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A Study of Intelligence in the State of Ash Shamaliyah, Sudan

Salaheldin Farah Attallah Bakhiet*
King Saud University, Riyadh, Saudi Arabia

David Becker
Chemnitz University of Technology, Chemnitz, Germany

Salaheldin Abdelrahman Elrasheed Seed Ahmed
Gharb Alneel College, Omdurman, Sudan

Richard Lynn
Ulster Institute for Social Research, London, UK

*Corresponding author: bakhiet@ksu.edu.sa

Data are reported for the intelligence of a sample of 500 schoolchildren 9 through 13 years old assessed with the Standard Progressive Matrices in Sudan's most northerly state of Ash Shamaliyah. The sample obtained a British-scaled IQ of 67 to 68, which is low compared to the scores previously determined for this country but close to scores typically found in its southern part. The age-related increase in cognitive test scores is relatively fast, even compared to the British norm sample, and indicates a different pattern than other studies from the Arabic world. However, this finding is limited by the short age span.
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Sudan is an ethnically diverse country. The principal people in the south are Nilotic shown in a genetic analysis by Cavalli-Sforza, Menozzi and Piazza (1994, Figure 3.9.1, p. 181). Nilotics have been considered one of the four sub-races of Negroids (Baker, 1974, p. 329). The people in the north are a mixed race population consisting of North African Caucasoids, with some admixture of sub-

Saharan Negroid peoples from the south and west, and with mixed race Arabic and Negroid peoples from Eritrea and Ethiopia from the east. Thus, "The northern provinces are Moslem and Arabic speaking. Though commonly called Arabs, the people are of mixed origin — Arab and Hamite, Hamite and Negro and, above all, Arab and Negro, the contrast is complete between the sophisticated Arabs and Arabicized Negroes of the north and the naked black-skinned peoples of the southern provinces" (K.C.B. 1960, p. 512-3).

It would be expected that intelligence in the south of Sudan would be lower than in the north because it has been shown in numerous studies that the average British-scaled IQ of Negroids in Africa is approximately 71 while the average British IQ of North Africans is approximately 83 (Lynn, 2015). This expectation was confirmed in a study of IQs assessed by the WISC-III in seven states of Sudan reporting a British IQ of 64 in the most southerly state of Darfur and IQs between 72.9 and 83.4 (averaging 76.4) for the six more northerly states (Bakhiet & Lynn, 2015). However, for the six more northerly states there was no association between latitude and IQ. In the most northerly state of Ash Shamaliyah (Arabic: Aš Šamāliya) the IQ was 79.1. Here we present a further study of intelligence in the state of Ash Shamaliyah.

Method

The data were presented in a study published in Arabic by Abdelradi and Al-Ajeel (2013). All numbers for age, *N* and raw scores presented in this paper are directly drawn from this source. The sample consisted of 100 children from each of the five age groups 9 through 13 years in the state of Ash Shamaliyah. The children were selected by the cluster sampling method. The first step was to select at random the Debba municipality that contains the three regions of Bebba, Altadamon and Algaba, from which Algaba was randomly selected. Male and female children were selected randomly from Algaba. The children were tested in classrooms in their schools. Intelligence was assessed with the Standard Progressive Matrices, a non-verbal matrix test that has been used in numerous studies for the assessment of intelligence throughout the world reviewed in Lynn and Vanhanen (2012). The results obtained with this test world-wide are included in Becker, 2019.

The Standard Progressive Matrices (SPM), the version of the test used in the study, was standardized in Britain in 1979 and these norms, reported in norm tables, were used to convert raw to IQ scores (Raven, 1981, Table RS1.10). As a second, parallel method, we used conversion formulas from Lynn and Becker (2019, Table 9), which have been described as producing smoother results, especially in lower percentile levels. The comparison between the two results can

also be considered as another test of the validity of these conversion formulas.

Both methods are based on the same British norms which are nearly 40 years out of date. For this reason, a correction in IQ scores to compensate norm inflation was necessary. Pietschnig and Voracek (2015) estimated an annual change in fluid intelligence in the United Kingdom between 1932 and 2008 of +0.21. In sum, for the time span of 29 years between the standardization in 1979 and the administration of the SPM on the sample reported here (after 2008), the necessary correction of -6.09 IQ points has to be made.

Results

According to the 1979 norm table in the Raven's manual, raw scores of separated age groups are equivalent to the following British percentiles: for 9 years olds the British percentile is the 3rd, for 10 and 12 year olds it is the 6th, for 11 years olds it is the 2nd and for 13 years olds it is the 5th. In a normal distribution with a mean of 100 and one standard deviation equivalent to 15, the 3rd percentile is equivalent to an IQ of 71.8, the 6th percentile is equivalent to an IQ of 76.7, the 2nd percentile is equivalent to an IQ of 69.2 and the 5th percentile is equivalent to an IQ of 75.3. The corrected IQ scores (-6.1 for norm inflation) are presented in Table 1, column M_{IQ1}. Column M_{IQ2} reported the IQ scores calculated via conversion formulas and corrected for norm inflation. The column to the right shows that the results of both methods differ by up to 2.58 IQ points, with a mean difference of 1.75.

Table 1. *Standard Progressive Matrices scores of children in North Sudan.*

(Sub-)samples		SPM raw scores				IQ scores		
Age	***N***	***M***	***LL***	***UL***	***SD***	M_{IQ1}	M_{IQ2}	$\Delta_{IQ1\text{-}IQ2}$
9	100	14.1	4	36	6.3	65.7	67.8	-2.1
10	100	18.2	4	43	8.6	70.6	68.0	2.6
11	100	21.2	4	49	9.8	63.1	63.4	-0.3
12	100	27.9	3	48	9.9	70.6	69.1	1.5
13	100	27.4	6	48	10.3	69.2	67.0	2.2
Total	500	21.75	4.2	44.8	9.1	67.84	67.06	1.75*

Notes: IQ1 estimated by norm tables from the SPM manual; IQ2 estimated by conversion formulas from the NIQ-Dataset (V1.3.1); for the total sample: *SD* is pooled; LL and UL are lower and upper limits of the score range; maximal possible raw score is 60; *calculated as the mean of absolute differences.

Table 2 compares the annual increases of raw scores in the British norm sample with those in the Sudanese sample from the current study and four additional samples from the same country and decade, also tested with the SPM. Fig. 1 describes these trends as second degree polynomials. The overall picture shows stronger increase of raw scores in the first half of the age range than in the second half and is therefore similar to the British norms. However, the sample from this study represents an irregularity since it shows the strongest annual increase from age 11 to 12. The overall increase from 9 to 13 is 13.36 for the sample from this study, which is 1.86 higher that the British norm sample and also higher than the majority of the other samples from Sudan, except the sample from Dutton et al. (2017). The last row gives the mean annual changes in raw scores for the age range observed. It is stronger in this study with +3.34 compared to the British norm sample with +2.88 and three of four samples from Sudan. Again, only the one from Dutton et al. (2017) surpasses it with +4.43. So, cognitive development can be faster in Sudan than in Britain in the age range observed.

Table 2. *Cognitive development measured as Raven raw scores compared between the British norm sample, the present sample of children in North Sudan, and other Sudanese samples.*

Age shift	Changes in SPM raw scores					
	British norm sample (1979)	North Sudan sample	Batterjee & Ashria (2015) general	Batterjee & Ashria (2015) comparison	Dutton et al. (2017)	Khaleefa et al. (2010)
9-10	+6.0	+4.2	-0.4	+9.1	+10.6	+0.8
10-11	+2.0	+2.9	+6.2	+1.4	+2.0	+2.8
11-12	+1.0	+6.7	+0.5	+0.4	+3.5	+0.1
12-13	+2.5	-0.4	+0.8	+1.9	+1.6	-3.5
9-13	+11.50	+13.36	+7.10	+12.80	+17.70	+0.23
Mean annual	+2.88	+3.34	+1.78	+3.20	+4.43	+0.06

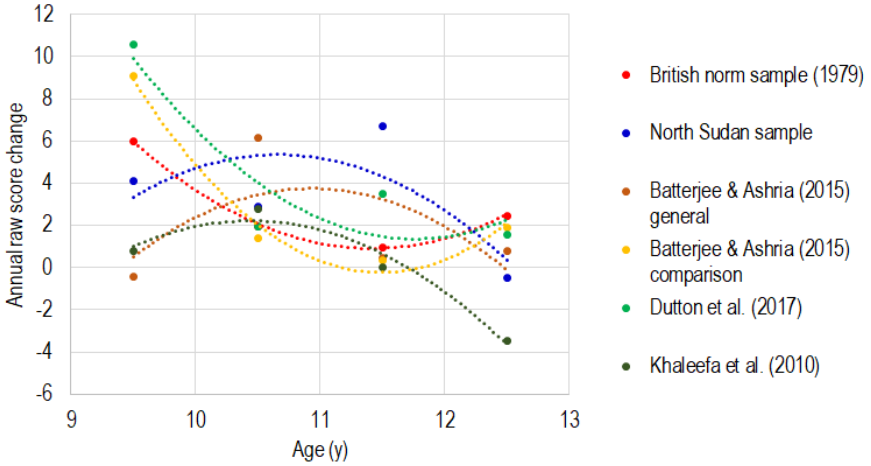

Fig 1. *Age-related changes of Raven raw scores compared between British norm sample, our sample of children in North Sudan, and other Sudanese samples as second-degree polynomials.*

Discussion

The relatively strong annual increases found could be interpreted as contrary to the phenomenon called Simber-Effect by Bakhiet et al. (2018), which describes an age-related decrease of British-scaled IQ due to a slower increase in raw scores in Arab countries than in Britain. However, the age span in the sample from Abdelradi and Al-Ajeel (2013) only covers a small part of the children's cognitive development, from age 9 to 13. While the delay Bakhiet et al. (2018) found in Arab countries was evident between 4 and 10 years of age, IQs seemed to follow overall a U-shaped trend and therefore a stabilization or even an increase from the age of 10 in the observed samples, which is congruent with our findings.

The average IQs, scaled using British 1979 norms, are far below the IQ of 79.1 obtained for the WISC-III for Ash Shamaliyah reported by Bakhiet and Lynn (2015) and also below the IQ of 77.5 for Sudan given by Lynn and Vanhanen (2012) in their compilation of IQs for all nations in the world. The NIQ-dataset (V1.3.3) from Becker (2018) reported mean IQs for the Sudan of 77.30 to 78.87 ($N_{samples}$ = 19; SD = 6.27), which are close to those from Lynn and Vanhanen and therefore also higher than the current findings. Since both methods used for raw to IQ score conversions in our study resulted in comparable scores, we consider a methodological error in the investigation to be less likely.

However, our results also contradict the Human Development Index. At national level, this index has a strong positive correlation with IQ (Becker & Rindermann, 2016; Lynn & Becker, 2019; Lynn & Vanhanen, 2006). The same pattern is expected at the level of provinces within large countries. But with .518 to .618 Ash Shamaliyah shows the second highest HDI of all Sudanese federal states during the last 12 years (2006 to 2017), just behind the capital Khartoum with .572 to .621 in the same time span (Global Data Lab, 2013-2019).

The sample observed here, along with other samples from Sudan, shows a fundamental problem in the application of IQ tests for cross-national comparisons. Whenever the annual changes in raw scores in a certain country deviate from those in Britain, the deviation between the country's IQ and the British IQ is unstable across the ages too. This has already been shown by Lynn and Becker (2019, p. 181-190, 1993-1998), who found a significant effect of the mean and highest age of a sample on its IQ at the cross-sample and cross-country level. Therefore the IQ-difference between two countries depends on the age difference between the samples used for both countries, which is all the more significant, the more different the living conditions in the two countries are.

Because of these limitations and contradictions, we conclude that the relatively low IQs of our sample are caused by a sampling error.

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