The General Psychologist

Race, Brain Size, and IQ

J. Philippe Rushton
University of Western Ontario

This article reviews the literature on racial-group differences in brain size and IQ. It documents: (1) a .40 correlation between brain size and cognitive ability; (2) mean group differences in brain size, with East Asians = 1,364 cm³, Whites = 1,347 cm³, and Blacks = 1,267 cm³; and (3) mean group differences in IQ scores with East Asians = 106, Whites = 100, and Blacks = 85, with sub-Saharan Africans = 70.

I was tempted to put all the words in the title of this article in the same kind of "scare quotes" used by Allen (2002) whose article aimed "to finesse the 'race'-IQ debate" (his Abstract), to which the present paper is a reply. I even thought of titling it "The relations between *so-called* race, *so-called* IQ, and (much less convincingly) *so-called* brain size." Allen's exercise in deconstructionism notwithstanding, all the words in the title of my paper are as real as any constructs in behavioral science. If they were not, the empirical findings I am about to document could not have been independently confirmed across cultures and methodologies.

Nothing in the history of psychology has been as contentious as the question of ethnic and racial group differences in cognitive ability. Ever since World War I and the widespread use of standardized mental tests, mean group differences have been found again and again. Only their cause has been subject to real debate. Few, however, dare to "let it all hang out." The APA Task Force on intelligence opted for a "limited hangout," only acknowledging (after prodding) that with respect to "racial differences in the mean measured sizes of skulls and brains [with East Asians averaging the largest, followed by Whites, and then Blacks] … there is indeed a small overall trend" (Neisser, 1997, p. 80). The *three-way* pattern in brain size is very well established and parallels the three-way pattern in IQ test scores.

In this paper I summarize the results of 150 years of research, most of which can be found in three recent book-length reviews. Lynn and Vanhanen's (2002) *IQ and the Wealth of Nations* examined test scores from around the world and showed they are reliable, valid, and predictive of GNP and GDP, with a world average IQ of 90. Jensen's (1998) *The g Factor* shows that *g*, the general factor of mental ability, is (1) the most predictive aspect of cognitive ability tests; (2) related to brain size, heritability indices, and other biological factors; and (3) shows significant mean racial-group differences. My own *Race, Evolution, and Behavior* (Rushton, 2000) reviews this literature and places it in an evolutionary context.

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Jensen's (1969) famous *Harvard Educational Review* article concluded that: (1) IQ tests measure a general-ability dimension of great social relevance; (2) individual differences in IQ have a high heritability; (3) compensatory educational programs have proved generally ineffective in changing the relative status of individuals and groups on this dimension; (4) social-class differences in IQ have an appreciable genetic component; and most controversially (5) the mean Black-White group difference in IQ probably has some genetic component. *The Bell Curve* (Herrnstein & Murray, 1994) presented an update of this evidence for general readers, along with an original analysis of 11,878 youths (3,022 of whom were Black) from the 12-year National Longitudinal Survey of Youth. The analysis demonstrated that most 17-year-olds with high scores on the Armed Forces Qualification Test, regardless of ethnic background, went on to occupational success by their late 20s and early 30s while many of those with low scores went on to welfare dependency. Herrnstein and Murray's (1994) study also found that the average IQ for "African" Americans was lower than those for "Latino," "White," "Asian," and "Jewish" Americans (85, 89, 103, 106, and 113, respectively, pp. 273-278).

Today, the average 1.1 standard deviation effect size for the mean Black-White group difference in IQ is no longer in itself a matter of dispute. A meta-analytic review by Roth, Bevier, Bobko, Switzer, and Tyler (2001) extended the range of the effect to include college and university application tests such as the Scholastic Achievement Test (SAT; N = 2.4 million) and the Graduate Record Examination (GRE; N = 2.3 million), as well as to tests for job applicants in corporate settings (N = 0.5 million), and in the military (N = 0.4 million). Since test scores are the best predictor of economic success in Western society (Schmidt & Hunter, 1998), these group differences have important societal outcomes (Gottfredson, 1997).

Brain Size-IQ Correlates Within-Race

Among individuals, intelligence is related to brain size. About two-dozen studies using Magnetic Resonance Imaging (MRI) to measure the volume of the human brain have found an overall correlation with IQ of greater than .40 (Rushton & Ankney, 1996; Vernon, Wickett, Bazana, & Stelmack, 2000). Altogether there are now about 15 studies on over 700 subjects showing that individuals with larger brain volumes have higher IQ scores. The greater than .40 correlation found using MRI is much higher than the .20 correlation found in earlier research using simple head size measures, though even those simple head size measures also showed a significant relationship. Rushton and Ankney (1996) reviewed 32 studies correlating measures of external head size with IQ scores, or with measures of educational and occupational achievement, and found a mean r = .20 for people of all ages, both sexes, and various ethnic backgrounds, including African Americans.

The most likely reason why larger brains are, on average, more intelligent than smaller brains is that they contain more neurons and synapses, which make them more efficient. Haier et al. (1995) tested the brain efficiency hypothesis by using MRI to measure brain volume and glucose metabolic rate (GMR) to measure glucose uptake (an indicator of energy use). They found a correlation of -.58 between glucose metabolic rate and IQ, showing that individuals with higher IQ scores have more efficient brains because they use less energy in performing a given cognitive task. And, larger brains tended to be more efficient brains. Several other studies, all supporting the within-race brain-size/efficiency model were reviewed in Gignac, Vernon, and Wickett (in press). Further, individual energy use increases with the increasing complexity of the cognitive task.

Twin studies indicate that genes contribute 90% of the variance to brain volume measured by MRI, and that common genetic effects mediate from 50% to 100% of the brain- size/IQ correlation (Posthuma et al., 2002; Thompson et al., 2002). Importantly, studies also show that the correlation between brain size and IQ occurs *within-families* not just *between-families*, so that the usual socio-economic factors on which families differ (e.g., parental income and educational level, child rearing style, general nutrition, schools attended, quality of neighborhood) cannot be responsible (Gignac et al., in press; Jensen, 1994; Jensen & Johnson, 1994). (One study that examined only sisters failed to find the within-family relation; Schoenemann, Budinger, Sarich, & Wang, 2000). Families with larger brains overall tend to have higher IQs and, within a family, the siblings with the larger brains tend to have higher IQ scores.

Race Differences in Brain Size

Race differences in mean brain size are observable at birth. For example, I (Rushton, 1997) analyzed data from the Collaborative Perinatal Project that recorded head circumference measurements and IQ scores from 50,000 children followed from birth to age seven (Broman, Nichols, Shaugnessy, & Kennedy, 1987). As shown in Figure 1, at birth, four months, one year, and seven years, the Asian American children averaged larger cranial volumes than did the White children, who averaged larger cranial volumes than did the Black children. Within each race, the children with larger cranial capacities had higher IQ scores. By age seven, the Asian American children averaged an IQ of 110, the White children averaged an IQ of 102, and the Black children averaged an IQ of 90. Since the Asian American children were the shortest in stature and the lightest in weight while the Black children were the tallest in stature and the heaviest in weight, these race differences in brain-size/IQ relations were not due to body size.

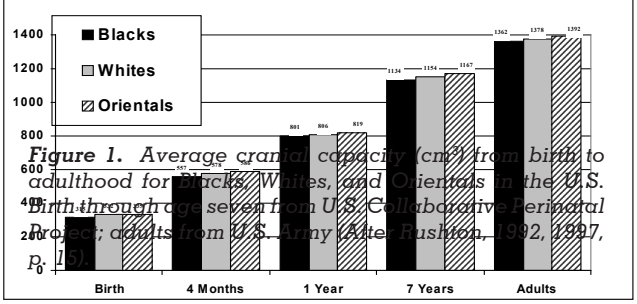

Figure 1. *Average cranial capacity (cm³) from birth to adulthood for Blacks, Whites, and Orientals in the U.S. Birth through age seven from U.S. Collaborative Perinatal Project; adults from U.S. Army (After Rushton, 1992, 1997, p. 15).*

External head size measurements (length, width, height) also have been used to estimate cranial capacities in adults. I carried out several studies of large archival data sets. Rushton (1991) examined head size measures in 24 international military samples collated by the U.S. National Aeronautics and Space Administration. After adjusting for the effects of body height, weight, and surface area, it found the mean cranial capacity for East Asians was 1,460 and for Europeans 1,446 cm^3. Rushton (1992; also see Figure 1) demonstrated that even after adjusting for the effects of body size, sex, and military rank in a stratified random sample of over 6,000 U.S. Army personnel, East Asians, Whites, and Blacks averaged cranial capacities of 1,416, 1,380, and 1,359 cm^3, respectively. Rushton (1993) re-analyzed a set of anthropometric data originally published by Herskovits who concluded there were not race differences in cranial capacity. The new analysis revealed that Whites averaged a cranial capacity of 1,421 and Blacks, 1,295 cm^3. Finally, Rushton (1994) analyzed data obtained on tens of thousands of people from around the world collated by the International Labour Office in Geneva, Switzerland. It showed that after adjusting for the effects of body size and sex, samples from the Pacific Rim, Europe, and Africa averaged cranial capacities, of 1,308, 1,297, and 1,241 cm^3 respectively.

These results, based on calculating average cranial capacity from external head size measures, joined those from dozens of other studies from the 1840s to the present on different samples using different methods, all revealing the same strong pattern. Three other methods of measuring brain size all reveal the same pattern of mean racial group differences: (1) endocranial volume from empty skulls, (2) wet brain weight at autopsy, and (3) high tech magnetic resonance imaging (MRI). For example, using MRI technology, Harvey, Persaud, Ron, Baker, and Murray (1994) found that 41 Blacks in Britain averaged a smaller brain volume than did 67 British Whites.

Using endocranial volume, the American anthropologist Samuel George Morton (1849) measured over 1,000 skulls by filling them with packing material and found that Blacks averaged about 5 cubic inches less cranial capacity than Whites. His results were confirmed by Todd (1923), Gordon (1934), and Simmons (1942). In 1984 Beals, Smith, and Dodd carried out the most extensive study of racial group differences in endocranial volume to date, by measuring 20,000 skulls from around the world. They reported that East Asians, Europeans, and Africans averaged cranial volumes of 1,415, 1,362, and 1,268 cm^3, respectively.

Using the method of weighing brains at autopsy, Paul Broca (1873) reported that Whites averaged heavier brains than did Blacks, with larger frontal lobes, and more complex convolutions. Broca also reported the mean Black-White group differences using the endocranial volume method, and found that East Asians averaged larger cranial capacities than Europeans. Subsequent autopsy studies have found a mean Black-White group difference in brain weight of about 100 grams (Bean, 1906; Mall, 1909; Pearl, 1934; Vint, 1934). A 1980 autopsy study of 1,261 American adults by Ho, Roessmann, Straumfjord, and Monroe found that the 811 White Americans in their sample averaged 1,323 grams and 450 Black Americans averaged 1,223 grams – a difference of 100 grams. Since the Blacks and Whites in the study were similar in body size, it was not responsible for the differences in brain weight.

Rushton (2000; Rushton & Ankney, 1996) summarized the world database using the three methods on which there are a sufficient number of studies (autopsies, endocranial volume, head measurements), as well as head measurements corrected for body size (see pp. 126-132, Table 6.6). The results in cm^3 or equivalents were: East Asians = 1,351, 1,415, 1,335, 1,356 (mean = 1,364); Whites = 1,356, 1,362, 1,341, 1,329 (mean = 1,347); and Blacks = 1,223, 1,268, 1,284, and 1,294 (mean = 1,267). The overall mean for East Asians is 17 cm^3 more than that for Whites and 97 cm^3 more than that for Blacks. Within-race differences, due to differences in method of estimation, averaged 31 cm^3. Since one cubic inch of brain matter contains millions of brain cells and hundreds of millions of synapses or neural connections, it would be surprising indeed if these group differences in average brain size have nothing at all to do with the group differences in average IQ.

It is important to note that Jensen and Johnson (1994) showed that the head size x IQ correlation exists within-families as well as between-families for Blacks, as for Whites, indicating an intrinsic or functional relationship within both races. Equally important is the fact that within each sex, Blacks and Whites fit the same regression line of head size on IQ. That is, when Blacks and Whites are perfectly matched for true-score IQ (i.e., IQ corrected for measurement error), whether at the Black mean or the White mean, the overall average Black-White group difference in head circumference is virtually nil. (Matching Blacks and Whites for IQ eliminates the average difference in head size, but matching the groups on head size does not equalize their IQs. This shows that brain size is only one, though a very important one, of a number of

brain factors involved in IQ.)

Race Differences in Cognitive Ability: A Global Perspective

Hundreds of studies on millions of people have now confirmed the *three-way* racial pattern in average levels of cognitive ability (Jensen, 1998; Lynn & Vanhanen, 2002; Rushton, 2000). Around the world, the average IQ for East Asians centers around 106; that for Whites, about 100; and that for Blacks, about 85 in the U.S. and 70 in sub-Saharan Africa. This same order of mean group differences is also found on "culture-fair" tests and on reaction-time tasks.

Just as in the case of brain size, racial-group differences in mean IQ can be seen early in development. For example, the Black and the White three-year-old children in the standardization sample of the Stanford-Binet IV show a one standard deviation mean difference after being matched on gender, birth order, and maternal education. Similarly, the Black and the White 2½- to 6-year-old children in the U.S. standardization sample of the Differential Aptitude Scale have a one standard deviation mean difference. To date, data are not available for East Asian children at the youngest ages. By age six, however, the East Asian children's IQ on the Differential Aptitude Battery averaged 107, compared to 103 for Whites and 89 for Blacks. Further, the size of the average Black-White group difference does not change significantly over the developmental period from three years of age on through to adulthood.

The average IQ obtained in studies of sub-Saharan Africans is 15 to 30 points (1 to 2 *SD*s) lower than elsewhere in the world. Lynn and Vanhanen (2002) reviewed over two-dozen studies from West, Central, East, and Southern Africa and found they yield an average IQ of around 70. For example, in Nigeria, Fahrmeier (1975) collected data on 375 6- to 13-year-olds in a study of the effects of schooling on cognitive development. The children's mean score on the Colored Progressive Matrices was 12 out of 36, giving them an IQ equivalent of less than 70. In Ghana, Glewwe and Jacoby (1992) reported on a World Bank study that tested a representative sample of 1,736 11- to 20-year-olds from the entire country. All had completed primary school; half were attending "middle-school." Their mean score on the Colored Progressive Matrices was 19 out of 36, which gives an IQ equivalent of less than 70. In Zimbabwe, Zindi (1994) gave the Wechsler Intelligence Scale for Children-Revised (WISC-R) and the Standard Progressive Matrices to 204 African 12- to 14-year-olds, and reported mean IQ scores of 67 on the WISC-R and 72 on the Matrices. In South Africa, Owen (1992) found that 1,093 African high school students solved 28 out of 60 problems on the Standard Progressive Matrices, which is around the tenth percentile, or an IQ equivalent of about 80.

University students in South Africa also show low mean test scores. A study at the University of Venda in South Africa's Northern Province by Grieve and Viljoen (2000) found 30 students in 4th-year law and commerce averaged a score of 37 out of 60 on the Standard Progressive Matrices, equivalent to an IQ equivalent of 78 on U.S. norms. A study at South Africa's University of the North by Zaaiman, van der Flier, and Thijs (2001) found the highest scoring African sample to that date — 147 first-year mathematics and science students who had an IQ equivalent of 100. Their relatively high mean score may have been because they were mathematics and science students, and also because they had been specially selected for admission to the university from a pool of 700 on the basis of a mathematics and science selection test. My colleagues and I found similar results with first-year psychology students and even with more highly select engineering students at the University of the Witwatersrand in Johannesburg (Rushton & Skuy, 2000; Rushton, Skuy, & Fridjohn, in press, 2002; Skuy, Gewer, Osrin, Khunou, Fridjhon, & Rushton, 2002). Under optimal testing conditions, the African students ranged in IQs from 84 to 103; in contrast, the White university students had IQs from 105 to 111; East Indian students had intermediate IQs, from 102 to 106.

In the U.S., most who have studied the problem have concluded that the tests *are* valid measures of racial differences, at least for people sharing the culture of the authors of the test (e.g., Neisser et al., 1996, p. 93), though many critics claim that Western-developed IQ tests are not valid for groups as culturally different as sub-Saharan Africans. A review by Kendall, Verster, and von Mollendorf (1988), however, showed that test scores for Africans have about equal predictive validity as those for non-Africans (e.g., .20 to .50 for students' school grades and for employees' job performance). The review also showed that many of the factors that influence scores in Africans are the same as those for Whites (e.g., coming from an urban versus a rural environment; being a science rather than an arts student; having had practice on the tests). Similarly, Rushton et al. (2002) found that scores from African and non-African engineering students at the University of the Witwatersrand on one IQ test correlated with scores on a different test measured three months

earlier (.60 for Africans; .70 for non-Africans) and with end-of-year exam marks measured three months later (.34 for Africans; .27 for non-Africans).

Moreover, several studies in sub-Saharan Africa have replicated Jensen's (1998) findings in the U.S., which show that Black-White IQ differences are mainly on *g*, the general factor of intelligence. Lynn and Owen (1994) were the first to find that Africans and Whites differed mainly on the *g* factor in their analysis of data from over 3,000 African, East Indian and White high-school students given 10 sub-tests of the South African Junior Aptitude Test. Subsequently, Rushton and Skuy (2000, in press, 2002) carried out item analyses in their studies of South African university students and found that the more the items measured *g* (estimated by item-total correlations), the more they were related to standardized African-White differences.

Other psychometric studies show the internal validity of the tests, as in Owen's (1992) study on thousands of high school students, and in Rushton and Skuy's (2000, in press, 2002) series of studies on hundreds of university students. Identical item structures were found in Africans, Whites, and East Indians. Items found difficult by one group were difficult for the others; items found easy by one group were easy for the others (mean *rs* = .90, $p < .001$). The item-total score correlations for Africans, Whites, and East Indians were also similar, showing the items measured similar psychometric constructs in all three groups. The only reliable example of bias so far discovered in this extensive literature is the rather obvious internal bias on the Vocabulary components of tests like the Wechsler for groups that do not have English as their first language. But even here, the language factor only accounts for at most 0.5 of a standard deviation, out of the overall 2.0 standard deviation difference, between Africans and Whites.

Research on reaction time, one of the simplest culture-free cognitive measures, corroborates the results from the standardized tests. Most reaction time tasks are so easy that 9- to 12-year-old children can perform them in less than one second. But even on these very simple tests, children with higher IQ scores perform faster than do children with lower scores. (The explanation usually adopted is that reaction times measure the neurophysiological efficiency of the brain's capacity to process information accurately — the same ability measured by intelligence tests.) Since children are not trained to perform well on reaction time tasks (as they are on certain paper-and-pencil tests), the advantage of those with higher IQ scores on these tasks cannot arise from practice, familiarity, education, or training.

Lynn and his colleagues carried out a series of reaction time studies on over 1,000 nine-year-old East Asian children in Japan and Hong Kong, White children in Britain and Ireland, and Black children in South Africa (summarized by Lynn & Vanhannen, 2002, pp. 66-67). The East Asian children in Hong Kong and Japan obtained the highest IQs, followed in descending order by the White children in Britain and Ireland, and then the Black children in South Africa. The same three-way pattern of average scores on these and other reaction time tasks (i.e., East Asians faster than Whites and Whites faster than Blacks) is found within the U.S. (Jensen, 1998).

Conclusion

It is an established finding of behavioral science that there is great variability within each racial group and it is well established that there are *average* differences in brain size and cognitive ability between races. There is also an ethical consensus that we treat people as individuals.

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John Philippe Rushton
Department of Psychology
University of Western Ontario
London, Ontario N6A 5C2
Telephone: 519-661-3685
Fax: 519-850-2302
E-mail: rushton@uwo.ca