Technical Test Battery Differential Item Functioning: Senior technical officers

Senior technical officers (electricians) tested as part of a validation study.
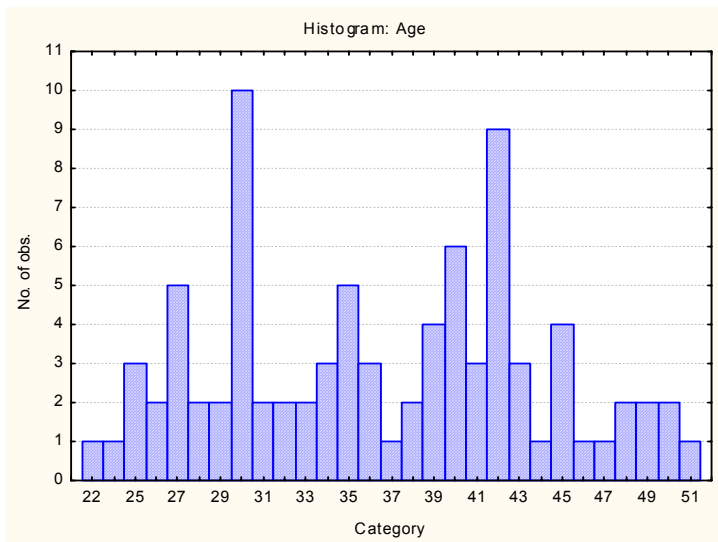
Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Technikon	1	1	1.13636	1.1364
Vocational Training	41	42	46.59091	47.7273
Grade 12	14	56	15.90909	63.6364
Grade 10 or 11	2	58	2.27273	65.9091
Missing	30	88	34.09091	100.0000

Category	Frequency table: First Language			
	Count	Cumulative Count	Percent	Cumulative Percent
isiZulu	8	8	9.09091	9.0909
isiXhosa	2	10	2.27273	11.3636
Afrikaans	29	39	32.95455	44.3182
English	8	47	9.09091	53.4091
Sesotho	8	55	9.09091	62.5000
Xitsonga	1	56	1.13636	63.6364
Setswana	1	57	1.13636	64.7727
isiNdebele	1	58	1.13636	65.9091
Missing	30	88	34.09091	100.0000

Category	Frequency table: Racegroup			
	Count	Cumulative Count	Percent	Cumulative Percent
White	51	51	57.95455	57.9545
Non-White	37	88	42.04545	100.0000
Missing	0	88	0.00000	100.0000

Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
European	51	51	57.95455	57.9545
Coloured	7	58	7.95455	65.9091
African	30	88	34.09091	100.0000
Missing	0	88	0.00000	100.0000

Variable	Descriptive Statistics					
	Mean	Std.Dev	Minimum	Maximum	N	No.cases Missing
Age	36.47059	7.344561	22.00000	51.00000	85	3

Method

Method

Applicants were classified into White (non-disadvantaged) and Non-White (previously disadvantaged) for the purpose of the analysis, since the size of the sample did not allow for finer distinctions.

Applicants were classified into score levels for the test being evaluated. The cut-offs for the levels were determined by examining the frequency distributions for both race groups, trying to ensure a sufficient number of cases for both races in each category.

The statistical technique used in this study was factorial analysis of variance. For every item a factorial analysis of variance was done, using the scored item response as dependent variable, and the race group and score level (on the overall test score for the subtest being investigated) as predictor variables. If a significant effect was found for race, that was taken as an indication of uniform item bias, and the least-square difference in the means for that item was plotted graphically to illustrate which race group had a higher probability of getting the item right. If a significant interaction effect was found for race group and score level, that was taken as an indication of non-uniform item bias, and the means at all levels for both race groups were plotted to illustrate the severity of the non-uniform bias that was found.

Detailed results by item: Mechanical Reasoning Test

Item number	Uniform bias	In favour of group	Non-uniform bias
1	No		No
2	No		No
3	No		No
4	No		No
5	No		No
6	No		No
7	No		No
8	No		No
9	No		No
10	No		No
11	No		No
12	No		No
13	No		No
14	No		No
15	No		No
16	No		No
17	Yes	White	No
18	No		No
19	No		No
20	No		No
21	No		No
22	No		No
23	No		No
24	No		No
25	No		Yes
26	No		No
27	No		Yes
28	No		No
29	No		No
30	No		No
31	No		No
32	No		No
33	No		No
34	No		No
35	No		No
36	No		No
37	No		No
38	No		No
39	No		No
40	No		No
41	No		No
42	No		No
43	No		No
44	No		No
45	No		No

Uniform bias was found in one item, in favour of the White group.
Non-uniform bias was found in two items.
The graphs in the detailed results that follow give more information about the nature of this bias.

Effect	Univariate Tests of Significance for item1 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	15.93523	1	15.93523	105.6273	0.000000
Racegroup	0.01264	1	0.01264	0.0838	0.773006
Scorelevel	3.12276	4	0.78069	5.1748	0.000957
Racegroup*Scorelevel	0.58887	4	0.14722	0.9758	0.425768
Error	11.61643	77	0.15086		

Effect	Univariate Tests of Significance for item2 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	0.049331	1	0.049331	1.899259	0.172153
Racegroup	0.049331	1	0.049331	1.899259	0.172153
Scorelevel	0.094012	4	0.023503	0.904864	0.465456
Racegroup*Scorelevel	0.094012	4	0.023503	0.904864	0.465456
Error	2.000000	77	0.025974		

Effect	Univariate Tests of Significance for item3 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.04834	1	0.048336	0.22850	0.633993
Scorelevel	2.00626	4	0.501566	2.37106	0.059657
Racegroup*Scorelevel	0.70172	4	0.175429	0.82931	0.510593
Error	16.28833	77	0.211537		

Effect	Univariate Tests of Significance for item4 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.10774	1	0.10774	0.6792	0.412421
Scorelevel					
Racegroup*Scorelevel	0.20744	4	0.05186	0.3269	0.859106
Error	12.21497	77	0.15864		

Effect	Univariate Tests of Significance for item5 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	30.31027	1	30.31027	213.9970	0.000000
Racegroup	0.02275	1	0.02275	0.1606	0.689673
Scorelevel	0.87518	4	0.21879	1.5447	0.197679
Racegroup*Scorelevel	1.22330	4	0.30583	2.1592	0.081498
Error	10.90619	77	0.14164		

Effect	Univariate Tests of Significance for item6 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.55015	1	0.55015	2.53155	0.115688
Scorelevel	1.93273	4	0.48318	2.22338	0.074165
Racegroup*Scorelevel	0.73046	4	0.18262	0.84031	0.503840
Error	16.73358	77	0.21732		

Effect	Univariate Tests of Significance for item7 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.18432	1	0.18432	1.11742	0.293779
Scorelevel					
Racegroup*Scorelevel	1.56482	4	0.39121	2.37166	0.059604
Error	12.70116	77	0.16495		

Effect	Univariate Tests of Significance for item8 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.11128	1	0.11128	0.50759	0.478339
Scorelevel	1.89235	4	0.47309	2.15788	0.081655
Racegroup*Scorelevel	0.73676	4	0.18419	0.84014	0.503942
Error	16.88124	77	0.21924		

Effect	Univariate Tests of Significance for item9 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	35.85169	1	35.85169	518.9602	0.000000
Racegroup	0.00420	1	0.00420	0.0607	0.805976
Scorelevel	0.55862	4	0.13965	2.0215	0.099680
Racegroup*Scorelevel	0.36267	4	0.09067	1.3124	0.272869
Error	5.31944	77	0.06908		

Effect	Univariate Tests of Significance for item11 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.42739	1	0.427385	2.12699	0.148792
Scorelevel	1.31103	4	0.327759	1.63117	0.174942
Racegroup*Scorelevel	0.23976	4	0.059940	0.29831	0.878209
Error	15.47193	77	0.200934		

Effect	Univariate Tests of Significance for item12 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.00996	1	0.00996	0.0635	0.801666
Scorelevel					
Racegroup*Scorelevel	0.85069	4	0.21267	1.3568	0.256773
Error	12.06931	77	0.15674		

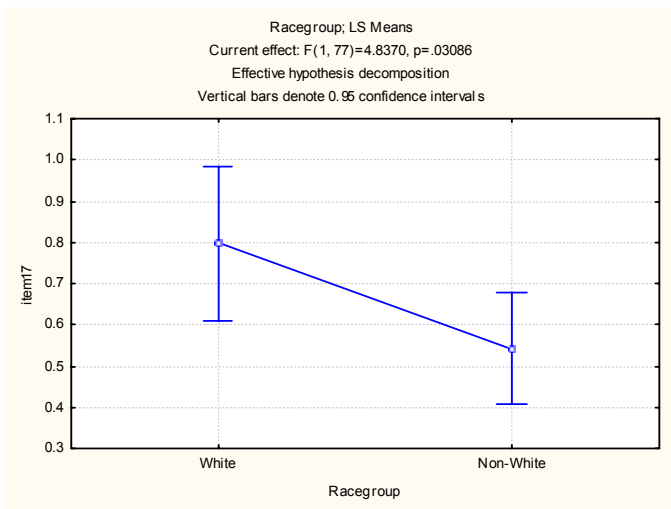| Effect	Univariate Tests of Significance for item13 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.01866	1	0.01866	0.08326	0.773698
Scorelevel	1.42701	4	0.35675	1.59188	0.184957
Racegroup*Scorelevel	1.30896	4	0.32724	1.46020	0.222531
Error	17.25624	77	0.22411		

Effect	Univariate Tests of Significance for item14 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	0.89243	1	0.892426	5.240020	0.024814
Racegroup	0.12418	1	0.124185	0.729170	0.395801
Scorelevel	0.32446	4	0.081115	0.476278	0.753014
Racegroup*Scorelevel	0.69606	4	0.174014	1.021753	0.401504
Error	13.11385	77	0.170310		

Effect	Univariate Tests of Significance for item15 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.47982	1	0.47982	2.13904	0.147662
Scorelevel	1.36529	4	0.34132	1.52163	0.204206
Racegroup*Scorelevel	1.30121	4	0.32530	1.45020	0.225650
Error	17.27225	77	0.22431		

Effect	Univariate Tests of Significance for item16 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.07248	1	0.07248	0.29647	0.587679
Scorelevel	1.62973	4	0.40743	1.66657	0.166355
Racegroup*Scorelevel	0.42317	4	0.10579	0.43273	0.784568
Error	18.82445	77	0.24447		

Effect	Univariate Tests of Significance for item17 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup					
Scorelevel					
Racegroup*Scorelevel	0.68762	4	0.17190	1.1485	0.340258
Error	11.52540	77	0.14968		

Racegroup; LS Means
Current effect: F (1, 77)=4.8370, p=.03086
Effective hypothesis decomposition
Vertical bars denote 0.95 confidence intervals

Effect	Univariate Tests of Significance for item18 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	13.97745	1	13.97745	77.84983	0.000000
Racegroup	0.37780	1	0.37780	2.10420	0.150957
Scorelevel	3.93379	4	0.98345	5.47748	0.000620
Racegroup*Scorelevel	1.21876	4	0.30469	1.69703	0.159283
Error	13.82486	77	0.17954		

Effect	Univariate Tests of Significance for item19 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.00264	1	0.00264	0.0225	0.881198
Scorelevel					
Racegroup*Scorelevel	0.83783	4	0.20946	1.7860	0.140214
Error	9.03032	77	0.11728		

Effect	Univariate Tests of Significance for item20 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.22701	1	0.22701	0.93547	0.336475
Scorelevel	0.23961	4	0.05990	0.24685	0.910741
Racegroup*Scorelevel	0.35254	4	0.08814	0.36319	0.834094
Error	18.68547	77	0.24267		

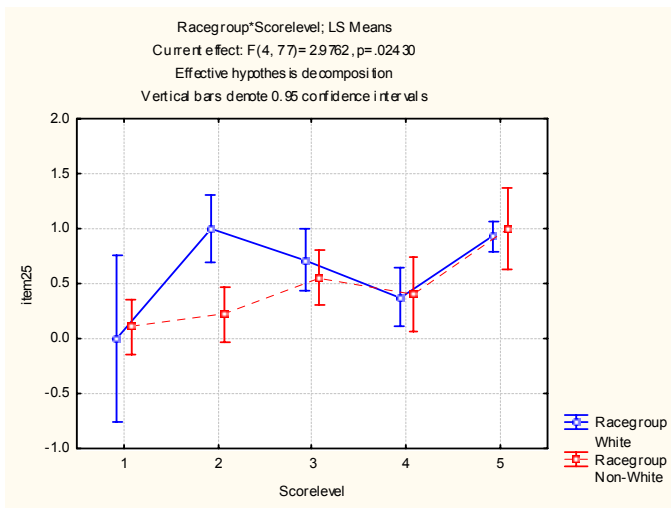| Effect	Univariate Tests of Significance for item21 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	4.91077	1	4.910769	24.21541	0.000005
Racegroup	0.00039	1	0.000394	0.00194	0.964957
Scorelevel	2.75928	4	0.689819	3.40156	0.012901
Racegroup*Scorelevel	0.68710	4	0.171775	0.84704	0.499739
Error	15.61523	77	0.202795		

Effect	Univariate Tests of Significance for item22 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.06361	1	0.06361	0.29014	0.591687
Scorelevel	0.88807	4	0.22202	1.01271	0.406194
Racegroup*Scorelevel	1.54283	4	0.38571	1.75936	0.145686
Error	16.88080	77	0.21923		

Effect	Univariate Tests of Significance for item23 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.08782	1	0.087819	0.42420	0.516789
Scorelevel	1.72811	4	0.432027	2.08685	0.090610
Racegroup*Scorelevel	0.20550	4	0.051375	0.24816	0.909946
Error	15.94083	77	0.207024		

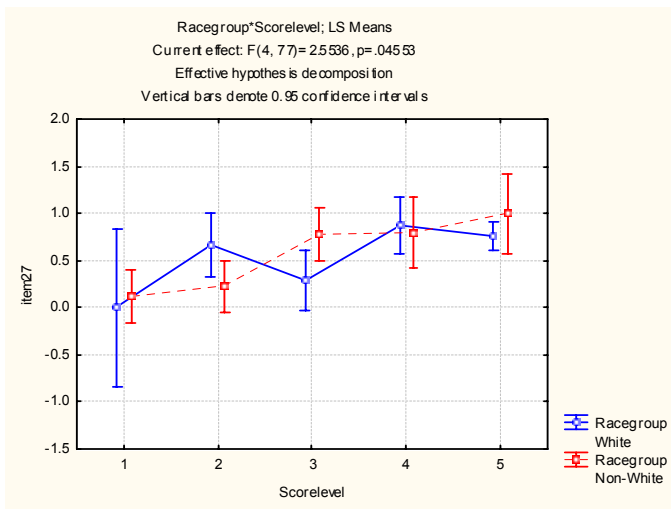| Effect	Univariate Tests of Significance for item24 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.18552	1	0.185519	0.89480	0.347139
Scorelevel					
Racegroup*Scorelevel	0.73561	4	0.183902	0.88700	0.475862
Error	15.96442	77	0.207330		

Effect	Univariate Tests of Significance for item25 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	12.51485	1	12.51485	87.34743	0.000000
Racegroup	0.23753	1	0.23753	1.65782	0.201754
Scorelevel	3.49540	4	0.87385	6.09904	0.000257
Racegroup*Scorelevel	1.70566	4	0.42641	2.97616	0.024297
Error	11.03231	77	0.14328		

Racegroup*Scorelevel; LS Means
Current effect: F(4, 77)= 2.9762, p=.02430
Effective hypothesis decomposition
Vertical bars denote 0.95 confidence intervals

Effect	Univariate Tests of Significance for item26 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.00707	1	0.007073	0.03252	0.857371
Scorelevel	1.10758	4	0.276895	1.27297	0.287927
Racegroup*Scorelevel	0.11398	4	0.028496	0.13100	0.970620
Error	16.74896	77	0.217519		

Effect	Univariate Tests of Significance for item27 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.04693	1	0.04693	0.26285	0.609640
Scorelevel					
Racegroup*Scorelevel					
Error	13.74725	77	0.17854		

Racegroup*Scorelevel; LS Means
Current effect: F(4, 77)= 2.5536, p=.04553
Effective hypothesis decomposition
Vertical bars denote 0.95 confidence intervals

	Univariate Tests of Significance for item28 Sigma-restricted parameterization Effective hypothesis decomposition				
Effect	SS	Degr. of Freedom	MS	F	p
Intercept	0.483031	1	0.483031	4.124674	0.045714
Racegroup	0.078627	1	0.078627	0.671408	0.415090
Scorelevel	0.245691	4	0.061423	0.524497	0.718004
Racegroup*Scorelevel	0.049443	4	0.012361	0.105550	0.980252
Error	9.017296	77	0.117108		

	Univariate Tests of Significance for item29 Sigma-restricted parameterization Effective hypothesis decomposition				
Effect	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.41410	1	0.41410	1.93499	0.168220
Scorelevel	1.61668	4	0.40417	1.88858	0.120925
Racegroup*Scorelevel	0.18340	4	0.04585	0.21425	0.929774
Error	16.47860	77	0.21401		

	Univariate Tests of Significance for item30 Sigma-restricted parameterization Effective hypothesis decomposition				
Effect	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.01318	1	0.013181	0.08254	0.774653
Scorelevel					
Racegroup*Scorelevel	0.26876	4	0.067190	0.42075	0.793200
Error	12.29620	77	0.159691		

Effect	Univariate Tests of Significance for item31 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	0.417842	1	0.417842	4.427129	0.038636
Racegroup	0.004139	1	0.004139	0.043853	0.834681
Scorelevel	0.652136	4	0.163034	1.727379	0.152520
Racegroup*Scorelevel	0.216095	4	0.054024	0.572393	0.683458
Error	7.267433	77	0.094382		

Effect	Univariate Tests of Significance for item32 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.29154	1	0.291535	1.59840	0.209944
Scorelevel					
Racegroup*Scorelevel	0.27011	4	0.067527	0.37023	0.829163
Error	14.04418	77	0.182392		

Effect	Univariate Tests of Significance for item33 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.44798	1	0.447977	3.24689	0.075473
Scorelevel					
Racegroup*Scorelevel	1.31013	4	0.327532	2.37392	0.059406
Error	10.62378	77	0.137971		

Effect	Univariate Tests of Significance for item34 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	0.115785	1	0.115785	2.089343	0.152388
Racegroup	0.010804	1	0.010804	0.194956	0.660061
Scorelevel	0.357032	4	0.089258	1.610661	0.180106
Racegroup*Scorelevel	0.034447	4	0.008612	0.155399	0.960007
Error	4.267105	77	0.055417		

Effect	Univariate Tests of Significance for item35 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	1.38482	1	1.384818	8.073184	0.005747
Racegroup	0.04011	1	0.040112	0.233842	0.630062
Scorelevel	1.90195	4	0.475488	2.771990	0.032921
Racegroup*Scorelevel	0.06548	4	0.016370	0.095432	0.983631
Error	13.20805	77	0.171533		

Effect	Univariate Tests of Significance for item36 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.01582	1	0.015825	0.120531	0.729406
Scorelevel					
Racegroup*Scorelevel	0.23919	4	0.059797	0.455452	0.768129
Error	10.10948	77	0.131292		

Effect	Univariate Tests of Significance for item37 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.12989	1	0.129891	0.82113	0.367677
Scorelevel					
Racegroup*Scorelevel	0.17648	4	0.044120	0.27891	0.890779
Error	12.18030	77	0.158186		

Effect	Univariate Tests of Significance for item38 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.00014	1	0.000142	0.00096	0.975416
Scorelevel					
Racegroup*Scorelevel	0.47575	4	0.118939	0.79812	0.530066
Error	11.47481	77	0.149023		

Effect	Univariate Tests of Significance for item39 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	0.116158	1	0.116158	1.211112	0.274540
Racegroup	0.116158	1	0.116158	1.211112	0.274540
Scorelevel	0.299485	4	0.074871	0.780641	0.541187
Racegroup*Scorelevel	0.299485	4	0.074871	0.780641	0.541187
Error	7.385057	77	0.095910		

Effect	Univariate Tests of Significance for item40 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	0.64291	1	0.642912	4.690004	0.033434
Racegroup	0.00292	1	0.002922	0.021318	0.884297
Scorelevel	1.30549	4	0.326373	2.380868	0.058799
Racegroup*Scorelevel	0.31207	4	0.078018	0.569138	0.685794
Error	10.55527	77	0.137081		

Effect	Univariate Tests of Significance for item41 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	0.052792	1	0.052792	0.620448	0.433299
Racegroup	0.052792	1	0.052792	0.620448	0.433299
Scorelevel	0.320216	4	0.080054	0.940846	0.445002
Racegroup*Scorelevel	0.320216	4	0.080054	0.940846	0.445002
Error	6.551724	77	0.085087		

Effect	Univariate Tests of Significance for item42 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	0.383894	1	0.383894	3.166178	0.079124
Racegroup	0.222332	1	0.222332	1.833688	0.179653
Scorelevel	0.101780	4	0.025445	0.209858	0.932225
Racegroup*Scorelevel	0.150023	4	0.037506	0.309330	0.870919
Error	9.336138	77	0.121249		

| Effect | Univariate Tests of Significance for item43
Sigma-restricted parameterization
Effective hypothesis decomposition | | | | |
	SS	Degr. of Freedom	MS	F	p
Intercept	0.161676	1	0.161676	3.374047	0.070090
Racegroup	0.069818	1	0.069818	1.457037	0.231097
Scorelevel	0.980663	4	0.245166	5.116401	0.001041
Racegroup*Scorelevel	0.423486	4	0.105872	2.209450	0.075700
Error	3.689655	77	0.047918		

| Effect | Univariate Tests of Significance for item44
Sigma-restricted parameterization
Effective hypothesis decomposition | | | | |
	SS	Degr. of Freedom	MS	F	p
Intercept	0.041193	1	0.041193	0.740803	0.392076
Racegroup	0.041193	1	0.041193	0.740803	0.392076
Scorelevel	0.088570	4	0.022143	0.398210	0.809350
Racegroup*Scorelevel	0.088570	4	0.022143	0.398210	0.809350
Error	4.281609	77	0.055605		

| Effect | Univariate Tests of Significance for item45
Sigma-restricted parameterization
Effective hypothesis decomposition | | | | |
	SS	Degr. of Freedom	MS	F	p
Intercept	0.000528	1	0.000528	0.042102	0.837967
Racegroup	0.000528	1	0.000528	0.042102	0.837967
Scorelevel	0.003202	4	0.000801	0.063843	0.992348
Racegroup*Scorelevel	0.003202	4	0.000801	0.063843	0.992348
Error	0.965517	77	0.012539		

Detailed results by item: Spatial Reasoning Test

Item number	Uniform bias	In favour of group	Non-uniform bias
1	No		No
2	No		No
3	No		No
4	No		No
5	No		No
6	No		No
7	No		No
8	No		No
9	No		No
10	No		No
11	No		No
12	No		No
13	Yes	White	No
14	No		No
15	No		Yes
16	Yes	Non-White	Yes
17	No		No
18	No		No
19	No		No
20	No		No
21	No		No
22	No		No
23	No		No
24	No		No
25	No		No
26	No		No
27	No		Yes
28	No		No
29	No		No
30	No		No

Uniform bias was found in two items. One item was biased in favour of the White group, and one item in favour of the non-White group.
Non-uniform bias was found in three items.
More information about this bias can be found in the graphs included in the detailed results that follow.

Effect	Univariate Tests of Significance for item1 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	27.50719	1	27.50719	143.2938	0.000000
Racegroup	0.68189	1	0.68189	3.5522	0.063241
Scorelevel	5.63148	4	1.40787	7.3341	0.000047
Racegroup*Scorelevel	0.05951	4	0.01488	0.0775	0.988934
Error	14.78119	77	0.19196		

Effect	Univariate Tests of Significance for item2 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.00063	1	0.00063	0.0033	0.954513
Scorelevel	1.50019	4	0.37505	1.9592	0.109150
Racegroup*Scorelevel	0.86813	4	0.21703	1.1338	0.346947
Error	14.74002	77	0.19143		

Effect	Univariate Tests of Significance for item3 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.12951	1	0.12951	0.7662	0.384129
Scorelevel					
Racegroup*Scorelevel	0.08606	4	0.02152	0.1273	0.972124
Error	13.01604	77	0.16904		

Effect	Univariate Tests of Significance for item4 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.02935	1	0.02935	0.1958	0.659332
Scorelevel					
Racegroup*Scorelevel	0.59095	4	0.14774	0.9858	0.420434
Error	11.54015	77	0.14987		

Effect	Univariate Tests of Significance for item5 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	6.17144	1	6.171436	26.54269	0.000002
Racegroup	0.32831	1	0.328306	1.41201	0.238375
Scorelevel	0.99592	4	0.248979	1.07083	0.376796
Racegroup*Scorelevel	1.30451	4	0.326128	1.40264	0.241048
Error	17.90325	77	0.232510		

Effect	Univariate Tests of Significance for item6 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.03495	1	0.03495	0.1782	0.674064
Scorelevel					
Racegroup*Scorelevel	0.47805	4	0.11951	0.6095	0.657009
Error	15.09799	77	0.19608		

Effect	Univariate Tests of Significance for item7 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.16270	1	0.16270	0.80002	0.373874
Scorelevel					
Racegroup*Scorelevel	0.52718	4	0.13180	0.64805	0.629954
Error	15.65958	77	0.20337		

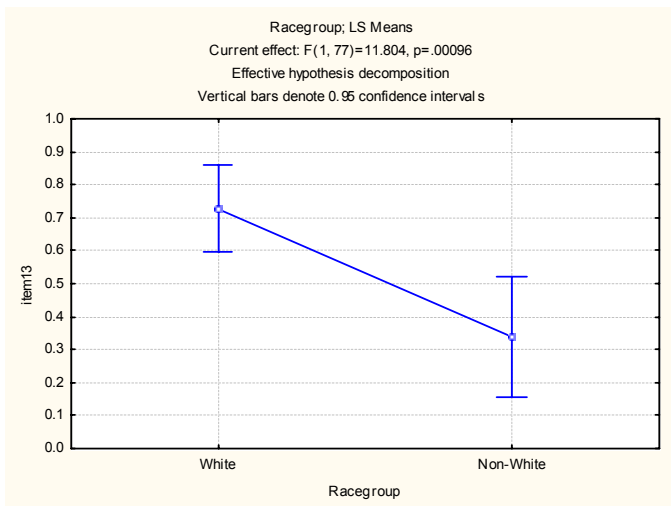| Effect	Univariate Tests of Significance for item8 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.00656	1	0.00656	0.0335	0.855311
Scorelevel					
Racegroup*Scorelevel	0.86222	4	0.21555	1.0996	0.362920
Error	15.09496	77	0.19604		

Effect	Univariate Tests of Significance for item9 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	11.04240	1	11.04240	62.54160	0.000000
Racegroup	0.02886	1	0.02886	0.16348	0.687091
Scorelevel	5.45348	4	1.36337	7.72181	0.000028
Racegroup*Scorelevel	0.15254	4	0.03814	0.21599	0.928792
Error	13.59519	77	0.17656		

Effect	Univariate Tests of Significance for item10 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.23773	1	0.237733	1.14499	0.287942
Scorelevel					
Racegroup*Scorelevel	1.57520	4	0.393800	1.89666	0.119518
Error	15.98734	77	0.207628		

Effect	Univariate Tests of Significance for item11 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.00101	1	0.00101	0.0061	0.937762
Scorelevel					
Racegroup*Scorelevel	0.76779	4	0.19195	1.1672	0.331893
Error	12.66261	77	0.16445		

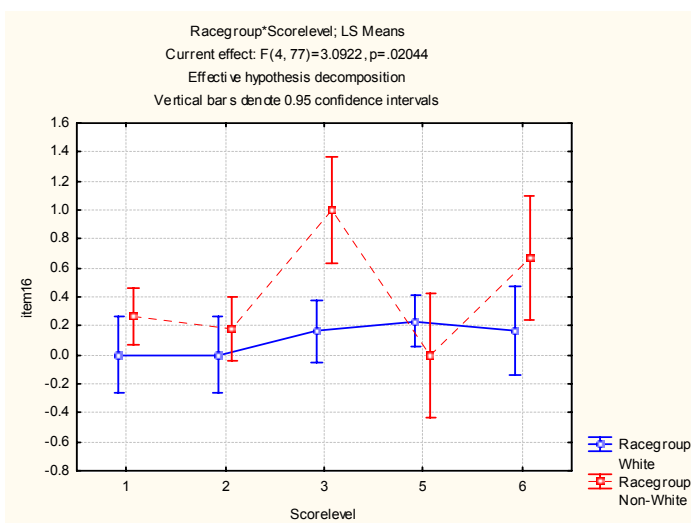| Effect	Univariate Tests of Significance for item12 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.36462	1	0.364624	1.60855	0.208517
Scorelevel	1.08603	4	0.271507	1.19776	0.318639
Racegroup*Scorelevel	1.04932	4	0.262329	1.15727	0.336309
Error	17.45428	77	0.226679		

Effect	Univariate Tests of Significance for item13 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	17.32248	1	17.32248	88.17650	0.000000
Racegroup	2.31887	1	2.31887	11.80375	0.000956
Scorelevel	1.57292	4	0.39323	2.00165	0.102610
Racegroup*Scorelevel	0.41954	4	0.10489	0.53390	0.711197
Error	15.12683	77	0.19645		

Racegroup; LS Means
Current effect: F(1, 77)=11.804, p=.00096
Effective hypothesis decomposition
Vertical bars denote 0.95 confidence intervals

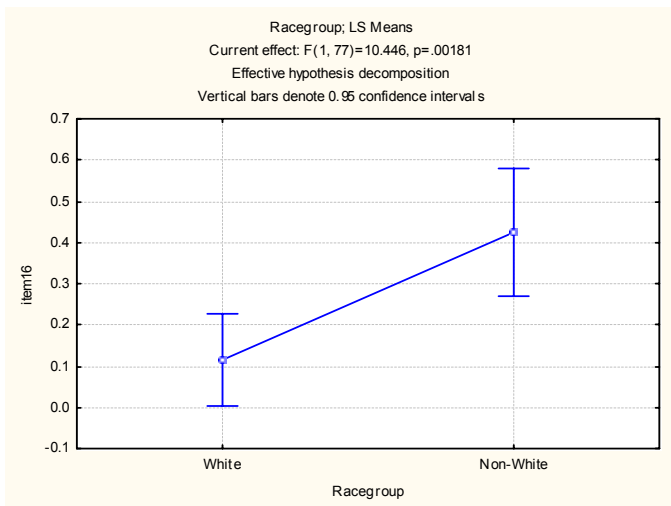| Effect	Univariate Tests of Significance for item14 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.34600	1	0.34600	1.90230	0.171813
Scorelevel					
Racegroup*Scorelevel	0.25288	4	0.06322	0.34758	0.844950
Error	14.00517	77	0.18189		

Effect	Univariate Tests of Significance for item15 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.31271	1	0.31271	1.95336	0.166239
Scorelevel					
Racegroup*Scorelevel					
Error	12.32683	77	0.16009		

Effect	Univariate Tests of Significance for item16 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	4.41052	1	4.410520	31.45939	0.000000
Racegroup	1.46457	1	1.464568	10.44649	0.001810
Scorelevel	2.45907	4	0.614769	4.38503	0.003016
Racegroup*Scorelevel	1.73407	4	0.433517	3.09219	0.020443
Error	10.79519	77	0.140197		

Racegroup; LS Means
Current effect: F(1, 77)=10.446, p=.00181
Effective hypothesis decomposition
Vertical bars denote 0.95 confidence intervals

Racegroup*Scorelevel; LS Means
Current effect: F(4, 77)=3.0922, p=.02044
Effective hypothesis decomposition
Vertical bars denote 0.95 confidence intervals

Effect	Univariate Tests of Significance for item17 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.01879	1	0.01879	0.10023	0.752412
Scorelevel					
Racegroup*Scorelevel	0.09581	4	0.02395	0.12776	0.971932
Error	14.43623	77	0.18748		

Effect	Univariate Tests of Significance for item18 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	4.09728	1	4.097275	28.20064	0.000001
Racegroup	0.00493	1	0.004933	0.03395	0.854299
Scorelevel	4.33594	4	1.083986	7.46083	0.000039
Racegroup*Scorelevel	0.78222	4	0.195554	1.34596	0.260631
Error	11.18734	77	0.145290		

Effect	Univariate Tests of Significance for item19 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.00171	1	0.00171	0.00743	0.931540
Scorelevel	1.61773	4	0.40443	1.75937	0.145685
Racegroup*Scorelevel	0.31292	4	0.07823	0.34032	0.849950
Error	17.70031	77	0.22987		

Effect	Univariate Tests of Significance for item20 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.01359	1	0.01359	0.0889	0.766366
Scorelevel					
Racegroup*Scorelevel	1.41106	4	0.35277	2.3080	0.065479
Error	11.76921	77	0.15285		

Effect	Univariate Tests of Significance for item21 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.31705	1	0.31705	1.68600	0.198005
Scorelevel					
Racegroup*Scorelevel	0.51604	4	0.12901	0.68603	0.603793
Error	14.47999	77	0.18805		

Effect	Univariate Tests of Significance for item22 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	2.43119	1	2.431186	13.39792	0.000460
Racegroup	0.02416	1	0.024157	0.13312	0.716215
Scorelevel	1.06393	4	0.265981	1.46579	0.220803
Racegroup*Scorelevel	0.21357	4	0.053393	0.29424	0.880872
Error	13.97242	77	0.181460		

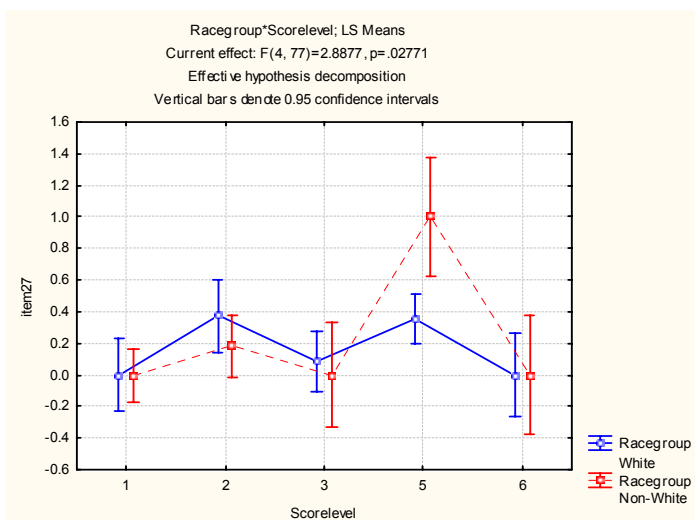| Effect	Univariate Tests of Significance for item23 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.32377	1	0.323766	1.91394	0.170524
Scorelevel					
Racegroup*Scorelevel	0.33978	4	0.084946	0.50216	0.734210
Error	13.02545	77	0.169162		

Effect	Univariate Tests of Significance for item24 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.17482	1	0.174819	1.16063	0.284698
Scorelevel					
Racegroup*Scorelevel	0.18086	4	0.045216	0.30019	0.876968
Error	11.59804	77	0.150624		

Effect	Univariate Tests of Significance for item25 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.00000	1	0.000000	0.00000	1.000000
Scorelevel					
Racegroup*Scorelevel	0.42030	4	0.105076	0.66037	0.621414
Error	12.25205	77	0.159118		

Effect	Univariate Tests of Significance for item26 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	2.41523	1	2.415227	14.72846	0.000253
Racegroup	0.15566	1	0.155662	0.94925	0.332960
Scorelevel	0.65415	4	0.163538	0.99728	0.414296
Racegroup*Scorelevel	0.27539	4	0.068848	0.41984	0.793853
Error	12.62674	77	0.163984		

Effect	Univariate Tests of Significance for item27 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.084077	1	0.084077	0.77901	0.380190
Scorelevel					
Racegroup*Scorelevel					
Error	8.310383	77	0.107927		

Racegroup*Scorelevel; LS Means
Current effect: F(4, 77)=2.8877, p=.02771
Effective hypothesis decomposition
Vertical bars denote 0.95 confidence intervals

Effect	Univariate Tests of Significance for item28 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.23502	1	0.235020	1.43152	0.235188
Scorelevel	1.24583	4	0.311458	1.89710	0.119442
Racegroup*Scorelevel	0.17994	4	0.044985	0.27401	0.893904
Error	12.64153	77	0.164176		

Effect	Univariate Tests of Significance for item29 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	0.677634	1	0.677634	7.374449	0.008164
Racegroup	0.037674	1	0.037674	0.409988	0.523876
Scorelevel	0.834635	4	0.208659	2.270759	0.069170
Racegroup*Scorelevel	0.027218	4	0.006805	0.074052	0.989850
Error	7.075490	77	0.091889		

Effect	Univariate Tests of Significance for item30 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	0.142892	1	0.142892	3.128496	0.080895
Racegroup	0.024189	1	0.024189	0.529599	0.468983
Scorelevel	0.238575	4	0.059644	1.305845	0.275334
Racegroup*Scorelevel	0.096264	4	0.024066	0.526905	0.716259
Error	3.516934	77	0.045674		

Detailed results by item for Visual Acuity Test

Item number	Uniform bias	In favour of group	Non-Uniform bias
1	No		No
2	No		No
3	No		No
4	No		No
5	No		No
6	No		No
7	No		No
8	No		No
9	No		No
10	No		No
11	No		No
12	No		No
13	No		No
14	No		No
15	No		No

No bias was found in any of the items.

	Univariate Tests of Significance for item1 Sigma-restricted parameterization Effective hypothesis decomposition				
Effect	SS	Degr. of Freedom	MS	F	p
Intercept	43.59779	1	43.59779	635.3014	0.000000
Racegroup	0.21750	1	0.21750	3.1694	0.078922
Scorelevel	4.39381	4	1.09845	16.0065	0.000000
Racegroup*Scorelevel	0.07415	4	0.01854	0.2701	0.896376
Error	5.35278	78	0.06863		

	Univariate Tests of Significance for item2 Sigma-restricted parameterization Effective hypothesis decomposition				
Effect	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.07852	1	0.07852	0.4283	0.514736
Scorelevel					
Racegroup*Scorelevel	0.26139	4	0.06535	0.3565	0.838777
Error	14.29802	78	0.18331		

	Univariate Tests of Significance for item3 Sigma-restricted parameterization Effective hypothesis decomposition				
Effect	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.41137	1	0.41137	2.2613	0.136682
Scorelevel					
Racegroup*Scorelevel	0.19421	4	0.04855	0.2669	0.898401
Error	14.18968	78	0.18192		

	Univariate Tests of Significance for item4 Sigma-restricted parameterization Effective hypothesis decomposition				
Effect	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.00146	1	0.00146	0.0136	0.907489
Scorelevel					
Racegroup*Scorelevel	0.51461	4	0.12865	1.1950	0.319712
Error	8.39762	78	0.10766		

Effect	Univariate Tests of Significance for item5 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	27.53202	1	27.53202	230.4810	0.000000
Racegroup	0.03906	1	0.03906	0.3270	0.569070
Scorelevel	7.38315	4	1.84579	15.4518	0.000000
Racegroup*Scorelevel	0.39361	4	0.09840	0.8238	0.513965
Error	9.31746	78	0.11945		

Effect	Univariate Tests of Significance for item6 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.00872	1	0.00872	0.0906	0.764229
Scorelevel					
Racegroup*Scorelevel	0.52244	4	0.13061	1.3563	0.256839
Error	7.51151	78	0.09630		

Effect	Univariate Tests of Significance for item7 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.00267	1	0.00267	0.0367	0.848525
Scorelevel					
Racegroup*Scorelevel	0.18133	4	0.04533	0.6243	0.646582
Error	5.66429	78	0.07262		

Effect	Univariate Tests of Significance for item8 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.11375	1	0.113750	0.71630	0.399949
Scorelevel					
Racegroup*Scorelevel	0.12075	4	0.030187	0.19009	0.942904
Error	12.38651	78	0.158801		

Effect	Univariate Tests of Significance for item9 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	4.23026	1	4.230261	32.52112	0.000000
Racegroup	0.02150	1	0.021503	0.16531	0.685430
Scorelevel	6.34513	4	1.586282	12.19491	0.000000
Racegroup*Scorelevel	0.54599	4	0.136498	1.04936	0.387357
Error	10.14603	78	0.130077		

Effect	Univariate Tests of Significance for item10 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.05079	1	0.050795	0.32616	0.569569
Scorelevel					
Racegroup*Scorelevel	0.33604	4	0.084011	0.53945	0.707173
Error	12.14722	78	0.155734		

Effect	Univariate Tests of Significance for item11 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.115910	1	0.115910	1.10770	0.295831
Scorelevel					
Racegroup*Scorelevel	0.534778	4	0.133695	1.27766	0.285974
Error	8.161905	78	0.104640		

Effect	Univariate Tests of Significance for item12 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.000080	1	0.000080	0.000684	0.979206
Scorelevel					
Racegroup*Scorelevel	0.100300	4	0.025075	0.215192	0.929254
Error	9.088889	78	0.116524		

Effect	Univariate Tests of Significance for item13 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	0.97783	1	0.977827	7.196947	0.008912
Racegroup	0.00615	1	0.006150	0.045262	0.832078
Scorelevel	1.96863	4	0.492157	3.622346	0.009246
Racegroup*Scorelevel	0.23471	4	0.058677	0.431869	0.785197
Error	10.59762	78	0.135867		

Effect	Univariate Tests of Significance for item14 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	0.007408	1	0.007408	0.215723	0.643612
Racegroup	0.007408	1	0.007408	0.215723	0.643612
Scorelevel	0.036731	4	0.009183	0.267401	0.898084
Racegroup*Scorelevel	0.036731	4	0.009183	0.267401	0.898084
Error	2.678571	78	0.034341		

Effect	Univariate Tests of Significance for item15 Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept					
Racegroup	0.054450	1	0.054450	0.560824	0.456181
Scorelevel	0.286772	4	0.071693	0.738418	0.568603
Racegroup*Scorelevel	0.114144	4	0.028536	0.293912	0.881099
Error	7.573016	78	0.097090		