The Average IQ of Sub-Saharan Africans: Comments on Wicherts, Dolan, and Van der Maas

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The average IQ of sub-Saharan Africans: Comments on Wicherts, Dolan, and van der Maas

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ABSTRACT

Wicherts, Dolan, and van der Maas (2009) contend that the average IQ of sub-Saharan Africans is about 80. A critical evaluation of the studies presented by WDM shows that many of these are based on unrepresentative elite samples. We show that studies of 29 acceptably representative samples on tests other than the Progressive Matrices give a sub-Saharan Africa IQ of 69; studies of the most satisfactory representative samples on the Standard Progressive Matrices give an IQ of 66; studies of 23 acceptably representative samples on the Colored Progressive Matrices give an IQ of 71. The international studies of mathematics, science, and reading give a sub-Saharan African IQ of 66. The four data sets can be averaged to give an IQ of 68 as the best reading of the IQ in sub-Saharan Africa.

Contents

1. Introduction

Wicherts, Dolan, and van der Maas (in press) (WDM) and Wicherts, Dolan, Carlson and van der Maas (in press) (WDCM) contend that the average IQ of sub-Saharan Africans is about 80 and that the international studies of achievement in mathematics, science, and reading corroborate this conclusion. These estimates are much higher than the average of 67 proposed by Lynn and Vanhanen (2006). We consider four data sets on this question consisting of (1) tests other than the Progressive Matrices; (2) the Standard

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Progressive Matrices; (3) the Colored Progressive Matrices; (4) the international studies of mathematics, science, and reading.

2. IQ studies other than the Progressive Matrices

WDM propose nine inclusion criteria for the acceptability of studies of the IQ in sub-Saharan Africa, but these do not include the crucial criterion that the African samples should be representative of the population. This is a strict criterion because there are no perfectly representative samples from sub-Saharan Africa. We therefore have to make judgments on which studies are sufficiently representative to use. We do not follow WDM in rejecting studies in which (1) "Test administration should not be described as problematic" because this means that the samples lacked the cognitive ability to understand the instructions and/or the test was too difficult; (2) sub-Saharan Africans are compared with matched whites, because in some studies this comparison is more appropriate.

In this section we summarize studies we consider sufficiently representative for inclusion. IQs are corrected for a Flynn effect of 3 IQ points a decade and calculated in relation to a British IQ of 100 (sd 15), and deduction of 2 IQ points from IQs calculated on American norms. These are described as FE/ British IQ adjusted.

Ani and Grantham-McGregor (1998). WDM give an IQ of 73.2 for this Nigerian study of boys tested with the similarities subtest of the WISC-R, but reject it. Comment: The similarities subtest is a good measure of reasoning.

Avenant (1988). WDM calculate a WAIS-R IQ of 76 for this study of South African prison wardens described by Nell (2000, p.27) as "competent men, all in long-standing employment in a sophisticated environment". They reject the study because the wording of some items was changed to facilitate understanding. Comment: These changes would improve performance and should not invalidate the results. Wicherts (2009) has acknowledged that he has made a mistake in calculating the IQ and that the correct figure for the IQ is 70.

Badri (1965a). WDM give an IQ of 61.9 for this Sudanese sample of Negroid boys but reject the study because they were "culturally deprived". Comment: The sample is described as representative of the people of this region of southern Sudan.

Bardet, Moreigne and Sénécal (1960). WDM's IQ of 66.3 for this sample of Senegalese school children is accepted.

Boivin et al. (1993). WDM report an IQ 66.6 for a sample of healthy children in the Congo but reject this study on the grounds that it was from an underdeveloped rural area and the test was adapted. Comment: Most of the Congo consists of underdeveloped rural areas, so the sample should be reasonably representative; the authors are confident that the K-ABC is suitable for use with their sample because they write "this measure was especially intended for use with nonverbal and non-English speaking children." The battery as a whole has "a good record in terms of construct validity when adapted for other cultural groups" (p. 221).

Boivin, Giordani and Bornefeld (1995). WDM give an IQ of 64.9 for this sample of children in the Congo but reject this study because the children had intestinal parasites. We are unable to find any reference to intestinal parasites in this paper, and the Boivin et al. (1993) study found that parasitic and malarial infections had only a marginal (2 points) adverse effect on the IQ.

Buj (1981). WDM give an IQ of 75.7 for this Ghanaian adult sample. Comment: This is only marginally acceptable because the sample came from the capital city and likely has a higher IQ than the population, and no information was given about the way the sample was recruited for the study.

Conant, Fasternau, Giordani, Opel and Nseyila (1999). This study reports a K-ABC IQ of 65 for this sample of children at school in the Congo. WDM do not list this study. The FE/ British IQ adjusted is 59.

Dent (1937). WDM calculate an IQ of 68 for this sample of children in South Africa tested with Koh's Blocks but they reject the study. Comment: Koh's Blocks is similar to the Wechsler block design subtest which provides a good measure of full scale IQ (Wechsler, 1974). The sample appears representative.

Fahmy (1964). WDM report an IQ of 84.3 for this sample of Nilotic school children in southern Sudan. Comment: Four tests were administered but WDM only use the one that gave the highest IQ. The average of the four tests is 74.5, FE/ British IQ adjusted to 69.

Fahrmeier (1975). WDM calculate an IQ of 72.3 for this sample of Nigerian children tested with the spatial relations subtest of the Primary Mental Abilities (PMA), but reject the study. Comment: The spatial relations subtest is acceptable as a measure of IQ and the sample appears to be representative.

Ferron (1965). This study reports IQs for seven samples of children in Nigeria and Sierra Leone that included three grammar school samples (IQs 91, 95, and 81), two samples taking the entrance exam to grammar schools (IQs given as 80+ and 70+), and two samples from two primary schools. WDM average the seven samples to give an IQ of "around 77". Comment: The first five samples should be excluded because grammar school students are selected for higher IQs and the imprecise IQs given for those taking the entrance exams to grammar schools are unusable. Ferron's two samples from primary schools are acceptable. The IQs of these were 74 and 66, averaged to 70.

Fick (1929). This study reports a non-verbal AAB IQ of 65 for children at school in South Africa in relation to an IQ of 100 of the white children. WDM reject this study on the grounds that the test used the concept of mental age and "the native does not grow up with pictures and diagrammatic representations of things". Comment: Since the black children were at school, they should have had adequate experience of pictures and diagrammatic representations. The AAB gave accurate results in the United States where blacks in the World War I military draft obtained an IQ of 83 compared with 100 for whites. This difference has been confirmed in numerous subsequent studies including the military drafts in World War II and the Korean War (Loehlin, Lindzey & Spuhler, 1975), and up to the present day, showing that the test gives valid results (Rushton & Jensen, 2005).

Giordani, Boivin, Opel, Dia Nseyila and Lauer (1996). WDM do not list this study of 130 healthy and apparently representative children in the Congo who obtained a K-ABC IQ of 65.

Haward and Roland (1954). WDM do not list this study of "a typical cross-section" of 30 adult Nigerians tested with the

DAM. "Special weighting was given to compensate for the penalization of lack of clothing" and scores were compared with a matched British sample ($n = 100$) in relation to which the Nigerians obtained an IQ of 67.

Holding et al. (2004). WDM calculate a K-ABC IQ of 63 for this sample of Kenyan children but reject the study on the grounds that the K-ABC was adapted and children had had malaria. Comment: The alterations made in the adaptation of the test were trivial and consisted of replacing less familiar with more familiar pictures. The effect of these alterations would have been to improve the performance of the Kenyan children. The authors note "similar procedural modifications made by other investigators have yielded enhancements in test performance relative to unmodified items" (p.252). The authors state that their results "demonstrate the utility of a cross cultural adaptation of the K-ABC and of other tests not originally designed for the children of the region" (p.252) and that "all children in our region have malaria" (p.249). Hence, it is considered that the sample can be regarded as representative.

Hunkin (1950). WDM calculate a DAM IQ of 74.5 for this large ($n = 2300$) urban South African sample of 6–13 year olds. Comment: As the sample is urban it likely gives an inflated IQ. Nevertheless, the sample is considered sufficiently representative to be acceptable.

Klein, Pohl and Ndagijimana (2007). WDM calculate an IQ of 69.6 for this sample of sub-Saharan African adults in Belgium. Accepted.

Lloyd and Pidgeon (1961). WDM assign this sample of Zulu children an IQ of 88.7. Comment: The study reports a Zulu IQ of 86.75 and an IQ of a white South African comparison sample as 103.2. WDM calculate the Zulu IQ in relation to British norms on the assumption that the sample is representative. But the authors state "it was not possible to make a random selection either of children or schools" (p. 146). To overcome this problem, "considerable care was taken to choose schools that would yield samples of children representative of the total population for each racial group". Hence it is better to calculate the Zulu IQ in relation to the IQ of the matched white sample. In relation to the white South African IQ of 100, the Zulu IQ is 83.5. The average sd for the white and the Zulu samples is 9.35. Adjustment for this reduces the Zulu IQ to 74.

Lynn and Owen (1994) give an IQ of 68 for blacks in a South African sample in relation to 100 for whites aged 16.5 and 15 years, respectively, calculated from the South African Junior Aptitude Test (JAT). WDM give an IQ for this sample but do not list it in their Table 2. They reject it on the grounds that the test has been shown to be biased for blacks because a test of invariance fails. Comment: This is the only study of sub-Saharan Africans that has been tested for measurement invariance, so it is unreasonable to reject it on these grounds. On 9 out of the 10 subtests (except memory) the blacks obtained IQs below 70. Four of the subtests are verbal and could have been biased against blacks. However, their IQs are the same on the verbal and non-verbal subtests. The lower reliability of the blacks' responses suggests that the main reason for the invariance failure is that many blacks were guessing the answers to many of the questions. The results are likely biased in favor of blacks because they were aged 16.6 years while the whites were aged 15.0 years, and many of the less able blacks leave school before this age. Finally, the same samples were tested with the Progressive Matrices on which WDCM (2009) calculate that the blacks obtained an IQ of 68. This identical result to that obtained on the JAT confirms the validity of this test for the blacks in this study.

Minde and Kantor (1976). WDM calculate an IQ of 83.9 for this Ugandan sample of children. The IQ obtained in this study is so much higher than that in any of the other 29 studies listed in this section that it could arguably be rejected as an outlier.

Murdoch et al. (1994). WDM do not consider this study that administered 6 subtests of the WISC-R to a sample of 13 year old adolescents at high schools in Johannesburg. The mean IQ was 79, FE/British IQ adjusted = 70.

Nissen, Machover and Kinder (1935). WDM give an AAB IQ of 63 for this sample in Guinea but reject the sample on the grounds that the children were handicapped in the mazes test by "inexperience in manipulating a pencil", and on the Manikin and Feature Profile test because "the subjects appeared utterly bewildered". Comment: The sample's performance was the same on these two tests as on the other tests. WDM also state that the sample consisted of "unschooled test takers", but the authors state that all the children had attended school and considered the sample as representative.

Richter, Griesel and Wortley (1989). WDM calculate an IQ of 74.5 for this sample of South African school children. Accepted.

Skuy, Schutte, Fridjhon and O'Carroll (2001). This study reports on two samples of South African Soweto high school students, both described as "representative of the Soweto high school population" (p. 1415). The first sample took six subtests from the WISC-R, the DAM, and the WCST (Wisconsin Card Sorting Test). WDM use the WISC-R and the DAM to give an IQ of 71.6. Comment: WDM did not use the WCST because "We did not consider scores on tests that are not meant to measure *g*, such as the (WCST), because this test is not an IQ test". The WCST manual states that the test was developed "as a measure of abstract reasoning ability" (Kongs, Thompson, Iverson, & Heaton, 2000, p. 1), so the WCST should be accepted as a measure of intelligence. The IQ of this sample on the WCST (scored for errors) is 62. The average of the three tests taken by this sample is an IQ of 68.

Skuy et al.'s (2001) second sample took the full WISC-R and the WCST. On this occasion WDM accept the WCST as a measure of intelligence (contrary to their rejection of it in the paragraphs immediately above and below) and combine it with the WISC-R performance scale to give an IQ of 74.3.

Sternberg et al. (2002). WDM accept the IQ of 72 given in Lynn (2006) for this sample of children in Tanzania tested with the WCST, but they reject this study on the grounds that the WCST is not a measure of *g*. Comment: The WCST is a good measure of *g* and the sample appears representative.

Sternberg et al. (2001). WDM accept the IQ of 64 given in Lynn (2006) for this sample of Kenyan children tested with the Mill–Hill vocabulary test but reject the study because vocabulary does not measure *g*. Comment: Vocabulary is an excellent measure of *g*; for instance, vocabulary has the highest correlation (0.74) of all the Wechsler subtests with the full scale WISC-R (Wechsler, 1974, p.47). The sample appears representative.

Zindi (1994). WDM calculate an IQ of 71.6 for this Zimbabwean sample of high school children. Comment: Wicherts (2009) has acknowledged that the correct figure is 70.7.

This section has summarized the results of 29 studies of acceptably representative samples. The median IQ is 69.

In this section we summarize studies we consider insufficiently representative for inclusion.

Ashem and Janes (1978). WDM calculate an IQ of 88.8 for this sample of 4 year old Nigerian children. Comment: The sample consisted of well nourished "higher socio-economic children" (1Q = 109), adequately nourished mainly middle class children (IQ = 91.4), and poorly nourished rural children (IQ = 79.6). WDM average the three results, but the combined sample cannot be accepted as representative. Furthermore, IQs for 4 year olds are unsatisfactory because many American studies have shown that the black-white IQ gap is relatively small at the age of 4 years but increases as children grow older (Jensen, 1974).

Badri (1965b). WDM give an IQ of 73.1 for this Sudanese sample. Comment: The population of central and northern Sudan is predominantly North African Caucasoid (Cavalli-Sforza, Menozzi, & Piazza, 1994, p.169).

Bakare (1972). WDM calculate an IQ of 83.1 for this sample of Nigerian upper-class and lower-class children. Comment: "Fathers in the upper class homes were senior civil servants or university administrators, lecturers or professors" (p. 356). Their children cannot be averaged with those of lower-class children to give a representative sample.

Claassen, Krynauw, Paterson and Mathe (2001). WDM calculate an IQ of 83.1 for this sample of English-speaking black South Africans, in relation to 100 for white South Africans. Comment: This was a well educated sample, and English-speaking black South Africans have a higher IQ than native language speakers (e.g. Shuttleworth Edwards et al., 2004), so the sample cannot be accepted as representative.

Khaleefa, Abdelwahid, Abdulradi and Lynn (2008). These Sudanese samples are predominantly North African Caucasoids.

Ohuche and Ohuche (1973). WDM calculate an IQ of 91.3 for this sample of children at an experimental school in Sierra Leone. Comment: The sample is unrepresentative; the ages of the children are unknown; all children repeating the year (i.e. those with low IQs) were excluded; the IQ of 5–6 year olds = 69.5; the IQ of 7–12 year olds = 94.2, a discrepancy indicating serious problems with the data; there was no correlation between IQs and tests of English, math and social science in grades 4–7, showing IQs have no validity for these ages. The study is so unsatisfactory it has to be rejected.

Shuttleworth Edwards et al. (2004). WDM give an average IQ of 94 on the US WAIS-III for this South African sample of "40 educated adults". Comment: The sample consists of those who have been educated to age 18. The authors write it "is not representative of the population" (p. 915), so it has to be rejected.

Wilson, Mundy-Castle and Sibanda (1991). WDM calculate an IQ of 86.2 for this Zimbabwean sample. Comment: This sample attended a primary school with whites in a middle class neighborhood and cannot be accepted as representative.

Other studies not listed above are rejected as unacceptable for the reasons given by WDM.

3. The Progressive Matrices

Studies of the Progressive Matrices also need to be considered to arrive at an estimate of the IQ in sub-Saharan Africa. For the Standard Progressive Matrices, Wicherts et al. (in press) (WDCM) give results for 40 studies, for which the median IQ is 78, Flynn effect corrected to 77, and reduced further to 76 to adjust for around 20% of Africans who do not attend school and are credited with an IQ of 71.

A number of these studies have to be rejected as based on clearly unrepresentative samples. These include five samples of university students; Crawford Nutt's (1976) sample of high school students (IQ 84) in math classes admission to which "is dependent on the degree of excellence of the pupil's performance in the lower classes" (p. 202) and described as "a select segment of the population" (p. 204), and who were coached on how to do the test; a sample of psychiatric patients (IQ 86) because these had to pay fees, would have been higher SES and are not a representative sample (Morakinyo, 1985); a selected sample of technical college students (IQ 79) in Zambia (MacArthur, Irvine, & Brimble, 1964); and a sample of Madagascans in France (IQ 82) (Raveau, Elster, & Lecoutre, 1976) because these are not pure Negroids but a mixed race people with substantial South East Asian ancestry.

We are not able to discuss these 40 studies in detail. Instead, we consider the two most satisfactory studies. Owen (1992) compared representative samples of 1093 blacks (age 16.5 years) and 1056 whites (age 15 years). Owen's analyses show that at the item level the test is not biased against blacks in terms of any of the standard statistical criteria for the detection of bias. There are no British norms for 16.5 year olds, but the 1979 norms for 15.5 year olds can be used. The score is at the 2nd percentile of these = 69 IQ. Deduct 2 for FE = 67.

The second of the most satisfactory studies is Vass's (1992) data for a representative sample of Xhosa-speaking South African secondary school students ($n = 711$, mean age = 19.3 years). The mean score was 32.9 (sd = 9.72), well below the British 5th percentile. Extrapolating the British norms downwards, the Xhosa scored at about the first percentile of the British norms (IQ 65). The average of these two studies is an IQ of 66.

WDCM summarize 16 studies of the Colored Progressive Matrices for which they give a median IQ of 78. The highest IQ of these samples is 96 for children at a private fee paying school in Nigeria and is evidently an elite sample that should be rejected. WDCM only count results for children aged 5–11 on the grounds that the CPM is too easy for those aged over 11 years and the African IQ is reduced by ceiling effects. This cannot be accepted because several studies have shown that Africans above the age of 11 obtain no-where near the full score. For instance, Knoetze, Bass and Steele (2005) report a standardization of the CPM in South Africa on a sample of 379 school students aged 7 to 18 and found that none of them obtained the full score. Heyneman and Jamison (1980) report a mean score of 23.1 out of a possible total of 36 on the CPM for 13 year olds in Uganda. The sd is 3.2, suggesting that none of the sample can have achieved near the maximum score. In Fahrmeier's (1975) sample of 12–13 year olds in Nigeria the mean score was 15.1. In Heady's (2003) sample of

9–18 year olds in Ghana, the highest score was 24.3 obtained by the 17 year olds in school. All these scores are well below the maximum of 36 and show no ceiling effect.

WDCM's exclusion of results on samples aged over 11 inflates the African IQ. For instance, WDCM give an IQ of 73 for 172 children aged 7–11 in Knoetze, Bass and Steele's (2005) study, but for the complete sample ($n = 379$) including older children the IQ is 71. WDCM's elimination strategy excludes eight CPM studies of adolescents listed in Lynn (2006). The IQs derived from these studies range from 62 to 69. If we add these to the 15 acceptable studies reported by WDCM, there is a total of 23 studies with a median IQ of 71.

4. Attainment in mathematics, science, and reading

We agree with WDM that international school assessments in mathematics, science, and reading are measures of attained intellectual competence and can be adopted as proxies for IQs. Country level correlations between school assessment results and IQs are around 0.92 (Lynn, Meisenberg, Mikk, & Williams, 2007). However, we contend that WDM have used an inappropriate method for calculating IQs of sub-Saharan Africans from the international school assessments. Because the more recent assessment programs are methodologically the most advanced, they will be discussed first.

4.1. Third International Mathematics and Science Study (TIMSS) 1995–2007

The TIMSS assessments were organized by the IEA (International Association for the Evaluation of Educational Achievement) in 1995, 1999, 2003 and 2007. Three African countries participated in the 8th-grade assessments: Botswana and Ghana in 2003 and 2007, and South Africa in 1995, 1999 and 2003. Ghana has a measured IQ of 71, and South Africa of 72. Botswana has no measured IQ. L&V offer an estimate of 70.

TIMSS results are available at http://timss.bc.edu/timss2003.html and http://nces.ed.gov/timss/tables07.asp, scaled to a mean of 500 and individual-level standard deviation of 100 for the countries participating in the 1995 study (see also Martin, Mullis, Gonzales, & Chrostowski, 2004; Martin, Mullis, & Foy, 2008; Mullis, Martin, Gonzales, & Chrostowski, 2004; Mullis, Martin, & Foy, 2008). The TIMSS Technical Reports show *within-country* standard deviations of about 85 (e.g., Gonzalez, Galia, Arora, Erberber, & Diaconu, 2004).

We have averaged the mathematics and science scores of 8th grade students separately for each of the four assessments, and applied a minor trend adjustment based on the means for the 18 countries participating in all four assessments. We have averaged these scores to produce a single TIMSS score for each country. The scores for the three African countries (Botswana, Ghana, South Africa) are shown in Table 1. Three non-African countries scored lower than Botswana: Qatar (306.9), Morocco (350.3), and the Philippines (350.8). The correlation of the TIMSS score with measured IQ is 0.88 for the 57 countries for which both measures are available.

Table 1
Countries grouped by their average L&V IQ (IQ).

Country	L&V IQ	TIMSS score	SAIQ regression	SAIQ direct	SAIQ equalized
IQ ≥ 105	106	569.0	104.0	109.6	105.0
United Kingdom	100	510.1	98.0	100.0	98.3
Non-African IQ 78–83	81	390.6	84.7	78.9	83.4
Botswana	(70)	361.1	81.4	73.7	79.7
Ghana	71	284.3	72.9	60.2	70.2
South Africa	72	275.3	71.9	58.6	69.1
55 non-African countries	94.5 ± 7.3	479.5 ± 58.6	94.6 ± 6.5	94.6 ± 10.3	94.5 ± 7.3

The school achievement IQ (SAIQ) is calculated by linear regression of the TIMSS scores on the L&V IQs, direct transformation to the 100/15 scale, and scaling to equal means and standard deviations.

The TIMSS score was converted into a "school achievement IQ" (SAIQ) by three alternative methods:

1. Following the method of WDM, the SAIQ was calculated by linear regression with TIMSS score and IQ for the 55 non-African countries having both measures:

$$IQ = 43.04 + 0.109 \times TIMSS\ score.$$

Table 1 shows the results for the three African countries, the four non-African countries with the lowest IQs (IQ 78–83: Egypt, Lebanon, Qatar, Syria), the four highest-scoring countries (Hong Kong, Japan, South Korea, Taiwan), and the United Kingdom. Ghana and South Africa have slightly higher SAIQs than expected from their L&V IQs, and the IQ of Botswana is a remarkable 81.4.

However, linear regression produces biased results because it systematically reduces the standard deviation in proportion to the correlation between the variables, as shown at the bottom of Table 1. It raises the scores for all low-scoring countries, and reduces those of high-scoring countries. Therefore we consider linear regression unsuitable for the rescaling of school achievement results into the IQ metric.

2. The results were rescaled directly, converting the score of the United Kingdom (503.3) to 100 and the within-country standard deviation of 85 to 15. This is our preferred procedure for comparisons of school achievement between countries. Now the between-country standard deviation is higher for school achievement than for IQ (10.4 versus 7.3 in the 55 non-African countries). This shows that school assessments have more "cultural bias" than IQ tests. One explanation that we have advanced before (Lynn et al., 2007) is that poor quality of schooling in low-scoring countries depresses school achievement to a greater extent than it depresses IQ.

With direct-scoring the SAIQs of Ghana and South Africa are substantially lower than expected from their IQs, whereas Botswana's is higher than its estimated IQ.

3. The TIMSS scores of the 55 non-African countries that have measured IQs were rescaled to equal mean and standard deviation with their IQs. This is our preferred procedure for scaling school achievement to the IQ metric because it controls for the handicap that low-scoring countries in general have on school assessments relative

to their IQ. Table 1 shows that the SAIQs for Ghana and South Africa are now only marginally lower than their IQs. However, Botswana's SAIQ of 79.7 is still remarkably high.

A similar exercise for calculating IQs of African countries from TIMSS and PIRLS data has been published by Rindermann, Sailer and Thompson (2009). They estimate IQs of 73.93 for Botswana, 61.25 for Ghana, and 63.28 for South Africa. These IQs are a little lower than our estimates calculated by direct transformation scaling.

To put African TIMSS scores in perspective, in 2003, when the three African countries participated, the average score of Botswana was at the 5th percentile of the English distribution in mathematics and well below the 5th percentile in science. Ghana and South Africa scored a bit below the 25th percentile of the Botswana distribution in mathematics and near the 15th percentile in science (Martin et al., 2004; Mullis et al., 2004). Age at testing was generally higher for the African than the non-African samples. For example, on the 2003 assessment the average age was 14.4 years (range: 13.8–15.2) for the non-African samples, 15.1 years for Botswana and South Africa, and 15.5 years for Ghana. However, age at testing has only a marginal effect on TIMSS performance.

4.2. PIRLS Reading, 2006

South Africa was the only African country participating in this assessment of reading literacy in 4th graders in 39 countries. Results are reported on a 500/100 scale. The within-country standard deviation is about 80 (Kennedy & Trong, 2007). The highest score (Russia) was 565. The United Kingdom scored 535, and South Africa obtained the lowest score with 302. Morocco was second-lowest, with a score of 323. The correlation between PIRLS score and IQ is 0.83 for the 32 non-African countries that have both measures.

The SAIQ of South Africa is 79.2 with linear regression, 56.3 with direct transformation, and 75.7 with equalization of mean and standard deviation. The reason for the large discrepancy between the scores obtained by direct transformation and by equalization is that for the 32 non-African countries that have both IQ and PIRLS score, the between-country standard deviation is far greater for the direct-transformed SAIQ (12.5) than for IQ (6.7). It appears that 4th-grade reading is even more "culturally biased" than 8th-grade mathematics and science.

For the 38 non-African countries the average age at testing was 10.3 years. For South Africa the average age was 11.9 years, and children were tested in grade 5 rather than grade 4 (Mullis et al., 2007). Linear regression predicting PIRLS score with IQ and age showed that each year adds 39.2 points to the PIRLS raw score (95% confidence interval: 6.7–71.7 points). Age-correction reduces the South African score (with equalized means and standard deviations) from 75.7 to 69.1.

4.3. 1991/92 Reading Literacy Assessment of the IEA

This study of 9 and 14 year olds pioneered the methods that were used later in TIMSS and PIRLS. 30 countries participated in the assessment of 14 year olds, including Nigeria, Zimbabwe and Botswana. Grading was done with a Rasch model, and the results are reported on a 500/100 scale (Elley, 1992). The within-country standard deviation is about 80. The correlation with IQ is 0.73 for the 25 non-African countries for which measured IQs are available.

The top score (560) was obtained by Finland, the United States scored 535, and the three African countries obtained the lowest scores: 401 for Nigeria, 372 for Zimbabwe, and 330 for Botswana. The lowest non-African scores were 417 for Venezuela and 430 for the Philippines. Table 2 shows the results for the three African countries and the average for the two lowest-scoring non-African countries. A minor correction for age at testing is included in Table 2. Direct scaling produces results that are somewhat higher than expected for Nigeria and Zimbabwe, and lower than expected for Botswana and the two non-African countries. With equalization of mean and standard deviation, however, SAIQs of Nigeria and Zimbabwe are up to 9.5 points higher than expected based on their IQs, although Botswana scores somewhat lower than expected.

4.4. IAEP Mathematics Study 1990/91

This study assessed mathematics in 13 year olds. 19 countries participated, with Mozambique as the only African country. The average percent correct is published by Lapointe (1992). The correlation between the scores of the 18 non-African countries and their IQs is 0.86.

Direct transformation of raw scores into SAIQ is not possible because within-country standard deviations are not published. Based on the 18 non-African countries, the SAIQ of Mozambique is 85.6 with linear regression and 82.2 with equalization of means and standard deviations.

This looks impressive, but the raw scores explain the result. China scored highest, with 80.2% correct answers. British children got 60.6% correct, and Americans 55.3%. Mozambique got 28.3%, which was the lowest score. The second-lowest country, Brazil, scored 34.7%. Multiple-choice exams usually have 4 or 5 answer choices. Therefore children who know nothing will score 20% or 25%. Even with equalization of mean and standard deviation, a raw score of 20% translates into an SAIQ of 77.1. To match their IQ of 64, Mozambiquan children would have to get −6% correct with equalization of means and standard deviations, and −17.5% with linear regression!

Table 2
Results of the three participating African countries in the 1991/92 IEA Reading Literacy Assessment.

Country	IQ	Reading score	SAIQ regression	SAIQ direct	SAIQ equalized
Philippines, Venezuela	85	423.5	86.5	77.1	82.6
Nigeria	69	401	83.4	72.3	78.5
Zimbabwe	66	372	79.7	66.5	73.6
Botswana	(70)	330	75.8	60.2	68.3
African average	68.3	367.7	79.6	66.3	73.5

Venezuela and the Philippines are the lowest-scoring non-African countries both on IQ and reading literacy. SAIQ, school achievement IQs corrected for age.

The 1990/91 mathematics assessment discriminated well between China and the United States, but the test was far too difficult for children in low-scoring countries. Scaling to an IQ equivalent is not possible with this raw score distribution.

4.5. Second International Science Study (SISS), 1983/84

This study covered the ages of 10 and 14 years. 23 countries participated at age 14, including Ghana, Nigeria and Zimbabwe. The results are published as percent of the questions answered correctly (Keeves, 1992). The top score (Hungary) was 70.7%, England scored 55.9%, and the United States 54.6%. The lowest scores were 39.7% (Philippines), 42.2% (Nigeria), 42.8% (Zimbabwe), and 46.7% (Ghana). The correlation with IQ is 0.44 for the 20 non-African countries.

With direct transformation of scores, based on the averaged English and US standard deviations (16.2), the SAIQ is 91.5 for Ghana, 87.3 for Nigeria and 87.9 for Zimbabwe. With equalization of means and standard deviations it is 86.2, 81.3 and 82.0, respectively. This time the between-country standard deviation is higher for IQ than for school achievement (6.5 versus 5.5, $N = 20$ non-African countries).

The average age at testing in the 20 non-African countries ranged from 14.2 years (England) to 17.1 years (Papua New Guinea), with an average of 15.1 years. Average age at testing was 16.1 years in Ghana and Zimbabwe, and 16.2 years in Nigeria. Nigeria also participated in the assessment of 10-year-olds. This time Nigeria obtained the lowest score (35.1%), followed by the Philippines (42.3%).

4.6. Second International Mathematics Study (SIMS), 1981

17 countries participated in this assessment of 13 year olds, including Nigeria and Swaziland. The raw scores are published in Medrich and Griffith (1992), separately for arithmetic (46 questions), algebra (30 questions), geometry (39 questions), measurement (24 questions), and descriptive statistics (18 questions).

Scores on the content areas were averaged, weighted by the number of questions. For the 14 non-African countries with measured IQ, SIMS score correlated 0.50 with IQ. SAIQ by linear regression is 93.8 for Nigeria and 93.1 for Swaziland, and by equalization of means and standard deviations it is 88.5 and 87.1, respectively. Direct transformation of the SIMS score into the IQ metric is not possible because the within-country standard deviations are not reported.

Nigerians would have to obtain a raw score of −40.7% to match their IQ of 69 when linear regression is used, and 4.3% when means and standard deviations are equalized. As in the 1991 IAEP Mathematics study, the reason is that the test was too difficult. The top-scoring country, Japan, achieved 62.1%, the United Kingdom 47.6%, Nigeria 33.6%, and Swaziland 31.5%. It is apparent that the African children knew very little.

Age is another confounding factor in this assessment. The average age for the 15 non-African countries was 13.8 years (range 13.0 to 14.1 years), but 15.1 years in Swaziland and 16.1 years in Nigeria.

To summarize, only the more recent studies (IEA Reading Literacy 1991/92, PIRLS 2006, TIMSS), that are graded with state-of-the-art methods of item response theory (IRT) that model student proficiency as a latent variable (Foy et al., 2008), can be scaled easily to the IQ metric. The sub-Saharan African countries perform poorly in these studies. Direct-transformed SAIQs in these three assessments range from 56.3 (South Africa, PIRLS 2006) to 73.7 (Botswana, TIMSS), with an average of 63.5 when taking account of the multiple participation of countries in TIMSS.

However, all three of the IRT-scaled assessments have a higher between-country standard deviation, relative to within-country standard deviation, than IQ. When we control for this general handicap of low-scoring countries on school assessments relative to IQ tests by equalizing means and standard deviations, the school achievement IQs range from 68.3 (Botswana, reading literacy 1991/92) to 79.7 (Botswana, TIMSS 2003/2007 average).

Using this scaling method and counting each TIMSS assessment separately, the average African school achievement translates into an SAIQ of 72.4. This is an overestimate of "the" African IQ for three reasons. First, participation in international school assessments is generally restricted to the economically and educationally more advanced African countries, such as South Africa and Botswana. IQ and school performance are likely higher in these countries than in the less developed African countries. For example, according to the Human Development Report of the United Nations, in 2002 the youth literacy rate was 88.6% in Nigeria, which has data for both IQ and school achievement, but only 19.8% in neighboring Niger, which has no cognitive test data of any kind.

The average of the L&V IQs of these countries, weighted for their frequency of participation in the school assessments, is 70.5, which is slightly higher than the overall African average. This includes the estimated IQ of 70 for Botswana, which is possibly an underestimate considering the advanced state of the country's economy and educational system.

Second, the TIMSS and PIRLS samples do not represent the whole population but only those in schools. Writing of the early years of the twenty-first century, Hanushek and Woessman (2007, p. 51) note that "In West and Central Africa, 59% of each cohort do not even complete grade 5, and 44% never enroll in school in the first place." Those who are in secondary schools will have above average IQs because typically they have secured entry by passing entrance examinations, their parents have paid school fees, they have done well and not dropped out by the age of 15, and because schooling has increased their IQs. Thus, Garden (1987) writes of the Second International Mathematics Study: "It should be noted that in Swaziland in 1980 19.9% of 12–17 year olds were in school." (p. 32). The average age of children tested in Swaziland was 15.6 years. Schools with high pass rates on external exams were somewhat overrepresented, and the author concludes that "… upward bias in achievement with respect to the population is indicated." (p. 99).

In Nigeria, the assessment was limited to students in state-owned secondary grammar schools, which prepare for the West African School Certificate Examination. "Students in trade schools, technical and other vocational and pre-vocational institutions" were excluded (Garden, 1987, p. 28). In Nigeria the assessment was limited to the southern states, which have 50% of the total population but approximately 90% of the enrolment in secondary grammar/commercial schools. There are no United Nations and World Bank data about secondary enrolment in Nigeria at that time, but Garden (1987) writes: "The enrolment rate is low in Nigeria and since mathematics is

compulsory for all students in Nigerian secondary schools it is apparent that the enrolment rate is much higher for boys than for girls." (p. 97). 72.8% of the Nigerian sample was male.

The same was observed in the Second International Science Study. Here, the percentage of children still in school in the older cohort was reported as 6% in Ghana and 30% in Zimbabwe, with data for Nigeria unavailable (Keeves, 1992, p. 54). In the Philippines, whose students scored even lower than the Africans, 60% were still in school. The good performance of the African children on this test (relative to the Philippines) is explained at least in part by the fact that the less capable African children were no longer in school at the age of testing (about 16 years). At the 10-year age level, however (actually 12.1 years in Nigeria, compared to 11.1 years in the Philippines and 10.7 years in the remaining 15 countries), 92% of the Nigerian children were still in school, and they got the lowest score.

The magnitude of the inflation of IQs calculated from TIMSS studies of secondary school students can be estimated from two studies. Ferron (1965) administered the Leone test "devised by an African for African children" to two primary school samples (average IQ 70) and a selected secondary school sample (IQ 81) in Zaria (Nigeria), suggesting that the secondary school sample inflates the African IQ by 11 IQ points. Heady (2003) found in samples of 12–18 year olds in Ghana that those in school had an IQ 2 points higher than those not in school. The average of the two results is a 6.5 advantage for those in secondary school. The adoption of this figure reduces the sub-Saharan African IQ estimated from TIMSS studies from 72.4 to 65.9, rounded to 66.

A third caveat is the presence of floor effects. Because of severe floor effects, the older assessments cannot be translated into the IQ metric. These tests were designed to discriminate between developed countries. Even for the otherwise "modern" IEA Reading Literacy assessment of 1991/92, the report states: "… Botswana, Nigeria and Zimbabwe… each had large numbers of students below the *chance level* mark of 25 percent." (Elley, 1992, p. 26, italics in original). Therefore it is likely that floor effects contributed to the relatively good performance of the Africans in this assessment (Table 2). We must not forget that the *actual* performance of the African samples (indexed by the direct-transformed scores) is well below the 2nd percentile of the British distribution in most cases.

An example for an extreme floor effect is the IAEP Mathematics assessment of 1991, which produced a score of 28% for Mozambique. The result is remarkable also because the sample was drawn from the cities of Beira and Maputo, omitting children from small towns and rural areas. Generally in Africa, children in urban and more developed areas perform better in school than those from backward rural areas. This has been demonstrated abundantly in the recent (2001–2004) SACMEQ assessment of reading and mathematics in 14 countries of South and East Africa (http://www.sacmeq.org/indicators.htm). In Mozambique, children in Maputo City scored 24.5 scaled points (equivalent to about 4 IQ points) higher than the Mozambiquan average.

5. Conclusion

The three IQ data sets show that studies of acceptably representative samples on tests other than the Progressive Matrices give a sub-Saharan Africa IQ of 69; studies of the most satisfactory representative samples on the Standard Progressive Matrices and on the Colored Progressive Matrices give IQs of 66 and 71. These results are corroborated by the international studies of math, science, and reading that give an IQ of 72.4, adjusted down to 66 because these studies are based mainly on high school samples in the more advanced African countries. The average of the four data sets gives an IQ of 68 and should be regarded as the best reading of the IQ in sub-Saharan Africa.

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