Color footage	4.188 <sup>a</sup>	.265	3.662	4.714
footage was superb.	Black and white footage	3.128 <sup>a</sup>	.233	2.665	3.591
The film was more	Color footage	5.082 <sup>a</sup>	.297	4.493	5.672
realistic than I expected.	Black and white footage	4.356 <sup>a</sup>	.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.

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

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

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.



Covariates appearing in the model are evaluated at the following values: Se

= .50, I expected the film to be in black-and-white. = 4.9065

# The film was appealing to look at.



Covariates appearing in the model are evaluated at the following values: Se = .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

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

# The film was more realistic than I expected.



Race with three categories



# Table 1Multivariate 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	Pillai's Trace	.139	1.847	.070	.773
(interaction)	Wilks' Lambda	.864	1.863	.068	.777
	Hotelling's Trace	.155	1.878	.065	.781
	Roy's Largest Root	.132	3.272	.015	.820



Table 2	
DV1: Q53 – I liked the way the film looked	d

	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
<b>Condition</b> 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
<b>Condition</b> 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
<b>Condition</b> 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	with	three	categ	ories
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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 homoscedacticity. In order to reject the null hypothesis, M should be nonsignificant. For these variables, Box's M test had a significance of .110. This indicates its nonsignificance (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	Pillai's Trace	0 125	1.588	0.13	0 694
(interaction)	Wilks' Lambda	0.879	1.595	0.10	0.696
(interdeneny	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

	Means	Sum of Squares	Df	Mean Squares	F	Sig.	Power
Race3Cat 1=African-American 2=Caucasian 3=Other	3.1429 4.2273 4.0000	21.203	2	10.602	4.709	0.011	0.777
<b>Condition</b> 1=Color 2=Black and White	4.1875 3.6949	12.282	1	12.282	5.455	0.022	0.638
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 7 DV1: Q53 – I liked the way the film looked

# Table 8

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	11.028	2	5.514	2.176	0.119	.476
Condition 1=Color 2=Black and White	3.4583 3.2034	15.140	1	15.140	5.975	0.016	0.677
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	0.1071	7.903	2	3.952	0.862	0.161	0.380
1=African-American 2=Caucasian 3=Other	3.1071 3.7879 3.9231						
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.