IQ Differences between Arts and Science Students at the University of Khartoum

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1001 first year students at the University of Khartoum were tested with the Standard Progressive Matrices (SPM) in 2008. The mean score was 44.2. This is equivalent to the 10th percentile of the British standardization sample of 1992. There were considerable differences in the IQs of the Khartoum students in different departments. Engineering and medical students obtained the highest IQs, and primary education students the lowest.

Key Words: Intelligence; Progressive Matrices; Sudan; University students; Gender differences.

From the 1920s to the present, intelligence tests have been administered in numerous countries throughout the world. The results of more than 500 of these studies have been reviewed in Lynn (2006) and show that average IQs are lower in economically developing countries of South Asia, Africa and Latin America than in the economically developed countries of North America, Europe, Japan, Australia and New Zealand. It has been argued that these IQ differences have contributed to the differences in economic development, and reciprocally, the differences in economic development have contributed to the differences in IQ, by a positive feedback process (Lynn & Vanhanen, 2002, 2006).

Most studies of intelligence in economically developing countries have been based on general population samples. These studies are open to the criticism that these samples have had less education and poorer education than samples in the economically developed countries, and these educational disadvantages could be wholly or partly

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responsible for the low IQs obtained in the economically developing countries. One way to meet this criticism is to examine the IQs obtained by university students in economically developing countries. University students have normally experienced some 12 years of school education, are fully literate and numerate, and are experienced in taking tests, although it is difficult to ascertain the quality of education in less developed countries. Nevertheless, if the low IQs obtained by general population samples in economically developing countries are biased because of poor education, we can expect that this bias would be very much reduced in university students and that these would obtain IQs much closer to comparable samples of university students in the economically developed countries. In this paper we examine this question for a sample of university students in Sudan.

The test used in the study is the Standard Progressive Matrices (SPM). Three studies have reported IQs of Sudanese general population samples on this test, and one study has used the Colored Progressive Matrices (CPM - an easier version of the test). The results of these are summarized in Table 1. The average IQ obtained in the four studies is 78.5. We now report the results of the IQ of a sample of students at the University of Khartoum.

Method and Results

The total number of first year students at the University of Khartoum in 2008 was 4344. A sample of 1001 were tested with the Standard Progressive Matrices (SPM) in 2008. This sample consisted of students in the five departments whose students obtained the highest scores in the examinations taken for admission to the university (engineering, medicine, dentistry, pharmacy and business administration) and the five departments whose students obtained the lowest scores in the examinations taken for admission to the university (general health, agriculture, forestry, nutrition and primary education).

Table 1. IQs on the SPM and CPM of general population samples in Sudan

Age	N	Test	IQ	Reference
8–12	148	SPM	75	Ahmed, 1989
6-9	1683	CPM	81	Khatib et al., 2006
9-25	6202	SPM	79	Khaleefa et al., 2008
9	3185	SPM	79	Irwing et al., 2008

Table 2. Scores on the Standard Progressive Matrices (SPM), educational achievement and creativity of students at the University of Khartoum. Mean ± standard deviation is shown.

Department	N	Creativity	Educational Achievement	SPM
Electrical Engineering	46	44.3 ± 18.9	94.0 ± 2.1	55.1 ± 8.9
Medicine	177	42.4 ± 17.3	93.2 ± 1.6	53.6 ± 4.6
Dentistry	47	40.2 ± 21.5	90.9 ± 4.0	50.0 ± 7.2
Pharmacy	79	36.6 ± 21.0	90.4 ± 10.6	48.6 ± 9.4
Business Administration	118	23.4 ± 19.2	87.4 ± 1.9	44.0 ± 9.4
Forestry	31	29.3 ± 20.6	73.9 ± 2.1	43.3 ± 22.8
Health	91	34.0 ± 18.2	80.2 ± 2.3	43.0 ± 9.7
Nutrition	81	38.8 ± 20.4	71.5 ± 2.1	42.7 ± 7.9
Agriculture	206	44.0 ± 23.8	75.9 ± 7.9	41.3 ± 11.5
Primary Education	125	22.3 ± 14.8	71.9 ± 7.4	28.2 ± 10.5

Table 3. Scores on the SPM of students in different departments at the University of Khartoum, United States percentile equivalents, United States IQs, and United States GRE scores

Department	N	SPM score	US %ile	US IQ	US GRE
Electrical Engineering	46	55.1	68	107	603
Medicine	177	53.6	58	103	-
Dentistry	47	50.0	41	96.5	-
Pharmacy	79	48.6	34	94	-
Business Admin	118	44.0	14	84	523
Forestry	31	43.3	13	83	-
Health	91	43.0	12	82.5	541
Nutrition	81	42.7	12	82.5	-
Agriculture	206	41.3	10	81	562
Primary Education	125	28.2	1	65	518

The Standard Progressive Matrices (SPM) is a test of non-verbal reasoning ability that has been used in three studies of general population samples in Sudan shown in Table 1, and that has been used extensively for the measurement of intelligence in many countries reviewed in Lynn & Vanhanen (2006) and Lynn (2006). The test is considered to be an excellent measure of intelligence, reasoning ability and, more specifically, of *g*, the general factor present in all cognitive tasks first identified by Spearman (1904) (Jensen, 1998; McGrew & Flanagan, 1998).

The students were aged between 16 and 19 years. Their mean score on the SPM was 44.2. This is equivalent to the 14.4^{th} percentile of the American standardization sample of 1993, and is equivalent to an American IQ of 84. On the British standardization sample of 1992, the score is equivalent to the 10^{th} percentile, and is equivalent to an IQ of 81 (Raven et al, 1998). The British standardization sample obtained an IQ approximately 2 points higher than the American standardization sample, because the American standardization sample contained substantial numbers of ethnic minorities whose IQs are generally lower than those of European Americans. No Flynn effect adjustment is made to the mean British IQ of 81 because there has been no increase in intelligence measured by the SPM in Britain between 1979 and 2008 among those aged 13.5 years and over (Lynn, 2009). The mean SPM scores of students in the 10 university departments are shown in Table 2. The male students (n=300) obtained a mean score of 46.1 (SD = 10.7) and the female students (n=701) obtained a mean score of 43.6 (SD = 11.6). The IQ equivalents are 87 and 83. The difference is statistically significant at $p< 0.002$ ($t= 3.182$).

The students were also given tests of educational achievement and creativity. The results of these are also shown in Table 2. The tests of educational achievement consist of examinations for a number of academic subjects

(sciences and arts) designed by the Ministry of General Education for the admission to Sudanese universities. The scores given in Table 2 are the average percentages obtained in these examinations. The test of creativity is the circles test in the Torrance (1966) Tests of Creative Thinking.

The American IQs of students in the ten departments at the University of Khartoum are shown in Table 3. These IQs are derived by first obtaining the American percentile equivalents of the University of Khartoum students (given in column 4), and then obtaining the American IQ equivalents of the percentiles (given in column 5).

It will be seen that there are considerable differences in the IQs of students in different departments, ranging from 107 for students in electrical engineering to 81 for students in agriculture and 65 for students in primary education. It may be interesting to compare the SPM scores obtained by students in these different departments in Khartoum with similar data for college students in different departments in the United States reported by Templer & Arikawa (2006). The American data consist of scores on the analytic test of the Graduate Record Examination (GRE) obtained by over 1 million students applying to graduate schools in the years 1994-1997. The analytic test is a non-verbal reasoning test measuring the same ability as the SPM. The American data are given in the right hand column of Table 3. The standard deviation of the GRE analytic test is 130. For the American data the score given for engineering is the average of material, chemical, mechanical, civil, industrial and other engineering. The score given for primary education is the average of elementary and early child education.

Discussion

The results contain five points of interest. First, the British IQ of 81 of students at the University of Khartoum obtained in this study is only a little higher than the average IQ of 78.5 obtained in the four general population studies whose results

are summarized in Table 1. This may seem a rather small difference but is about what would be expected on the basis of studies of American and European university students. The median IQ of these in 16 samples is 105, only 5 points higher than the average IQ of 100 of the general population (Lynn, 2006, p.25). The more general interest of the present result is that it shows that university students who have had some 12 years of schooling and are fully literate and numerate obtain an average IQ only marginally higher than that of general population samples.

Second, the male students at the University of Khartoum obtained a higher average IQ than the females by 4 points. This is closely similar to the male advantage of 4.6 IQ points found in the meta-analysis of 22 studies of sex differences in university students by Irwing & Lynn (2005), and the male advantage of 5 IQ points found in the meta-analysis of general population samples found by Lynn & Irwing (2004). These meta-analyses were based on studies in economically developed countries. The present result shows a similar sex difference in an economically developing country. This suggests that a male advantage on this test is a universal phenomenon, and is a further refutation of the assertion made by Mackintosh (1996, p.564) that "large scale studies of Raven's tests have yielded all possible outcomes, male superiority, female superiority and no difference", from which he concluded that "there appears to be no sex difference in general intelligence" (Mackintosh (1998, p.189).

Third, there are considerable differences in the University of Khartoum students between the IQs of students in the different departments. The IQ of 107 of the Khartoum engineering students is fractionally higher than that of European university students, but the IQ of 65 of the Khartoum primary education students is a lot lower. The main reason for this difference is that Khartoum engineering students (and also medical students) are highly selected on

the basis of their performance in the entrance examination to the university. The engineering and medical departments require higher performance in the entrance examination, than the other departments. Based on the low IQs of the primary education students, we can surmise that the quality of primary education is not high in the Sudan, and that this contributes to the unimpressive average IQ scores that are found in general population samples in this country (see Table 1).

Fourth, the IQ differences between students in different departments in Khartoum are broadly similar to those in the United States shown in Table 3. In both countries, engineering students obtain the highest IQs and primary education students obtain the lowest IQs, while students of business administration, health, and agriculture obtain intermediate scores. In the United States, the IQ of engineering students is 0.66*d* (SD units) (approximately 10 IQ points) higher than that of primary education students. However, the difference in Khartoum of 42 IQ points between engineering students and primary education students is much greater. The principal explanation for these differences in the United States is the same as that in Sudan, i.e. that engineering (and science) departments require higher IQs for admission. A more fundamental reason for these IQ differences between students in different departments is that there is greater demand to enter departments of engineering, medicine and dentistry because these professions are more financially rewarding and carry greater prestige than primary education, agriculture, nutrition, health, etc. Hence, departments of engineering, medicine, and dentistry can be more selective in the students they accept.

Fifth, the different creativity scores obtained by students in different departments in Khartoum are broadly similar to the IQ differences. The highest creativity scores are obtained by students in the departments of engineering, medicine and

dentistry (and also agriculture), and the lowest scores are obtained by students in the department of primary education. Probably the explanation for this is that creativity is correlated with intelligence, or is a component of intelligence, as shown by Carroll (1993, pp. 423-9).

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