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Jensen Effects and African/Coloured/Indian/White differences on Raven's Standard Progressive Matrices in South Africa

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Abstract

A test is made to determine whether various ethnic group differences on tests of cognitive performance in South Africa are like the Black/White differences in the United States in being positively associated with a tests' *g* loadings, where *g* is the general factor of intelligence. A non-parametric re-analysis is made of data from 1056 White, 1063 Indian, 778 mixed-race "Coloured," and 1093 Black 14 year olds on the Raven's Standard Progressive Matrices Test in South Africa, given without time limits by Owen (1992) [*Personality and Individual Differences, 13*, 149]. The new analyses showed that the more highly correlated an item was with *g*, the more it predicted the White/Indian/Coloured/African differences on the test (Spearman's rhos from 0.35 to 0.85; all $Ps < 0.01$). The effects remained regardless of which group *g* was extracted from. Understanding group differences around the world requires new research on the nature and nurture of *g*.

Keywords: IQ scores; *g*-Factor; Race differences

Black/White differences on cognitive performance tests in the United States are more pronounced on high *g*-loaded tests than they are on low *g*-loaded tests, *g* being the general factor of intelligence. Jensen (1980, p. 535) formally designated this view as "Spearman's hypothesis," because Spearman (1927, p. 379) was the first to suggest it. Subsequently, Osborne (1980) dubbed it the "Spearman–Jensen hypothesis" because it was Jensen who brought Spearman's hypothesis to widespread attention, and it was Jensen who did all the empirical work confirming it. More recently, to honor one of the great psychologists of our time, Rushton (1998) proposed that the term "Jensen Effect" be used whenever a significant correlation occurs between *g*-factor loadings and any variable, *X*; otherwise there is no name for this finding, only a long explanation of how

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the effect was achieved. Jensen Effects are not omnipresent and their absence can be as informative as their presence. For example, Rushton (1999) found that the Flynn Effect is not a Jensen Effect because the secular rise in IQ does not appear to be on *g*.

The Black/White difference on the *g*-factor is the best known of all the Jensen Effects. The reason Jensen pursued Spearman's (1927) hypothesis was because it so exquisitely solved a problem that had long perplexed him. Jensen had noted that the race differences were markedly smaller on tests of rote learning and short-term memory than they were on tests of abstract reasoning and transforming information. Moreover, culture-fair tests tended to give Blacks slightly lower scores than did more conventional tests, as typically did non-verbal tests compared with verbal tests. Furthermore, contrary to purely cultural explanations, race differences could be observed as early as 3 years of age, and controlling for socioeconomic level only reduced the race differences by four IQ points (Jensen, 1980, 1998).

After Jensen (1980) re-read Spearman, he realized that the Black/White differences were explained by the general hypothesis proposed by Spearman (1927, p. 379), namely that it "was most marked in just those [tests] which are known to be saturated with *g*." Jensen tested Spearman's hypothesis by first extracting the *g* factor from a variety of cognitive tests (a vector of scores, i.e. possessing both direction and quantity), and then relating these scores to the standardized mean Black/White differences on those same tests (a second vector of scores). It is worth emphasizing that Spearman's hypothesis concerns the *relative* magnitude of the group difference across various tests that differ in their *g* loadings and not the *absolute* magnitude of group differences. It is therefore conceptually independent of any secular trend in absolute test scores, viz. the Flynn (1999) Effect.

In The *g* factor (1998, chap. 11), Jensen summarized the results from 17 independent data sets of nearly 45,000 Blacks and 245,000 Whites derived from 171 psychometric tests in which g loadings consistently predicted the magnitude of the Black/White difference ($r = 0.63$; Spearman rho $= 0.71$, $P < 0.05$). Spearman's hypothesis was borne out even among 3 year olds administered eight sub-tests of the Stanford–Binet, where the rank correlation between *g* loadings and the Black/White differences was 0.71 ($P < 0.05$). Even when the *g* loading is calculated from performance on elementary reaction-time tasks which correlate with IQ (such as moving the hand to press a button to turn off a light, which all children can do in less than 1 s), the correlations between the *g* loadings of these tasks and the Black/White differences range from 0.70 to 0.81.

Subsequent studies of Black/White differences in *g* have come not only from the United States (Jensen, in press; Nyborg & Jensen, 2000), but also from the Netherlands (te Nijenhuis & van der Flier, 1997), and from South Africa (Lynn & Owen, 1994; Rushton, 2001; Rushton & Skuy, 2000). For example in South Africa, Rushton and Skuy (2000) gave untimed Raven's Standard Progressive Matrices to 309 17 to 23 year old first-year psychology students at the University of the Witwatersrand in Johannesburg. The 173 African students solved an average of 44 of the 60 problems whereas the 136 White students solved an average of 54 of the 60 problems ($P < 0.001$). There was no evidence of test bias because over 70% of the items were answered correctly by African students and the inter-item correlation matrices showed that the items "behaved" in the same way for both Africans and Whites. Nonetheless, by the standards of the 1993 United States normative sample, the African students scored at the 14th percentile and the White students scored at the 61st percentile, yielding IQ equivalents of 84 and 104, respectively.

Importantly, item analyses showed the race differences were mainly on *g*. Because the total score on the Raven's Test is generally considered to be an excellent measure of *g*, the correlation of each item with the test's total score (the item–total correlation) provides a good estimate of each item's *g* loading. The item *g*-loadings correlated positively and highly significantly with the differences in percentage of Africans and Whites passing the same items using both the African item–total correlations, $r = 0.39$ ($P < 0.01$, $N = 58$, with rho = 0.43, $P < 0.01$), and the White item-total correlations, $r = 0.34$ ($P < 0.01$, $N = 46$, rho = 0.41, $P < 0.01$). The results remained significant also after the African and White pass rates were normalized to standard scores before being subtracted from each other. Alternative ways of statistically correcting the percentile pass rates, such as the odds-ratio correction, or alternative item selection procedures, such as eliminating those items with higher than a 95% pass rate, did not alter the basic finding. Thus, African/White differences in these university students were on the *g*-factor and so demonstrate a Jensen Effect.

1. Data

The largest and most comprehensive study of ethnic differences carried out in South Africa to date, by Owen (1992), did not explicitly test Spearman's hypothesis but, when its results are re-analyzed, they provide very clear evidence of Jensen Effects. Owen (1992) gave the Raven's Standard Progressive Matrices Test without time limits to 1056 White, 1063 Indian, 778 mixed-race "Coloured," and 1093 Black 14 year olds. Out of 60 total items, Whites averaged 45 correct, Indians, 42, Coloureds, 37, and Blacks 28. Owen expressed these differences in S.D. units: White/Indian: −1.35; White/African: −0.52; White/Coloured: −2.78. He also presented a full psychometric profile showing that the test measured the same aptitude within each group. Importantly, the items that best measured the aptitude *within* each group (i.e. items with the largest item–total correlations, Table 1) were the ones that best measured the differences *between* groups (i.e. in percent passing, Table 2). These two quite independent item values correlated from 0.37 to 0.85

Table 1
Owen's (1992) item–total correlations for items of the Standard Progressive Matrices by ethnic group

Set A					Set B					Set C					Set D					Set E				
#	W	I	C	B	#	W	I	C	B	#	W	I	C	B	#	W	I	C	B	#	W	I	C	B
1	Practice example				13	0.18	0.21	0.23	0.23	25	0.33	0.40	0.40	0.50	37	0.25	0.40	0.52	0.61	49	0.36	0.39	0.47	0.47
2	0.03	0.06	0.08	0.13	14	0.23	0.19	0.28	0.37	26	0.26	0.39	0.53	0.49	38	0.35	0.46	0.59	0.67	50	0.48	0.45	0.37	0.36
3	0.09	0.14	0.21	0.24	15	0.26	0.48	0.52	0.63	27	0.31	0.46	0.47	0.65	39	0.38	0.41	0.53	0.62	51	0.47	0.47	0.36	0.37
4	0.10	0.09	0.23	0.24	16	0.28	0.41	0.54	0.54	28	0.35	0.37	0.48	0.54	40	0.39	0.41	0.58	0.65	52	0.55	0.58	0.39	0.27
5	0.09	0.10	0.28	0.25	17	0.33	0.50	0.50	0.56	29	0.37	0.44	0.57	0.63	41	0.37	0.43	0.57	0.67	53	0.55	0.56	0.40	0.24
6	0.04	0.17	0.28	0.29	18	0.25	0.48	0.44	0.56	30	0.33	0.45	0.49	0.56	42	0.36	0.46	0.62	0.64	54	0.48	0.42	0.35	0.25
7	0.14	0.41	0.49	0.61	19	0.27	0.37	0.44	0.50	31	0.41	0.57	0.53	0.61	43	0.38	0.41	0.45	0.58	55	0.35	0.34	0.19	0.21
8	0.14	0.31	0.27	0.28	20	0.36	0.49	0.48	0.61	32	0.31	0.41	0.33	0.46	44	0.37	0.44	0.42	0.49	56	0.42	0.45	0.29	0.10
9	0.20	0.35	0.38	0.49	21	0.35	0.47	0.51	0.60	33	0.31	0.43	0.44	0.55	45	0.44	0.46	0.43	0.49	57	0.41	0.37	0.25	0.15
10	0.20	0.41	0.51	0.54	22	0.40	0.52	0.59	0.65	34	0.42	0.40	0.29	0.40	46	0.54	0.54	0.43	0.43	58	0.29	0.24	0.04	0.04
11	0.20	0.48	0.47	0.51	23	0.39	0.50	0.50	0.58	35	0.30	0.34	0.28	0.26	47	0.22	0.20	0.12	0.12	59	0.09	0.06	−0.05	0.00
12	0.37	0.42	0.43	0.45	24	0.43	0.51	0.43	0.46	36	0.25	0.13	−0.03	−0.16	48	0.23	0.25	0.11	0.16	60	0.16	0.11	−0.01	−0.11

#, item number; W, White; I, Indian, C, Coloured; B, Black.

(all $Ps < 0.01$) across the four population groups, which Owen interpreted as indicating an absence of test bias.

A stronger conclusion may be warranted. Since the total score on the Raven's is an excellent measure of *g* (Jensen, 1980; Rushton & Skuy, 2000), each item's correlation with the total score is a good estimate of that item's *g* loading, which means that all the observed group differences on the items (viz. White/African, White/Coloured, White/Indian, Indian/African, Indian/Coloured, Coloured/African) are primarily on *g*. Nonetheless, because Owen had not standardized the *P*-values (percents passing) before subtracting the group differences on them (standardization being required under the assumption that each item is normally distributed), this extra inference can only be taken as tentative.

2. Results, analysis, and re-analysis

Following a suggestion by Arthur Jensen (personal communication, 31 May 2001), I carried out a purely non-parametric analysis of Owen's (1992) data to directly examine which of the group differences were on *g*. This nonparametric procedure circumvents the necessity for standardizing and is as follows: (1) all 240 of Owen's *P*-values (Table 2) were ranked along one continuous ranking (Table 3; each of the four groups' percent passing of each of the 60 items); (2) the African ranks were subtracted from the White ranks and the same operation performed for the other five comparisons; finally (3) Spearman's rho was calculated between each group's item–total correlations (Table 1) and the ranked item pass rates (Table 3). These results are shown in Table 4.

The analysis showed that the African item–total correlations (the items' g loadings) predicted the African/White differences in ranked item pass rates (rho = 0.85, $P < 0.01$) as did the White item–total correlations (rho = 0.41, $P < 0.01$). For all the comparisons between groups, Spearman's

Table 2
Proportion of 14 year olds selecting the correct answer on items of the Standard Progressive Matrices by ethnic group (From Owen, 1992)

Set A					Set B					Set C					Set D					Set E				
#	W	I	C	B	#	W	I	C	B	#	W	I	C	B	#	W	I	C	B	#	W	I	C	B
1	Practice example				13	0.98	0.98	0.99	0.96	25	0.97	0.91	0.97	0.80	37	0.98	0.93	0.96	0.78	49	0.79	0.52	0.71	0.32
2	0.99	0.99	0.99	0.99	14	0.99	0.96	0.98	0.89	26	0.96	0.87	0.94	0.72	38	0.96	0.86	0.94	0.64	50	0.77	0.36	0.66	0.22
3	0.99	0.98	0.99	0.97	15	0.98	0.91	0.95	0.75	27	0.95	0.85	0.94	0.71	39	0.94	0.81	0.90	0.58	51	0.67	0.43	0.60	0.20
4	0.99	0.98	0.99	0.96	16	0.97	0.87	0.89	0.57	28	0.86	0.71	0.80	0.51	40	0.89	0.76	0.87	0.47	52	0.60	0.28	0.46	0.13
5	0.99	0.98	0.99	0.95	17	0.95	0.78	0.84	0.45	29	0.93	0.84	0.91	0.55	41	0.95	0.86	0.93	0.61	53	0.64	0.25	0.46	0.10
6	0.99	0.98	0.99	0.95	18	0.88	0.72	0.81	0.49	30	0.85	0.67	0.74	0.46	42	0.90	0.72	0.86	0.42	54	0.51	0.24	0.36	0.11
7	0.98	0.87	0.90	0.65	19	0.76	0.64	0.74	0.45	31	0.89	0.67	0.80	0.40	43	0.79	0.60	0.70	0.35	55	0.38	0.23	0.34	0.15
8	0.95	0.87	0.91	0.83	20	0.81	0.61	0.74	0.32	32	0.64	0.44	0.50	0.29	44	0.77	0.60	0.69	0.36	56	0.37	0.13	0.25	0.07
9	0.99	0.93	0.95	0.80	21	0.85	0.61	0.79	0.40	33	0.78	0.65	0.82	0.40	45	0.73	0.50	0.62	0.31	57	0.34	0.14	0.25	0.10
10	0.96	0.82	0.87	0.67	22	0.95	0.74	0.88	0.45	34	0.53	0.32	0.45	0.20	46	0.78	0.47	0.68	0.26	58	0.14	0.05	0.10	0.04
11	0.90	0.75	0.79	0.52	23	0.82	0.57	0.76	0.32	35	0.42	0.22	0.39	0.18	47	0.22	0.17	0.24	0.11	59	0.06	0.05	0.05	0.06
12	0.72	0.48	0.53	0.33	24	0.64	0.41	0.58	0.21	36	0.10	0.03	0.05	0.07	48	0.15	0.09	0.11	0.05	60	0.09	0.06	0.09	0.08

#, item number; W, White; I, Indian; C, Coloured; B, Black.

Table 3
Owen's (1992) data from Table 2 expressed as ranked item pass rates across ethnic group, by ethnic group for Items of the Standard Progressive Matrices

Set A					Set B					Set C					Set D					Set E				
#	W	I	C	B	#	W	I	C	B	#	W	I	C	B	#	W	I	C	B	#	W	I	C	B
1	Practice example				13	16	1	16	30	25	26	26	54	90	37	16	30	50	98	49	94	118	151	186
2	1	1	1	1	14	1	16	30	62	26	30	46	68	114	38	30	46	74	131	50	102	128	179	200
3	1	1	16	26	15	16	37	54	107	27	37	46	78	118	39	46	58	87	144	51	124	140	169	204
4	1	1	16	30	16	26	62	68	146	28	74	90	118	153	40	62	68	104	159	52	140	161	192	212
5	1	1	16	37	17	37	81	98	164	29	50	54	81	148	41	37	50	74	137	53	131	161	194	217
6	1	1	16	37	18	66	87	114	157	30	78	109	124	161	42	58	74	114	170	54	153	179	197	214
7	16	58	68	129	19	104	109	131	164	31	62	90	124	173	43	94	121	140	182	55	177	183	199	208
8	37	54	68	83	20	87	109	137	186	32	131	155	168	191	44	102	122	140	179	56	178	194	212	225
9	1	37	50	90	21	78	94	137	173	33	98	84	129	173	45	113	136	155	190	57	183	194	210	217
10	30	68	84	124	22	37	66	109	164	34	149	164	186	204	46	98	123	159	193	58	210	217	230	235
11	58	94	107	151	23	84	104	146	186	35	170	176	200	206	47	200	197	207	214	59	227	230	230	227
12	114	149	158	185	24	131	144	172	203	36	217	230	236	225	48	208	214	221	230	60	221	221	227	224

#, item number; W, White; I, Indian; C, Coloured; B, Black.

Table 4
Spearman rank–order correlations (rhos) between item–total correlations and differences in ranked item pass rates

	Item–total correlations			
Differences in ranked item pass rates	White	Indian	Coloured	African
White/Indian	0.358	0.614	0.461	0.365
White/Coloured	0.573	0.811	0.659	0.570
White/African	0.410	0.732	0.902	0.846

All correlations significant ($P < 0.01$).

rho ranged from 0.36 to 0.85 (all P s < 0.01). Thus, the group differences clearly support Spearman's hypothesis; they *are* Jensen Effects.

3. Discussion

The main purpose of the current study was to test whether the African/Coloured/Indian/White differences on the Raven's Progressive Matrices test (whatever their absolute magnitude) were mainly on the *g*-factor. The correlation between item–total differences calculated from the African or any other ethnic group sample in Table 4, predicted the ranked pass rate differences in all the other groups. Thus, the take home message is that the African/Coloured/Indian/White test score difference on the Raven's is on the *g*-factor.

The data presented in this study provides the fourth independent demonstration from South Africa that ethnic differences in mean cognitive performance test scores are more pronounced on those items and sub-tests with the highest *g* loadings (following Lynn & Owen, 1994; Rushton, 2001; Rushton & Skuy, 2000). The effect is very robust. It shows that *g* is the same in South

Africa as it is in the United States (Jensen, 1998) and the Netherlands (te Nijenhuis & van der Flier, 1997). This is important to know because it supports the view that the main source of the varied population differences around the world on cognitive performance tests (Lynn & Vanhanen, 2002), is likely the same as that for the differences among individuals within each ethnic group, namely, Spearman's and Jensen's *g*.

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