Performance on Raven's Matrices by African and White University Students in South Africa

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Untimed Raven's Standard Progressive Matrices (SPM) were administered to 309 17- to 23-year-old students at the University of the Witwatersrand and the Rand Afrikaans University in Johannesburg, South Africa (173 Africans, 136 Whites; 205 women, 104 men). African students solved an average of 44 of the 60 problems whereas White students solved an average of 54 of the problems ($p < 0.001$). By the standards of the 1993 US normative sample, the African university students scored at the 14th percentile and the White university students scored at the 61st percentile (IQ equivalents of 84 and 104, respectively). The African–White differences were found to be greater on those items of the SPM with the highest item–total correlations, indicating a difference in *g*, or the general factor of intelligence. A small sex difference favoring males was found in both the African and the White samples, but unrelated to *g*.

For many psychologists, South Africa's transition to majority rule in 1994 and the concomitant dismantling of the "apartheid" system of "separate development" raised questions about whether Euro-American test norms were equally suitable for the nation's recognized population groups, namely "Africans," "Coloreds" (mixed-race), "Asians" (Indians), and "Whites." (In South Africa today, the term "Black" designates all those other than Whites, including Indians, Coloreds, and Africans; the term "African" is used to describe the indigenous habitants who comprise over 80% of the population). The discussion of test validity centered the on pragmatic problems of assessing cognitive impairment in African adults and children following motor vehicle accidents, selecting disadvantaged students for university admission, establishing baselines against which to evaluate interventions, and examining why the various groups differed in test performance (Hartshorne, 1992; Owen, 1998; Skuy, Zolezzi, Mentis, Fridjhon, & Cockcroft, 1996).

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Lower mean test scores are routinely obtained in African samples relative to Euro-American test norms. For example, Skuy, Schutte, Fridjohn, and O'Carroll (1999) found scores of 1–2 standard deviations (*SD*) below American norms in 154 African secondary school students from Johannesburg on a variety of tests including the Wechsler Intelligence Scale for Children-Revised (WISC-R), the Rey Auditory Verbal Learning Test, the Stroop Color Word Test, the Wisconsin Card Sorting Test, the Bender Gestalt Visual Motor Integration Test, the Rey Osterreith Complex Figure Test, the Trail Making Test, the Spatial Memory Task, and various Drawing Tasks. Thus, on the WISC-R, the African students were −1.81 *SD* below American norms (−1.58 *SD* with the vocabulary sub-test excluded).

The question of African test performance came to attention in the US when *The Bell Curve* (Herrnstein & Murray, 1994, pp. 288–289) examined an often stated hypothesis: "The test scores of American blacks have been depressed by the experience of slavery and African blacks will be found to do better (p. 565)." However, black Africans turned out to be, on average, substantially below black Americans in intelligence test scores. *The Bell Curve* cited Richard Lynn's (1991) review of 11 studies from East, West, and Southern Africa reporting an average IQ of 70 (median = 75), 15 points (1 *SD*) lower than the mean of 85 typically found for black Americans and 30 points (2 *SD*) lower than the mean of 100 typically found for Whites. The tests used included the Standard Progressive Matrices (SPM), the Colored Progressive Matrices (CPM, a simpler version of the SPM), the Army Beta, the Junior Aptitude, and the Culture Fair.

Lynn (1978) had earlier summarized seven other African studies, mainly on pupils using Raven's Matrices, and found average IQ equivalents ranging from 75 to 88 with a mean of 82. Lynn noted the difficulties of obtaining representative samples as well as accurate information on ages, both necessities for valid group comparisons. Despite inadequacies in many samples, Lynn reported the results are consistent. For example, scores do not vary when samples of Africans are selected in ways that will tend to bias the results upward—by limiting the sample to people who have completed primary school (many of the least academically able having dropped out), people who are employed, or people who live in urban areas.

Subsequent studies (some with quite large *N*s) have corroborated the low mean test scores of Africans Lynn reported. In South Africa, Owen (1992) gave the SPMs without time limits to 1,093 African, 778 Colored, 1,063 Indian, and 1,056 White 14-year-olds. Except for the Indians, subjects were tested by school psychologists of their own ethnic group. Owen (1992) presents the full psychometric profile for the test results (distributional characteristics, reliability, item difficulty, item discrimination, congruence coefficients, and discriminant analysis), showing that the test did measure the same construct in each of the various ethnic groups. He reported the differences in test means, expressed in *SD* units, as follows: White–Indian: −.52; White–Colored: −1.35; White–African: −2.78. Converting Owen's *SD* differences into IQ equivalents gives Africans an average IQ of 58 in relation to a mean for Whites of 100, and of 80 for Coloreds. A higher mean African IQ of 72 results if one uses the percentile equivalents from the SPM standardization data of British Whites instead of making the calculations using the noticeably small *SD* of the White South African sample in Owen's study.

Zindi (1994), a Zimbabwean, matched 204 black Zimbabwean and 202 white English pupils from London inner-city schools for age (12–14 years old), sex, and educational

level, both samples being characterized as "working class." Despite the fact that the white sample was below average for the Whites, with a mean IQ measured by the WISC-R of 95, the African–White difference was 1.07 *SD* on the SPM and 2.36 *SD* on the WISC-R. Zindi (1994) expressed the SPM results as IQ scores. The means for the Zimbabwean sample were 72 for the SPM and 67 for the WISC-R. The WISC-R score was depressed by language considerations, but not by much since the (nonverbal) performance IQ score of the Zimbabwean sample was 70.

Lynn (1997) reviewed five additional studies of African IQ scores published between 1985 and 1996. Mean IQs were in the range of 60–74. One study reported the results from a random sample of 1,639 adolescents in Ghana drawn from the entire country (Glewwe & Jacoby, 1992). Their mean age was 15.2 and their mean score on the CPM (the simpler version of the SPM) was 12.5, equivalent in British samples to an IQ of 60.

African–White differences are also found on simple reaction time (RT) measures. In one of these (the "odd-man-out" test), 9- to 12-year-old children are asked to decide which of several lights stands out from the others, and then press the button that corresponds to that light. The test is so easy that all children can perform it in less than 1 sec. But even on this very simple test, children with higher IQ scores perform faster than do children with lower IQ scores. Lynn (1991) found that Black children from South Africa average slower RTs than do White children from Britain and Ireland. Earlier, Poortinga (1971) had also shown African–White differences in South Africa on four- and eight-choice RT tasks for both auditory and visual stimuli. The magnitude of the mean African–White differences on these RT measures ranged from 1.26 to 1.53 *SD* (see Jensen, 1998, p. 392, for discussion of this study).

An exception to the pattern of low African test scores is a study by Crawford-Nutt (1976) who found that 228 African high school students from Johannesburg had a mean score equal to that for Whites. Crawford-Nutt (1976) used a special demonstration apparatus to administer the SPM to ensure complete understanding of the test requirements. The mean score for the African pupils was the same as the mean for the Raven's normative group. The author concluded that "[T]he frequently encountered poor performance of Blacks on tests of ability could be simply an artifact of the method of administering the test" (p. 205). Unfortunately, the author did not use a control group, which did not receive the special instructions. Whether the performance of Crawford-Nutt's testees is attributable to the special test instructions or to the fact that this particular high school attracts only the top students from feeder schools is not clear.

Only one previous study has reported mental test scores for African post-secondary students. Poortinga (1971) used the Advanced Progressive Matrices (APM, the more difficult version of the SPM) at a select college in South Africa. He found an IQ equivalent of 92. Although this score is 1.5 *SD* above the mean for Africans as a whole, it is also 2.2 *SD* below the mean for the white South African college students also tested in that study. Poortinga (1971) stated that the APM was too difficult for the African students. (On two other psychometric tests, the groups differed by 2.3 and 1.5 *SD*).

One South African study found African–White differences were most pronounced on *g*, the general factor of intelligence. Lynn and Owen (1994) examined scores of several thousand South African secondary school students on the 10 sub-tests of the Junior Aptitude Test (four verbal, six non-verbal). They found an overall African–White difference of 2 *SD*, with variation among the subtests correlating 0.62 ($p < 0.05$)

with the *g* factor as extracted from the African sample (although only 0.23 with *g* extracted from the White sample). This finer-grained observation is similar to those made in the US, where Black–White differences are typically greater on tests with higher *g*-loadings (Jensen, 1998).

The male–female difference in mean IQ is also a topic of current debate. Lynn (1999), in particular, has marshaled much evidence that supports a 2- to 5-point mean IQ difference favoring males, including on the SPM (although an earlier review by Court, 1983, failed to find a consistent sex difference on the Raven's). Lynn's results, however, have been challenged by Jensen (1998, pp. 536–542). The present study, therefore, examines the sex difference among both African and White university samples.

Method

Overview

The primary purpose was to examine performance on the Raven's SPM in a sample likely to score at least 1 *SD* above the general South African population mean. First-year psychology students from the University of the Witwatersrand (Wits) and the Rand Afrikaans University (RAU) in Johannesburg were invited to take part in an "international study" of the widely used SPM for which participants would be paid 50 rand (about US$10). At Wits, students of all races were invited to participate; at RAU only Africans were invited. Both universities require students to have graduated from high school (although lower pass scores may be accepted for disadvantaged students). To help obtain the data, the first author visited the University of the Witwatersrand in October of 1998.

Wits is a pre-eminent English-speaking research institution with a reputation for political liberalism, while RAU is an Afrikaans-speaking institution (Afrikaans being the Dutch-derived language of South Africa). Wits' policy since its inception (in 1922) has been not to discriminate on racial (or any other) grounds and Africans have always been at least a small part of the student body. African student enrollment at Wits was 8 percent in 1986, 13 percent in 1990, 23 percent in 1994, and 35 percent in 1997. The figures are higher for "Blacks" (i.e., all non-Whites grouped together): e.g., 36 percent in 1994 and 48 percent in 1997. When Africans enrol at RAU, their language of instruction is English.

Background

Historically in South Africa, Blacks and Whites have differed markedly in culture, language, politics, and history as well as average educational and socio-economic status. Only recently has there been an end to a century plus of discriminatory policies, including apartheid. Nonetheless, Black South Africans have achieved higher literacy rates than is typical elsewhere on the African continent and many South African Black university students are from middle-class homes. By 1986, the literacy rate reached about 60 percent with up to 80 percent of all Black children of school age (about 6 million) being in school. By 1993, Black children spent an average of 11 years enroled in school although the average attainment of all those leaving school was only 9th grade (Hartshorne, 1992; Macro-Economic Work Group, 1993). Currently, about 85 percent of South African children attend primary school. In South African schools, standardized examinations are

administered and a requirement for graduating from secondary school (mainly essays, with some multiple choice questions).

At the university level, until the late 1970s, African, Colored and Indian students could enrol only at those universities established for them, except for very small numbers at English language universities such as Wits. Most African students were enroled at one of five predominantly African universities such as Fort Hare and the University of Zululand, as well as the University of South Africa (UNISA), a teletuition university originating in Pretoria with students all over the world. Since South Africa's transition to majority rule in 1994, Blacks have been entering traditionally White universities in record numbers.

Subjects

To facilitate between-group comparisons, an initial pool of 392 subjects was reduced to 309 by eliminating ambiguous categories. There were 173 Africans (49 men, 124 women) and 136 Whites (55 men, 81 women) aged 17 to 23. Excluded were those who self-identified as ''Indians'' ($n = 30$), ''Coloreds'' ($n = 10$), ''Other'' ($n = 3$), those who listed their age as over 23 ($n = 33$), who failed to give biographical data, who placed their answers in an inappropriate place, or who left parts of the answer sheet blank ($n = 7$).

Test Instruments

Raven's SPM is probably the most well-known, most researched, and most widely used of all culture-reduced tests. Its popularity is evident from the fact that it has been used in well over 1,000 studies (Raven, Court, & Raven, 1996). As an untimed ''capacity'' test, and even as a 20-min ''speed'' or ''efficiency'' test, the results have been found to demonstrate reliability and validity across a wide range of populations. Retest reliabilities of 0.83–0.93 are found with an interval of approximately 1 year between administrations. Internal consistency coefficients of 0.80 are found across many cultural groups, including South African Blacks (Owen, 1992).

The SPM is usually regarded as a good measure of the non-verbal component of general intelligence not bound by culturally specific information. It was designed to measure Spearman's (1927) *g*, the general factor of intelligence, or at least the non-verbal component thereof. It is also described as a measure of ''the ability to identify relationships,'' ''analogical thinking,'' and the ability to ''think clearly'' (Raven et al., 1996, SPM 1). It consists of 60 diagrammatic puzzles, each with a missing part that the test taker attempts to identify from eight options. The 60 puzzles are divided into five sets (A, B, C, D, and E) of 12 items each. In each set, the first problem is as nearly self-evident as possible. The problems which follow build on the same reasoning as those that have gone before and provide opportunities to grasp the method of thought required to solve the problems, which become progressively more difficult. To ensure sustained interest and freedom from fatigue, each problem is boldly presented, accurately drawn, and, as far as possible, pleasing to look at. No time limit is set and all testees are allowed to complete the test.

Procedure

Testing was conducted by both of the authors and five MA research assistants, two of whom were African, in large examination halls with desks spaced well apart to prevent

copying from others. To ensure the diligence with which participants approached their tasks, the instructions requested students to wait quietly at their desks if they finished before 30 min. After 30 min, however, they could come to the front of the room, hand in their answer sheets and test booklets, and receive payment. A handful of students (all African) took the full time available. The SPM was administered without any time limits (up to 1.5 h), but was typically completed within 30 min.

RESULTS

Means, SD, and Internal Consistencies

All calculations are based on raw scores of the SPM, with each of the 60 items scored as 0 (incorrect) and 1 (correct). Internal consistencies based on Cronbach's alpha were .83 for White males, .73 for White females, .89 for African males, and .92 for African females. Table 1 shows the means (M) and SD of the various groups for each of the five sub-tests and for the full test. Fig. 1 shows the percentage of Africans and of Whites who attained various raw scores. The longer tail of low scores in the African distribution and the ceiling effect for both groups are clearly visible. The secondary peak of high scores for the Africans suggests a possible bimodal distribution.

Analysis of variance (ANOVA) with Race and Sex as factors showed significant main effects and a marginally significant interaction, $F(1,305) = 131.85$, $p < 0.001$; $F(1,305) = 8.89$, $p < 0.01$; and $F(1,305) = 3.67$, $p < 0.10$. Whites averaged higher scores than Africans (unweighted means = 54, 44; SD = 5, 9; Ranges = 42–60, 10–59, respectively); men averaged higher scores than women (unweighted means = 50, 47; SD = 7, 9; Ranges = 29–60, 10–60, respectively), and the sex difference was marginally greater among Africans than among Whites (Means 46, 42 vs. 54, 53). Expressed in terms of the White SD, the African–White differences for sets A to E were: 0.83, 2.01, 2.21, 1.36, and 2.07, respectively. For the total score the African–White difference was 1.2 SD (based on Black SD), and 2.6 SD (based on the White SD).

The 1993 US norms for 18- to 22-year-olds show that the White men, with 54 out of 60 correct responses, average at the 61st percentile; that the White women, with 53 correct responses, average at the 55th percentile; that the African men, with 46 correct responses, average at the 19th percentile; and the African women with 42 correct responses average at the 11th percentile (Raven et al., 1996, p. 65, Table SPM 12). These SPM grades and percentile points convert to IQ equivalents of 105 for White men, 102 for White women, 87 for African men, and 82 for African women (Raven et al., 1990, p. 98).

Item Difficulty Values (p)

Table 2 shows the proportion of each of the samples, which selected the correct answer on each of the 60 items. For all groups, set E was the most difficult, followed by sets C and D while sets A and B were the easiest. Across the 60 items, the difficulties were virtually identical for Africans and for Whites (Pearson's $r = 0.88$; $p < 0.001$; Spearman's rho = 0.90, $p < 0.001$).

Most of the SPM items were too easy for these university students. From Table 2, it is apparent that relatively few of the 60 items display p-values (proportion passing) within the optimal range of 0.30–0.70, which provides maximum discriminatory power;

Table 1. Mean and SD of Raw Scores of the Standard Progressive Matrices (and Subsets of Items) by Race and Sex

	African						*White*					
	Male (N = 49)		*Female (N = 124)*		*N-weighted Sex Combined (N = 173)*		*Male (N = 55)*		*Female (N = 81)*		*N-weighted Sex Combined (N = 136)*	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
A (Items 1–12)	11.37	1.11	10.94	1.49	11.06	1.40	11.62	1.16	11.82	0.45	11.74	0.82
B (Items 13–24)	10.86	1.57	9.80	2.48	10.10	2.30	11.60	0.66	11.52	0.76	11.55	0.72
C (Items 25–36)	9.43	1.85	8.04	2.39	8.43	2.33	11.16	0.92	10.72	1.21	10.90	1.12
D (Items 37–48)	9.67	1.70	8.98	2.38	9.17	2.23	10.62	1.16	10.56	0.94	10.58	1.03
E (Items 49–60)	4.98	3.14	4.40	2.64	4.56	2.79	9.44	2.57	8.93	1.92	9.13	2.21
Total	46.31	7.19	42.15	9.11	43.32	8.79	54.44	4.57	53.33	3.76	53.90	4.11

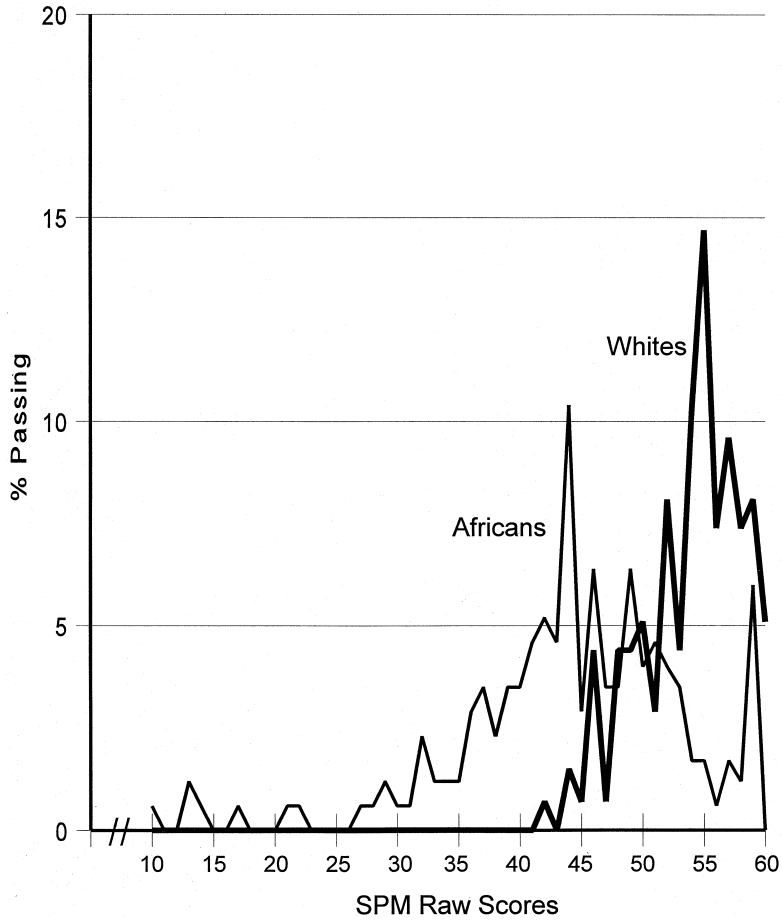

Figure 1. Percentage of African and White first-year psychology students in South Africa attaining various scores on the SPM.

there are only six such items for the White and 12 for the African testees. Using a proportion of 70 percent of respondents passing as the criterion for judging an item as "too easy," 54 of the 60 items (90%) proved as too easy for Whites and 41 of the 60 items (68%) too easy for Africans. None of the items was found to be "extremely difficult" ($p \leq .10$) by the Whites but items C12, E10, E11, and E12 were found to be so for the Africans. Overall, Africans found the items more difficult than did the Whites, as did women compared to men.

Item Discrimination Values (r_{it})

Another index for comparing items across groups is the item–total correlation (r_{it}). This is the correlation of each item with the total score on the test. It indicates the extent to which a particular item measures the construct that is measured by the test as a whole, as well as

Table 2. Proportion of Sample Selecting the Correct Answer on Items of the Standard Progressive Matrices by Race

Set A			*Set B*			*Set C*			*Set D*			*Set E*		
Item	*African*	*White*	*Item*	*African*	*White*	*Item*	*African*	*White*	*Item*	*African*	*White*	*Item*	*African*	*White*
1	1.00	1.00	13	0.99	0.99	25	0.94	1.00	37	0.96	1.00	49	0.77	0.89
2	1.00	1.00	14	0.98	1.00	26	0.91	1.00	38	0.94	0.99	50	0.68	0.98
3	0.99	1.00	15	0.96	1.00	27	0.92	1.00	39	0.93	0.98	51	0.64	0.93
4	0.98	1.00	16	0.90	1.00	28	0.86	0.93	40	0.89	0.97	52	0.47	0.91
5	0.97	0.98	17	0.90	0.99	29	0.88	1.00	41	0.92	1.00	53	0.50	0.96
6	0.98	0.99	18	0.86	0.99	30	0.73	0.94	42	0.87	0.99	54	0.39	0.87
7	0.94	0.99	19	0.74	0.90	31	0.86	0.99	43	0.79	0.94	55	0.38	0.76
8	0.90	0.98	20	0.77	0.91	32	0.46	0.87	44	0.80	0.95	56	0.23	0.79
9	0.96	0.99	21	0.83	0.97	33	0.72	0.87	45	0.79	0.92	57	0.25	0.79
10	0.92	0.99	22	0.85	1.00	34	0.55	0.86	46	0.73	0.95	58	0.11	0.52
11	0.82	0.95	23	0.76	0.93	35	0.46	0.86	47	0.33	0.48	59	0.06	0.35
12	0.60	0.87	24	0.56	0.86	36	0.13	0.57	48	0.21	0.43	60	0.08	0.38

how well the item discriminates among the testees within each group. These correlations are given in Table 3.

Jensen (1980, p. 445) pointed out that an ideal (i.e., unbiased) test has item–total correlations that are the same for each item when the two groups are compared. However, this rarely occurs in practice because of low reliability at the item level and the effect of marked group differences in item difficulties (as seen in Table 2). Ceiling effects, the result of extremely easy items (seen in Table 2), also cause low correlations because of restriction of variance among items.

Nonetheless, the item–total correlations in Table 3 do allow testing a hypothesis of considerable interest: If the test measures the same ability in the African and the White groups, then items that best measure ability *within* each group (i.e., those items with the largest item–total correlations) should also discriminate most *between* the groups. Difference in item difficulties between Africans and Whites were, therefore, correlated with the items' discrimination values for the total sample. The results support the hypothesis using either Pearson's ($r = 0.70$, $p < 0.01$) or, to ensure against scale artifacts, Spearman's rank–order correlation (rho = 0.72, $p < 0.01$). Those items that best measure individual differences *within* each ethnic group are the same items that most discriminate *between* ethnic groups.

Differences in *g*

The total score on the Raven's is a very good measure of *g*, the general factor of intelligence (Jensen, 1998, p. 38). Thus, the item–total correlation is an estimate of each item's *g* loading. This provides an opportunity to test whether African–White differences are more pronounced on the more *g* loaded items. The respective Pearson and Spearman correlations between African–White differences in percentage passing each item (Table 2) and the item–total correlations (Table 3) were: $r = 0.39$ ($p < 0.01$, $N = 58$) and rho = 0.43 ($p < 0.01$, $N = 58$) using the African item–total correlations; $r = 0.34$ ($p < 0.01$, $N = 46$) and rho = 0.41 ($p < 0.01$, $N = 46$) using the White item–total correlations. Sex differences, however, did not show up in *g*.

In the analyses reported above, the *N* varied because items with 100 percent pass rates were necessarily eliminated because item–total correlations could not be computed. Also, the African and White pass rates were first normalized to standard scores before being subtracted from each other. Alternative correction procedures, such as the odds-ratio correction for percentiles, where item $X = \log[\%/1-\%]$, or alternative item selection procedures such as eliminating those items with higher than a 95 percent pass rate, do not alter the basic finding. (Note that it would be incorrect to use the item–total correlations from the *combined* samples because these would reflect the *between*-groups variance in addition to the *within*-groups variance and so inflate the effect.)

Discussion

The difference in mean test scores of African and White, and of male and female university students in South Africa on the untimed SPMs corroborate the previously found group differences reviewed in the Introduction. With Africans and Whites averaging Raven's scores at the 14th and 61st percentiles, respectively, Whites average 1 to 2 *SD* higher than Africans. (The IQ equivalents are 84 and 105, respectively.) Men also averaged slightly higher than did women.

Table 3. Item–Total Correlations for Items of the Standard Progressive Matrices by Race

Set A			*Set B*			*Set C*			*Set D*			*Set E*		
Item	*African*	*White*	*Item*	*African*	*White*	*Item*	*African*	*White*	*Item*	*African*	*White*	*Item*	*African*	*White*
1	–	–	13	0.37	−0.02	25	0.48	–	37	0.31	–	49	0.38	0.31
2	–	–	14	0.46	–	26	0.31	–	38	0.51	−0.02	50	0.45	0.22
3	0.11	–	15	0.59	–	27	0.57	–	39	0.42	0.09	51	0.50	0.32
4	0.26	–	16	0.50	–	28	0.36	0.18	40	0.40	0.12	52	0.51	0.47
5	0.32	0.19	17	0.45	−0.02	29	0.51	–	41	0.60	–	53	0.54	0.37
6	0.27	0.17	18	0.40	0.01	30	0.50	0.25	42	0.42	0.24	54	0.41	0.58
7	0.44	0.18	19	0.44	0.29	31	0.52	0.12	43	0.45	0.19	55	0.33	0.43
8	0.27	0.11	20	0.51	0.18	32	0.48	0.43	44	0.54	0.21	56	0.49	0.50
9	0.44	0.17	21	0.46	0.12	33	0.50	0.26	45	0.49	0.08	57	0.35	0.51
10	0.44	0.17	22	0.56	–	34	0.53	0.33	46	0.57	0.32	58	0.15	0.57
11	0.51	0.25	23	0.56	0.21	35	0.40	0.45	47	0.33	0.48	59	0.21	0.44
12	0.40	0.47	24	0.51	0.35	36	0.31	0.43	48	0.36	0.34	60	0.48	0.55

Note: Hyphen indicates that correlation could not be computed because of lack of variance on item (see Table 2).

Black South African university students are a highly selected population. They have passed standardized school matriculation exams, entered university, and been chosen for a first-year course in Psychology on the basis of academic performance. Assuming that these students are 1 *SD* above the population mean, the results are in accord with earlier work finding that Africans, in general, average a tested IQ of 70.

A very wide range of interpretations, however, is possible for these results. Interpreting them in terms of external IQ norms will carry little conviction for most readers. It is difficult to believe that ''true'' scores at the 14th percentile on the Raven's (with an IQ equivalent of 84) will allow entry to a select university. Can the African students' motivation to succeed academically override their apparently low scores? Or is their Raven performance, unlike other groups, for some reason unconnected with their academic achievement?

A very important point in testing is that test takers should be sufficiently similar in cultural, educational, and social background to those on whom the test has been standardized and the test norms based. If the testee or group differs markedly from the standardization sample, the use of the norms may be inappropriate. Although the 1993 US standardization sample (Raven et al., 1996) included a representative sample of black Americans (i.e., African-Americans), the social context of Blacks in Africa is obviously very different from that in the US. Although there have been centuries of discriminatory practices in both countries, the apartheid system imposed on the majority population in South Africa, along with confinement to ''tribal'' areas, has been different in kind from the legacy of slavery of the minority population in the US.

Another problem in applying the test norms pertains to the White students. There is a lack of fine discriminative power at the upper end of the SPM distribution where the difference in raw score between percentiles is small (a ''ceiling effect''). For 18- to 22-year-olds, the difference between the 61st and the 100th percentile is only six correct answers, or 6 percentile points per 1 SPM score point. Thus, the mean IQ of 105 for White university students in this study is likely an underestimate. Arthur Jensen (personal communication, July 29, 1999) reports that University of California, Berkeley undergraduates, an elite US sample, averages 55 out of 60 items correct on the SPM (*SD* of 2). This places them at the 68th percentile with an IQ equivalent of 107 (Raven et al., 1990, p. 98), very similar to the White South African students. But they, and other White students at good universities in North America, typically have average IQs of about 115 on other IQ tests (e.g., Rushton, 1992).

Rough-hewn though these results may be, they show population differences in accord with earlier findings (reviews in Jensen, 1998; Lynn, 1997; Rushton, 1995). Further, items found easy or difficult by Africans were the same ones found easy or difficult by Whites, showing that the test measured the same construct in both groups. Since nearly 70 percent of the items were ''easy'' for the African students (who averaged 44 correct out of the 60 problems), they can perform the required operations. The item difficulties and inter-item correlations show that the items that best measure individual differences within each ethnic group are the same items that best differentiate between the ethnic groups. Whatever the cause of the substantial mean African–White differences, the systematic relationship found between the difficulty of an item for Africans relative to its difficulty for Whites, and that item's discrimination value within these groups, does not support the view that differences between the groups are caused by biased test instruments.

The African–White IQ differences were greatest on those items correlating most highly with the total test score, a good measure of *g*. This is the second demonstration of this effect in an African population, following Lynn and Owen's (1994) study of South African secondary school students using the Junior Aptitude Battery. Thus, the effect seems robust. One implication may be that the causes of African–White differences are similar to those for the Black–White difference in the US (Jensen, 1998; Rushton, 1995).

However, Olson (1986) argued that much of the supposed "culture fairness" of the non-verbal SPM is illusory and that it requires the same analytical rules, rules for analysis, coding, and transforming relationships as are required for analysis of verbal content. Associated with this interpretation is the view that African languages and black cultures are more "wholistic," and so not encouraging of the kind of thinking prevalent in Western cultures. Seen from this perspective, Raven's scores do reflect culture specifics. More generally, Sowell (1994) has observed a preference for spontaneity and improvization over abstract thinking in Black cultures throughout the world, from indigenous West African ancestors to their descendants in modern Brazil, the Caribbean, and the US. He argues that black cultural patterns are deeply rooted and transmitted in subtle ways. One can also posit the deleterious effects of the apartheid system's century plus of institutional discrimination.

All the above interpretations view the low African scores as a valid measure of the current level of abstract ability of the population, perhaps resulting from the adverse effects of discrimination. Even now, South African Blacks have greater unemployment, poorer schools, libraries, and study facilities than do Whites. They live in overcrowded homes, often with no running water or electricity, and have poorer nutrition. Thus, Africans may have had less exposure or stimulation to the constructs measured on IQ tests, and therefore, their poor performance is the result of specific cognitive deficiencies.

Such cognitive deficits have been remedied by intervention techniques. For example, some evidence from South Africa suggests that "dynamic mediation" with the Learning Propensity Assessment Device (LPAD; Feuerstein, 1980) has improved the performance of Black secondary school students on Raven's SPM. A study by Skuy and Shmukler (1987) found that following such mediation, at least under certain conditions, the skills learned were generalized to improved performance on the Raven's test. Skuy, Hoffenberg, Visser, and Fridjhon (1990) found generalized improvements on the Raven's for those individuals with what was termed a "facilitative temperament."

Rather than abandoning standardized testing in South Africa as "racist," research should be conducted even more intensively. A useful first step is developing educational programs to identify, nurture, and recognize more of the talents of more of the pupils. This requires obtaining normalized distributions for the African population on existing tests and developing new tests, including those of social intelligence. Experimental treatments such as teaching problem-solving techniques and assessing the effectiveness of mediation (e.g., as defined by Feuerstein, 1980), as well as providing vitamin and mineral supplements to enhance cognitive functioning, should be examined. (There is evidence that vitamin–mineral supplements can add necessary trace elements to the brain in those who may have been deprived of them and so improve test scores; Eysenck & Schoenthaler, 1997.) Examining these questions will tell us a lot, not just about group differences, but about the nature and nurture of intelligence as well.

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