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Non-Verbal Ability of Zulu Children across 56 years

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Several studies have investigated the nonverbal intelligence of Zulu speaking children in KwaZulu-Natal (South Africa) since the mid-20th century. We review four studies of schoolchildren that have been performed between 1948 and 2004 and that allow us to estimate secular trends in test performance. The results show that generational gains (Flynn effects) in this population were not larger and most likely were smaller than in European populations during this period. However, rising school enrolment is likely to have contributed to the apparent lack of progress in schoolchildren.

Key Words: Intelligence; South Africa; Zulus; Piagetian tests; Progressive Matrices.

A research program to collect IQs for all peoples and nations in the world was initiated by Lynn (1978) and has been updated in subsequent publications. In this research program population IQs are expressed in relation to a British mean of 100 and standard deviation of 15. They are described as "British IQs" or "Greenwich IQs", a term proposed by Rindermann (2012), analogous to the measurement of longitude which is set as a deviation from zero through Greenwich. Because performance on cognitive tests has increased over time in Britain as in other western countries, IQs are calculated according to British norms at the time a study was performed.

In this paper we contribute to this research program by reporting data on the non-verbal intelligence of Zulu primary school children in the South African province of KwaZulu-Natal. The province has a population of approximately 8 million, of which 60% is rural. Black Africans comprise 82% of the population today, with the largest proportion being Zulus. Pietermaritzburg is the capital city of the province, and Durban is the largest city.

In their most recent compilation, Lynn and Vanhanen (2012, p. 412) summarize 25 studies of the intelligence of black South Africans, with a range of British IQs between 65 and 82 and a median of 71. In the present study, we compare the performance of Zulu children from KwaZulu-Natal on tests of non-verbal abilities. Results from four studies performed up to 56 years apart are analyzed.

Study 1

Notcutt (1949) reported the results of a study performed in 1948 in which Raven's Standard Progressive Matrices (SPM) test was administered to 762 Zulu primary school pupils aged 11 to 15 years in the vicinity of Durban. The children are described as "living under urban and peri-urban conditions." The SPM is a non-verbal test of inductive reasoning in which subjects have to identify the missing piece in a sequence of visual patterns. The easiest items require primarily visual pattern matching while the more difficult ones require the detection of regularities based on abstract properties such as symmetry, numerosity and directionalty. Therefore the test is thought to discriminate mainly on visual-perceptual ability in low-scoring samples and on non-verbal reasoning ability in high-scoring samples.

Although the Raven tests are described as "culture-reduced," there have been large performance increases ("Flynn effects") on these tests in Western countries during the 20th century (Flynn, 2007, 2009; Lynn, 2009; Raven, 2008; Raven, Raven & Court, 1998). These gains indicate that performance on these tests does respond to changing environmental conditions across time.

The results of the Notcutt (1949) study are summarized in Table 1. The table also shows the IQ equivalents of the scores according to British norms derived from standardizations in 1943 (Raven, 1960) and 1979 (Raven, Raven and Court, 1998). The higher scores on the 1943 than the 1979 norms indicate the IQ gain that was taking place in Britain during this interval. The last column gives the British IQ in 1948 as the time-weighted average calculated from the 1943 and 1979 IQs.

Table 1. *Mean score and standard deviation (SD) obtained by Zulu schoolchildren on Raven's Standard Progressive Matrices test in 1948. Also shown are the British IQs according to 1943 norms and 1979 norms, and calculated for 1948.*

Age	N	Mean	SD	1943 IQ	1979 IQ	1948 IQ
11	145	18.3	6.5	75	70	74
12	158	22.0	8.4	75	70	74
13	159	23.7	9.4	78	70	77
14	149	24.1	9.5	77	66	75
15	151	26.9	10.7	73	68	72
11-15	762	23.0	8.9	75	69	74

Study 2

In another early study, Cowley and Murray (1962) reported data on Piagetian tests for 40 white and 40 Zulu children matched for age and aged 5-12 years, with equal numbers of boys and girls. The children were in schools in townships in KwaZulu-Natal. Three Piagetian tests were administered including tests of topological space (drawings of shapes), projective space (drawings of perspective), and Euclidian space (identification of shapes). The authors write that "The children's reactions were classified into stages of development …based on that of Piaget." Means and standard deviations are given for the three tests for the two groups. The white children scored significantly higher on all three tests ($p<.001$). The differences expressed in standard deviation units were 1.30, 1.52 and 2.53.

When the scores of the white children are scaled to the IQ metric with a mean of 100 and standard deviation of 15, the IQ equivalents of the black children are 77.9, 77.3 and 62.1, giving an average of 73. This is an upper-bound estimate because cognitive test scores tend to be lower for white South Africans than for the British. For example, the results of Owen (1992), based on scores from the Standard Progressive Matrices administered to 1056 white 15-year-olds, translate into an average non-verbal IQ of 94.

Study 3

This study used the Colored Progressive Matrices (CPM) (Raven, 2008; Raven, Court and Raven, 1995), the children's version of Raven's Progressive Matrices. It is described as "made up of diagrammatic puzzles that are designed to assess the intellectual processes of young children. It can be used satisfactorily with people who come from different cultural backgrounds, speak different

languages or who have language difficulties" (Raven, 2008, p. 1). It closely resembles the Standard Progressive Matrices in that the easier items require perceptual matching and pattern completion while the more difficult ones also require abstract reasoning ability.

The test was first constructed in 1947 and has been used in numerous studies for the assessment of intelligence in many countries throughout the world reviewed by Lynn and Vanhanen (2012). British standardizations were carried out in 1982 (Raven, Court & Raven, 1995) and most recently in 2007 (Raven, 2008). A comparison of the two standardizations has shown that the CPM scores of British children increased substantially between 1982 and 2007, especially among those of lower ability (Flynn, 2009; Lynn, 2009).

Jinabhai et al. (2004) administered the Colored Progressive Matrices to 806 3rd-grade primary school children aged 8 to 10 (450 boys and 356 girls) in a rural area of KwaZulu-Natal, one to two hours by road south of Durban. The area is described as economically depressed, with a majority of households lacking electricity and only 32.4% of economically active persons formally employed. 40% of the population in the area had less than 6 years of schooling.

Table 2. *Raw score mean and standard deviation (SD) on the Colored Progressive Matrices administered to rural school children in KwaZulu-Natal around 2002. IQs are shown according to the 1982 and 2007 British standardizations, and calculated for the approximate time of the study.*

Age	N	Mean	SD	1982 IQ	2007 IQ	2002 IQ
	Boys					
8	177	13.3	3.1	74	58	61
9	175	13.3	3.0	70	54	57
10	98	13.7	3.8	70	50	54
8-10	450	13.4	3.3	71	54	57
	Girls					
8	128	14.3	4.2	76	59	62
9	145	14.6	4.4	73	56	59
10	83	15.1	4.8	72	52	56
8-10	356	14.7	4.5	74	56	59

Results are presented in Table 2. In addition to raw score means and standard deviations, the table shows IQs according to norms from the 1982 and 2007 British standardizations. These IQs are estimates because the raw score averages are somewhat outside the norming range of the British standardizations, which extend to lower bounds of IQ 75 and IQ 60, respectively.

The differences between the 1982 and 2007 IQs show that there were strong Flynn effects at the lower end of the ability distribution in Britain during this time (Flynn, 2009; Lynn, 2009). The last column shows the IQ calculated for the approximate time of the study in 2002. Girls scored significantly higher than boys, with p<.0005 (independent samples t test).

Study 4

The Colored Progressive Matrices test was administered to a sample of 522 Zulu primary school pupils aged 5 to 12 years in the province of KwaZulu-Natal in a study designed to provide normative data for Zulu children. The study was carried out in 2004 and reported in an unpublished MA thesis by Kihn (2005). The sample was drawn from two geographical locations to represent rural and urban children. The urban location was in the township of Imbali, situated approximately 30 km from Pietermaritzburg, and the rural location was in a small farming community in New Hanover, situated approximately 100 km from Pietermaritzburg.

The results are shown in Table 3 giving the ages, numbers, mean scores and British IQs in the 1982 and 2007 British standardizations (Raven, 2008; Raven, Court and Raven, 1995). The last column shows the British IQ equivalent in 2004, the time of the study. There are no British norms for 12 year olds. The average of the 2004 IQs, weighted by sample size, is 67.1. We propose this figure should be adopted as the best estimate of the intelligence of Zulu children obtained in this study.

Table 3. *Zulu children's scores on the Colored Progressive Matrices.*

Age	N	Score	1982 IQ	2007 IQ	2004 IQ
5.0	2	14.5		90	
5.5	3	14.3	98	90	91
6.0	24	15.0	97	84	86
6.5	23	14.2	91	80	81
7.0	32	15.2	87	77	78
7.5	40	14.3	82	70	71
8.0	46	15.3	82	67	69
8.5	53	15.6	80	62	64
9.0	64	16.4	79	62	64
9.5	54	17.3	78	62	64
10.0	65	19.3	78	65	67
10.5	50	17.5	74	57	59
11.0	33	18.7	73	57	59

Age	N	Score	1982 IQ	2007 IQ	2004 IQ
11.5	22	19.5	71	56	58
12.0	8	17.4			
12.5	2	28.5			

The study reports that the mean score of the urban sample was 17.35 (SD 5.66) (n = 237) and the mean score of the rural sample was 16.14 (SD 5.74) (n = 285). The difference is statistically significant (t = 2.40, p<.05). The study also reports that the mean score of the boys was 17.3 (SD 6.21) (n = 263) and the mean score of the girls was 16.2 (SD 5.14) (n = 285). The difference is statistically significant (t = 2.42, p<.05).

Discussion

A comparison of these four studies is interesting because it adds a time dimension to the study of cognitive ability in this well-defined local South African population. We find that the British IQs in these studies are reasonably consistent across more than half a century, with IQs calculated or estimated at 74 in the 1948 study, 73 or slightly lower in 1960, 58 in 2002, and 67 in 2004.

All these scores are low by international standards. The scores on the two recent studies using the CPM are low also in comparison with norms from a CPM standardization performed in Free State Province (formerly Orange Free State) in central South Africa in 2001 (Linstrom, Raven and Raven, 2008). In this standardization, median scores for those whose home language is not English or Afrikaans (i.e., black South Africans) were 14 at age 8½, 17 at age 9½, and 20 at age 10½. Comparison with the raw scores in Tables 2 and 3 shows that the results of Kihn (2005) are marginally lower, and those of Jinabhai et al. (2004) are significantly lower.

The rather large discrepancies between the results of studies 3 and 4, which both used the CPM in samples of school children only 2 years apart, are best explained by the different localities. Jinabhai et al. (2004) surveyed children in a backward rural district, while Kihn (2005) included both urban and rural children. The latter study found the expected difference between locations, with rural children scoring lower than urban children, although even the rural children scored higher than those in Jinabhai et al. (2004). The remaining discrepancy between the two studies may be attributable to differences in economic conditions or the effectiveness of the educational system in the two locations.

The apparent tendency for lower IQ scores in the later studies does not indicate a loss of ability in absolute terms. It merely shows that secular gains of non-verbal ability in Zulu schoolchildren were lower than the massive gains that

occurred among lower-scoring British children during this time (Flynn, 2007, 2009; Lynn, 2009; Raven, 2008; Raven, Court and Raven, 1995). Because scores on the CPM and SPM are directly equivalent at raw scores below 20 (Raven, Raven and Court, 1998, p. SPM71), we can directly compare the scores in Table 1 with those in Tables 2 and 3. Unfortunately the only common age group are 11-year-olds in Tables 1 and 3, which show a small raw score increase from 18.3 in 1948 to 19.5 in 2004.

We also need to take into consideration that these studies were done with schoolchildren. They did not include children who were not enrolled in school at the age of testing or were not present in school when the tests were administered. When school enrolment is incomplete or many children who are officially enrolled do not attend school regularly, those who are in school tend to be an elite group. Not only do they receive instruction that (hopefully) raises their intelligence, but in many cases bright children are more likely than those who appear dull to be sent to school by their parents. For example, Heyneman (1977, page 255) observed in Uganda that "…children from the two most remote and economically impoverished ethnic groups outperformed all others on an intellectual test of perceptual ability (the Raven's Progressive Matrices—RPM)…in future research it would seem reasonable to explore the possibility that in the less wealthy areas there might be a tendency for the more able to receive the first opportunity for schooling." Heyneman (1977) interprets his observations as a result of rational choice. Parents realize that education is a major investment, and the returns on this investment are higher for bright children than for the dull.

According to the South African census of 2001, primary school enrolment was virtually complete throughout the country at that time. However, 26.1% of black adults aged 20 and above in KwaZulu-Natal had no schooling (compared to 22.3% in South Africa as a whole), and another 19.5% (18.5% in South Africa) had incomplete primary education (Lehohla, 2004). For the time of the Notcutt (1949) study, we only have estimates for South Africa as a whole. In 1955, 34.8% of South Africans aged 15-19 had never been in school and another 10.1% had incomplete primary education. Total average length of schooling in the country was 5.1 years for this age group (Barro and Lee, 2010). This statistic includes all ethnic groups. The proportion of unschooled or poorly schooled children was most likely much higher in the black population. In the 1960 census, 68% of South Africans (74% in Natal) were classified as Bantu. Thus the subjects in the Jinabhai et al. (2004) and Kihn (2005) studies were in all likelihood representative of the total population of Zulu children in the studied locations. However, those in Notcutt (1949) certainly were not because only schoolchildren were included. Therefore, the results of this early study are likely to overestimate the average

cognitive level of Zulu children at that time.

Both the CPM test (Raven, 2008) and Piagetian tests (Case et al, 2001; Humphreys and Parsons, 1979; Lim, 1988) are widely recognized as good indicators of general intelligence (*g*), since scores on these tests correlate highly with scores on other bona-fide intelligence tests. Therefore, the results of the two studies confirm the estimate of the British IQ of 71 for black South Africans, calculated by Lynn and Vanhanen (2012) as the median of 25 studies.

The two recent studies using the Colored Progressive Matrices give some indication about possible causes of low performance. The results from Kihn (2005) in Table 3 show that raw scores rise only to a modest extent, from 15 at age 6.0 to 19.5 at age 11.5, while scaled scores (IQ) decline from 86 to 58. Jinabhai et al. (2004) found the same trend for the 8-10 years age range (Table 2), with IQ declining by 6 to 7 points from age 8 to 10. This relative lack of cognitive progress with increasing age, relative to British norms, has frequently been reported in economically disadvantaged populations, for example in Egypt (Bakhiet and Lynn, 2014), Oman (Khaleefa, Al-Kudri and Lynn, 2012), Syria (Khaleefa and Lynn, 2008b) and the United Arab Emirates (Khaleefa and Lynn, 2008a). There are two possible explanations for this. First, the initial and easier items in the test are measures of visualization ability sometimes designated gestalt visualization, while the later items are measures of abstract reasoning ability (Lynn and Irwing, 2004). It is abstract reasoning ability that has improved most with modernization in western countries (Flynn, 2007). Another possible factor may be that young children do better than older ones because children growing up under economically disadvantaged conditions have a less cognitively stimulating education, and this has a cumulative effect as children grow older. More specifically, cognitive decline (relative to economically advanced nations) during the school years points to deficiencies in the school system.

The two recent studies report sex differences in mean scores on the Colored Progressive Matrices, but the results are contradictory. While Jinabhai et al. (2004) find slightly higher scores for girls (Table 2), Kihn (2005) reports that boys scored significantly higher than girls by approximately 1 raw score point, or 3 IQ points. Taken together, the two studies suggest that today, girls are not significantly disadvantaged for the development of intelligence in South Africa. This is similar to results for primary school children in many economically developed countries reported by Lynn and Irwing (2004), which show no substantial gender difference in this age group.

There is no agreement among studies 3 and 4 about gender differences in variability either. Jinabhai et al. (2004) report higher standard deviations for girls (Table 3). Kihn (2005), however, reports that boys had greater variability than girls

shown by their greater standard deviation of 6.21, compared with 5.14 for the girls. The latter study supports the theory of greater male variability that has frequently been stated, e.g. by Havelock Ellis (1904) ("It is undoubtedly true that the greater variational tendency in the male is a psychic as well as a physical fact"), Ceci and Williams (2007) ("all sides in the gender wars agree that there is greater variability in male distributions of many abilities"), and Deary, Penke & Johnson (2010) ("Males have a slightly but consistently wider distribution than females at both ends of the range"). However, the Jinabhai et al. (2005) study shows that this is not a universal finding, at least in KwaZulu-Natal.

Conclusions

The main conclusion is that progress in the development of non-verbal cognitive abilities has been slow in KwaZulu-Natal. This conclusion may apply to the indigenous African populations of South Africa more generally, as is suggested by the results of a study that compared scores of black South Africans on the Draw-a-Man test over a 50-year period from 1938 to 1988 (Richter, Griesel and Wortley, 1989). The small magnitude of cognitive gains with increasing age during the school years that is evident in studies 3 and 4 (Tables 2 and 3) suggests that deficiencies in the school system may be a causal factor that is potentially remediable. The low scores on tests of nonverbal ability parallel the lackluster performance of South African schoolchildren on tests of scholastic achievement in curricular subjects. In the Trends in International Mathematics and Science Study (TIMSS) of 2011, for example, South African children were tested in grade 9 instead of the usual grade 8 and still achieved very low scores, lower than Botswana and on a par with Honduras, and only slightly higher than 8th-grade children in Ghana (Martin et al., 2012; Mullis et al., 2012).

We also need to see the results in the context of sweeping educational reforms in South Africa after the end of apartheid in the 1990s, which included racial desegregation and were intended to open up educational opportunities for black children (Fiske and Ladd, 2004; Ndimande, 2009). The present results show that at the time of the more recent studies (2002 and 2004), these reforms had not been effective in raising the cognitive level of native African schoolchildren in KwaZulu-Natal. The more recent results from TIMSS (Martin et al., 2012; Mullis et al., 2012) show that this relative lack of progress is not limited to KwaZulu-Natal and to nonverbal ability, but indicates a deeper-rooted problem with educational and cognitive progress in South Africa.

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