

Sex and Race Differences in Cranial Capacity From International Labour Office Data

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Recent studies have shown that even after correcting for body size, significant sex and race differences exist in brain size whether estimated from weight at autopsy, from endocranial volume, or from external head measurements. In this study, cranial capacities are calculated from external head measurements reported for 40 samples from a 1990 review of ergonomically important body measurements compiled by the International Labour Office in Geneva. The measurements had been gathered over the previous 30 years from tens of thousands of men and women aged 25 to 45 years. After adjusting for the effects of stature and race, 14 male samples averaged 1,362 cm³ and 14 female samples averaged 1,201 cm³. After adjusting for the effects of stature and sex, 6 East Asian samples averaged 1,308 cm³, 18 European samples averaged 1,297 cm³, and 4 African samples averaged 1,241 cm³.

A threefold increase in the relative size of the hominid brain has occurred in the last 3 million years with *australopithecines* averaging about 500 cm³ (the size of a chimpanzee); *Homo erectus*, about 1,000 cm³; and *Homo sapiens*, about 1,300 cm³. If the encephalization quotient (EQ), the expected brain ratio given a certain body size, is plotted over the same evolutionary time frame, the increase is proportionately less, although still substantial: 3.0 to 6.9 (Jerison, 1973; Passingham, 1982). On the most recent calculations, the figures go from 2.4 to 5.8 (McHenry, 1992).

Metabolically, the human brain is an expensive organ. Representing only 2% of body mass, the brain uses about 5% of the body's basal metabolic rate in rats, cats, and dogs, about 10% in rhesus monkeys and other primates, and about 20% in humans (Armstrong, 1990). Across species, large brains are also expensive in life–history tradeoffs, requiring more stable environments, longer gestation, slower rates of maturation, higher offspring survival, lower reproductive output, and longer lives (Pagel & Harvey, 1988). From an adaptationist perspective, unless large brains substantially contributed to evolutionary fitness (defined as increased survival of genes through successive generations), they would not have

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evolved. Comparing brains within and across species may shed light on evolutionary processes (Harvey & Krebs, 1990; Wilson, 1975). The brain size of individuals, of course, is also affected by nutrition and early experience (Eysenck, 1991b; Lynn, 1990).

It is reasonable to hypothesize that the bigger human brain evolved to increase the ability to process information. Passingham (1982) provided evidence using a visual discrimination task to measure the speed with which children and other mammals abstracted such rules as "pick the same object each time to get food." More intelligent children, assessed by standardized tests of mental ability, learn these strategies faster than those who are less intelligent, and mammals with larger brains learn faster than those with smaller brains (i.e., chimp > rhesus monkey > spider monkey > squirrel monkey > marmoset > cat > gerbil > rat = squirrel). Moreover, among primates, bigger brains promote larger and more complex social groups (Dunbar, 1992).

Among humans, there is a small but robust correlation between brain size and intelligence test scores. Using a simple tape measure, head perimeter reliably correlates between .10 and .30 with intelligence test scores of children, university students, and military conscripts, with some studies controlling for extraneous factors such as body size (Jensen & Sinha, 1993; Rushton, 1995; Wickett, Vernon, & Lee, 1994). This relationship has been found among Orientals as among Whites (Rushton, 1992b) and shows up early in life. For example, the National Collaborative Perinatal Project (Broman, Nichols, Shaughnessy, & Kennedy, 1987) found that head perimeter at birth, 1 year, and 4 years predicted IQ at age 7 from $r = .13$ to $.24$ in 19,000 Black and 17,000 White children. Higher correlations between brain size and intelligence, of about .40, have been found in studies using magnetic resonance imaging to measure brain size *in vivo* in healthy, White, middle-class samples (Andreasen et al., 1993; Raz et al., 1993; Wickett et al., 1994; Willerman, Schultz, Rutledge, & Bigler, 1991).

With respect to sex differences, following results reported to be "minor" by Swaab and Hofman (1984; Hofman & Swaab, 1991) based on autopsies and head circumferences, and "tentative" by Willerman et al. (1991) using magnetic resonance imaging, Ankney (1992) showed clear evidence of major sex differences in brain size after controlling for body size. He reexamined the brain-weight analyses of autopsy data published by Ho, Roessmann, Straumfjord, and Monroe (1980) on 1,261 adults and found that at any given surface area or height, brains of White men are heavier than those of White women as are brains of Black men heavier than those of Black women. Thus, the brain of an average 168-cm tall man weighs about 1,300 g—100 g more than that of a woman of a similar height. Ankney (1992) showed that a serious statistical error had been made in the previous literature. The mistake has been to examine sex differences in brain weight using brain-weight–body-size ratios, because these ratios decline as body size increases so that the mean ratios do not differ between men and women.

Ankney's results on sex differences were confirmed by Rushton (1992a) in a

study of a stratified random sample of 6,325 U.S. Army personnel. After adjusting for the effects of stature, weight, rank, and race, the cranial capacity of men averaged 1,442 cm³ and women 1,332 cm³. The sex difference was replicated across samples of Blacks and Whites by Ankney, and across Asians, Whites, and Blacks by Rushton, as well as across officers and enlisted personnel, showing the robustness of the relationship.

For racial differences in adult brain size, converging evidence from 1980 onwards comes from three procedurally independent sources: (a) weight at autopsy (g), (b) endocranial volume from skulls (cm³), and (c) volume calculated from external head measurements. Ho et al. (1980) examined weight at autopsy for 1,261 American subjects aged 25 to 80 after excluding obviously damaged brains. They found significant sex-combined differences between 811 Whites, with a mean of 1,323 g (*SD* = 146), and 450 Blacks, with a mean of 1,223 g (*SD* = 144). This difference remained after controlling for age, stature, body weight, and total body-surface area. With respect to endocranial volume, Beals, Smith, and Dodd (1984) computerized the world database of up to 20,000 crania and found that sex-combined brain cases differed by continental area. Excluding non-frost areas of Asia and frost areas of Africa (Beals et al., 1984, Table 5), 19 Asian populations averaged 1,415 cm³ (*SD* = 51), 10 European groups averaged 1,362 cm³ (*SD* = 35), and 9 African groups averaged 1,268 cm³ (*SD* = 85).

Rushton (1991) used external head measures to calculate cranial capacities for 24 (male only) international military samples collated in 1978 by the U.S. National Aeronautics and Space Administration. After adjusting for the effects of height, weight, and total body-surface area, the mean for East Asians was 1,460 cm³ and for Europeans, 1,446 cm³. Subsequently, Rushton (1992a) used external head measurements from a stratified random sample of 6,325 U.S. Army personnel measured in 1988. After adjusting for the effects of stature, weight, rank, and sex, Asian Americans averaged a larger cranial capacity (1,416 cm³) than European Americans (1,380 cm³) or African Americans (1,359 cm³).

Racial differences in head size show up early in life. Data from the National Collaborative Perinatal Project showed that 19,000 Black infants had smaller head perimeters at birth, and were shorter in stature, lighter in weight, and had an earlier age of gestation than 17,000 White infants (Broman et al., 1987). By age 7, catch-up growth favored the Black children in body size but not in head perimeter.

The new evidence on sex and race differences in brain size has not been accepted unconditionally. Criticisms have been made of particular studies (e.g., Reed & Jensen, 1993; Willerman, 1991) and more generally. Following Gould's (1981) hostile analysis of the early literature, claims continue to be made that (a) uncontrolled variables such as age, body size, and social background have not been adequately controlled; (b) poor sampling has misrepresented the "true" population means which are held to be all the same; (c) systematic bias, including "racial bias," has operated to create unidirectional errors of measurement; and (d)

the predicted direction of the results does not always occur (Cain & Vanderwolf, 1990; Fausto-Sterling, 1993; Maddox, 1992; Peters, 1993). These critiques have been replied to (Rushton, 1995; Rushton & Ankney, in press), and this article analyzes additional new data gathered "blindly," in that the measurers had no knowledge of the use that would ultimately be made of their data.

METHOD

I report here an internationally based study providing new data on sex and race differences in cranial capacity using external head measures. I extracted the summarized data shown in Table 1 directly from an overview of 19 ergonomically important body measurements compiled by the International Labour Office in Geneva, Switzerland (Jurgens, Aune, & Pieper, 1990). The measurements had been gathered over a 30-year period from men and women ages 25 to 45. Some 300 references had been examined from 7 sources: handicraft workers such as tailors and shoemakers, anthropology, medical records, sports, growth surveys, forensic and legal investigations, and ergonomic studies. Notably lacking were the studies of military personnel reported on earlier (Rushton, 1991, 1992a). The present data are independent of previously published sets.

A long period of preparation allowed all possible data sets to be obtained including those from unpublished sources (Jurgens et al., 1990). Information was taken almost exclusively from studies carried out after 1960 in order to help standardize the measures and to limit the effects of the secular trend of acceleration, that is, the trend for each generation to become taller, especially in the industrialized countries, and also to limit the effects of migrations and other demographic changes. Acceleration trends that could be detected were standardized by correcting forward to the year 2000.

Data from tens of thousands of individuals were grouped into the 20 world regions shown in Table 1. The number of references cited to arrive at the figures are shown for each region. For each of 19 measurements, data were presented at the 5th, 50th, and 95th percentiles separately for men and women. Summarized in Table 1 are the 50th percentile measures of stature, head length, and head breadth, separated by sex, taken directly from Jurgens et al. (1990). From these I derived cranial capacity (CC) using equations from Lee and Pearson (1901, p. 235) modified to subtract 11 mm for fat and skin around the skull (Rushton, 1993). For men,

$$CC \text{ (cm}^3\text{)} = 6.752(L - 11 \text{ mm}) + 11.421(B - 11 \text{ mm}) - 1,434.06,$$

and for women,

$$CC \text{ (cm}^3\text{)} = 7.884(L - 11 \text{ mm}) + 10.842(B - 11 \text{ mm}) - 1,593.96,$$

where L and B are head length and head breadth in millimeters.

As pointed out by Lee and Pearson (1901), smaller errors in prediction of cranial capacity occur when different regression equations are used for each sex separately. As shown by Rushton (1993), cranial capacity estimated using Lee and Pearson's equations for head length and head breadth are within 25 cm³ of estimates for Whites and 16 cm³ of those for Asians using regressions that also take head height into account. Head height was not available in this data set.

Because the regions are fully described in the research report with respect to the included countries (see Table 1), it is possible to eliminate ambiguous categories thereby facilitating racial comparisons. I excluded 6 regions from the analysis: Regions 2 (Latin American Indian populations), 3 and 10 (combining Caucasoid and Negroid countries such as Argentina and the Caribbean Islands), 14 and 15 (North and South India including Nepal, Maldives, and Sri Lanka), and 18 (combining mixed Caucasoid-Mongoloid countries such as Indonesia, Malaysia, and the Philippines). The excluded data are presented in Table 1 to allow readers to do additional analyses.

RESULTS

The first analysis was carried out on the absolute (raw, unadjusted) cranial capacities using a general linear model (SAS Institute, 1985) and testing significance using a Type 3 sum of squares. From Table 1, there were 6 clear East Asian or Mongoloid samples (Regions 16, 17, and 20), 18 predominantly European or Caucasoid samples (Regions 1, 4, 5, 6, 7, 8, 9, 13, and 19), and 4 clear African or Negroid samples (Regions 11 and 12). Each of the 28 male/female sample means was treated as an independent entry. The overall model was highly significant, $F(5, 22) = 64, p < .001$. There was a highly significant effect for sex, $F(1, 19) = 200, p < .0001$; men had larger cranial capacities than women ($M = 1,401, SD = 42$ and $M = 1,186, SD = 53$, for men and women, respectively). Race was also significant, $F(2, 22) = 14.5, p < .001$; Europeans had larger cranial capacities than Asians, and Asians had larger cranial capacities than Africans ($M = 1,311, SD = 117$; $M = 1,286, SD = 103$; and $M = 1,211, SD = 144$, for Europeans, Asians, and Africans, respectively). The Sex \times Race interaction was not significant. The cell means are presented in Table 2.

The groups also differed in stature. Sex was highly significant $F(1,26) = 139; p < .0001$; men were taller than women ($M = 1,730, SD = 47$ and $M = 1,611, SD = 50$, for men and women, respectively). Race was also significant, $F(2,25) = 3.89, p < .05$. Europeans were taller than Asians, and Asians were taller than Africans ($M = 1,698, SD = 68$; $M = 1,628, SD = 75$; and $M = 1,613, SD = 74$, for Europeans, Asians, and Africans, respectively). For the sample as a whole, the correlation between stature and cranial capacity was .89. It should be noted that this large correlation is based on the means of large groups, which of course eliminates individual differences from the regression. The correlation between cranial capacity and stature based on measurements of individuals is around .30 to .40 (Jensen & Sinha, 1993; Rushton, 1992a). Also, because these

TABLE I
Body Measurements for World Populations of 25- to 45-Year-Olds

Region, Number of References, and Countries	Men				Women			
	Stature (mm)	Head Length (mm)	Head Breadth (mm)	Cranial Capacity ^a (cm ³)	Stature (mm)	Head Length (mm)	Head Breadth (mm)	Cranial Capacity ^b (cm ³)
1. North America (34 refs. from Canada and U.S.)	1,790	195	155	1,453	1,650	180	145	1,191
2. Latin America (20 refs. from Indian population in Bolivia, Honduras, Peru, etc.)	1,620	185	150	1,328	1,480	175	145	1,152
3. Latin America (15 refs. from European-Negroid populations in Argentina, Chile, Caribbean Island States, etc.)	1,750	190	155	1,419	1,620	175	150	1,206
4. Northern Europe (28 refs. from Denmark, Germany, Sweden, etc.)	1,810	195	155	1,453	1,690	180	150	1,246
5. Central Europe (42 refs. from Austria, Switzerland, etc.)	1,770	190	155	1,419	1,660	180	145	1,191
6. Eastern Europe (14 refs. from Poland and Soviet Union)	1,750	190	155	1,419	1,630	180	150	1,248
7. South-Eastern Europe (40 refs. from Bulgaria, Greece, Romania, etc.)	1,730	190	155	1,419	1,620	175	150	1,206
8. France (20 refs.)	1,770	195	155	1,453	1,630	180	140	1,137
9. Iberian Peninsula (6 refs. from Spain and Portugal)	1,710	185	155	1,385	1,600	180	150	1,246
10. North Africa (10 refs. from Algeria, Ethiopia, Niger, Sudan, etc.)	1,690	190	145	1,305	1,610	185	140	1,177

11. West Africa (10 refs. from Congo, Ghana, Nigeria, Zaire, etc.)	1,670	195	145	1,339	1,530	180	135	1,083
12. South-Eastern Africa (16 refs. from Angola, Kenya, Uganda, Zam- bia, etc.)	1,680	195	145	1,339	1,570	180	135	1,083
13. Near East (5 refs. from Iraq, Lebanon, Turkey, etc.)	1,710	190	150	1,362	1,610	180	140	1,137
14. North India (23 refs. from Bangladesh, Nepal, Pakistan, etc.)	1,670	190	145	1,305	1,540	180	135	1,083
15. South India (23 refs. from India, Maldives, and Sri Lanka)	1,620	180	145	1,237	1,500	175	130	989
16. North Asia (5 refs. from China, Mongolia, etc.)	1,690	190	150	1,362	1,590	180	145	1,191
17. South China (9 refs. from Hong Kong, Macao, Taiwan, etc.)	1,660	190	150	1,362	1,520	180	145	1,191
18. South-East Asia (11 refs. from Brunei, Indonesia, Malaysia, Philippines, etc.)	1,630	185	145	1,271	1,530	175	135	1,043
19. Australia (6 refs. from European population in Australia and New Zealand)	1,770	192	155	1,433	1,670	180	145	1,191
20. Japan (26 refs. from Japan and Korea)	1,720	190	155	1,419	1,590	180	145	1,191

^aCranial capacity for men: (cm³) = 6.752 (head length - 11 mm) + 11.421 (head breadth - 11 mm) - 1434.06.

^bCranial capacity for women: (cm³) = 7.884 (head length - 11 mm) + 10.842 (head breadth - 11 mm) - 1593.96.

TABLE 2
Observed and Adjusted Cranial Capacities (cm³) for Six Populations

	Observed		Adjusted	
	Men	Women	Men	Women
East Asians	1,381	1,191	1,371	1,244
Europeans	1,422	1,199	1,378	1,215
Africans	1,339	1,083	1,337	1,144

statistics are calculated on group means, their standard deviations may be smaller than the standard deviations of individual differences in these variables.

Because of the sex and race differences in stature and the correlation of stature with cranial capacity, I examined the sex and race differences in cranial capacity after correcting for the effect of stature as a covariate, and again tested significance with Type 3 sum of squares. The overall model was highly significant, $F(5, 22) = 63.7, p < .0001$, with $R^2 = .95$. Sex was highly significant, $F(1, 21) = 30.94, p < .001$; men had larger adjusted cranial capacities than women ($M = 1,362, SD = 51$ and $M = 1,207, SD = 85$, for men and women, respectively). Race was also significant, $F(2, 21) = 5.97, p < .01$; Asians had larger adjusted cranial capacities than Europeans, and Europeans had larger adjusted cranial capacities than Africans ($M = 1,308, SD = 37$; $M = 1,297, SD = 38$; and $M = 1,241, SD = 38$, for Asians, Europeans, and Africans, respectively). There was no significant interaction between sex and race. Orthogonal comparisons among the means confirmed the male/female differences within each racial group and the predicted rank order of the racial differences. Specific comparisons showed Asians = Europeans > Africans. The cell means are presented in Table 2.

The choice of samples to be taken from Table 1 to produce the cleanest test of the hypothesis of a racial gradient in brain size is problematic. One might hold that additional regions should have been included. For example, Region 14, North India, which includes Bangladesh, Nepal, and Pakistan, might be considered as "Caucasoids," and Region 18, South-East Asia, which includes Indonesia, Malaysia, and the Philippines, might be considered as "Mongoloids." These particular additions do not, in fact, change the overall pattern. Adding Regions 3 and 10, excluded because they were Negroid-Caucasoid mixtures, to either the Caucasoid or Negroid group did not alter the results either. However, still other combinations and permutations did lead to null findings. Weighting the stature and cranial capacity of the different regions by the number of references on which they were based, a proxy for sample size, did not alter the results.

DISCUSSION

A range of interpretations is possible concerning the strength of the effects found in these data, ranging from "very weak" to "very strong." The most stringent conclusion would be based on the limitations of this data set. Although the regions presented in Table 1 sample most of the globe and include thousands of individuals of a standard age and historical epoch, there is little detail provided in the compiling source regarding the reliability of the measures or the variations found. Indeed, the rounding of the data by Jurgens et al. (1990), prior to publication, has obviously homogenized the summary statistics presented in Table 1. For example, 50% of the male samples had a head breadth of 155 mm, and 70% of the female samples had a head length of 180 mm. Also, because means were presented without variations, it was necessary to use very small sample sizes for analyses, thus reducing statistical power (each region for each sex was an independent entry).

Some concern may center on the selectivity of the sets chosen from Table 1 to produce Table 2. Further data analyses suggest that selectivity may not be a serious problem. All the data are set out in Table 1 to allow readers to do additional analyses. To avoid the appearance of selectivity, it might have been better to err on the side of overinclusion. With a large number of cases, aggregation procedures can be expected to nullify perturbations due to outlier variance (Rushton, 1995; Rushton, Brainerd, & Pressley, 1983). Given the small sample sizes in this study, it was considered best to depend on the purest cases with respect to the Mongoloid and Negroid populations. The longer term answer to sampling problems is further research.

No exact solution is possible, of course, to the problem of how large the group differences are in cranium size. Noteworthy, however, is the consistency of the results shown across different procedures. In *Race, Evolution and Behavior* (Rushton, 1995), I review the world database from (a) autopsies, (b) endocranial volume, (c) head measurements, and (d) head measurements corrected for body size, including this study, and find, respectively, in cm³: Mongoloids = 1,351; 1,415; 1,335; and 1,356 ($M = 1,364$); Caucasoids = 1,356; 1,362; 1,341; and 1,329 ($M = 1,347$); and Negroids = 1,223; 1,268; 1,284; and 1,294 ($M = 1,267$). I calculate a world average of 1,326 cm³. The mean Mongoloid–Caucasoid difference is 17 cm³ overall, favoring Mongoloids, and the mean Caucasoid–Negroid difference is 80 cm³, favoring Caucasoids. The pervasive sex difference in brain size is clearly observable across all methodologies and does not "disappear" when variables such as age and body size are controlled.

Differences within a race due to method of estimation average only 31 cm³. For Mongoloids, the discrepancies from autopsies to head measurements corrected for body size range from 5 to 80 cm³, with a mean of 41 cm³; for Caucasoids they range from 6 to 33 cm³, with a mean of 19 cm³; and within Negroids

they range from 10 to 71 cm³, with a mean of 38 cm³. Thus, the results from this investigation triangulate with those using other procedures.

How is the pattern to be explained? Environmental effects obviously operate. Evidence has been provided that some of the variation in brain size and performance on mental tests is attributable to nutrition (Eysenck, 1991b; Lynn, 1990). Indeed, Eysenck (1991a), commenting on a global review of aptitude test scores by Lynn (1991a), held that nutrition might account for *all* the observed racial differences. It can hardly be doubted that severe early deprivation or trauma can leave irreversible neurological deficiencies. Genetic and evolutionary factors may also be operative. Both environmental and genetic effects, of course, are necessarily mediated by anatomical and physiological mechanisms.

Within humans, Haug (1987 p. 135) has reported a correlation of $r = .479$ ($n = 81$, $p < .001$) between number of cortical neurons and brain size. The regression equating the two is given as:

$$N \text{ of cortical neurons (in billions)} = 5.583 + 0.006 (\text{cm}^3 \text{ brain volume}).$$

This means that a person with a brain size of 1,400 cm³ would have, on average, 600 million fewer cortical neurons than an individual with a brain size of 1,500 cm³. The difference between the low end of normal (1,000 cm³) and the high end (1,700 cm³) works out to be 4.283 billion neurons (a difference of 27% more neurons from a 41% increase in brain size).

Across primates, it is brain size rather than body size that acts as the biological constant determining many life-history and ecological variables, including speed of physical maturation, degree of infant dependency, maximum recorded life span, and upper limit on the size of the group cohesively maintained through time (Dunbar, 1992; Harvey & Krebs, 1990). It is within such a nexus of evolutionary life-history variables that some of the origins of brain size differences might be found (Rushton, 1995).

With the sex difference in brain size, Ankney (1992) has pointed to a paradox. Women have relatively smaller brains than men but apparently have the same intelligence test scores. Ankney resolved the problem by proposing that the sex difference in brain size relates to those intellectual abilities at which men excel. Briefly, according to Kimura (1992), women excel in verbal ability, perceptual speed, and motor coordination within personal space; men do better on various spatial tests and on tests of mathematical reasoning. Ankney hypothesized that it may require more brain tissue to process spatial information. Just as increasing word processing power in a computer may require extra capacity, increasing three-dimensional processing, as in graphics, requires a major jump in capacity. In support of Ankney's hypothesis, Andreasen et al. (1993) showed that brain size correlates most highly with performance IQ in men and with verbal IQ in women.

The 19th century proposition that men average slightly higher in *general* intelligence than do women (e.g., Broca, 1861, p. 153) has recently been reactivated by Jackson (1993) and Lynn (1994). Jackson reported a 12 percentile point advantage to men in data from 186,000 medical school applicants, and Stumpf and Jackson (1994) reported a .50 standard deviation advantage to men in reasoning ability. Lynn (1994) showed that men average about 4 IQ points more than do women on a number of published tests.

On the evolution of sex differences in brain size, Ankney (1992) suggested that the differing roles of men and women during human evolution produced a dichotomy in abilities between the sexes. Men roamed from the home base to hunt, which would select for accurate targeting ability and navigational skills; women were relatively stationary, taking care of children as well as attending to food, clothing, and household activities. This scenario has been suggested as explaining the male advantage in spatial ability (Kolakowski & Malina, 1974). Lynn (1994) has also proposed that men evolved larger (more costly) brains because this enhances their ability to become socially dominant and thus to become reproductively more successful; female reproductive success is much less dependent on social status.

Racial group differences in brain size parallel those using intelligence tests. A review by Lynn (1991a) found that Caucasoids of North America, Europe, and Australia obtain mean IQs of around 100. Asians from both North America, Europe, and Australia obtain mean IQs of around 100. Asians from both North America and the Pacific Rim obtain means in the range of 101 to 106. Africans from south of the Sahara, African Americans, and Afro-Caribbeans obtain means of 70 to 90. Lynn (1991a) also reviewed international studies of cognitive decision time estimating the neurological efficiency of the brain and found that East Asians have the fastest decision times, followed by Europeans, and then Africans. A similar racial gradient using decision times has been found within the United States (Jensen, 1993; Jensen & Whang, 1993, 1994). Because of the small but robust correlation between brain size and intelligence (Wickett et al., 1994), within Black and White samples (Broman et al., 1987) as also within an Oriental sample (Rushton, 1992b), it is reasonable to hypothesize that there is some relationship between the global distribution of relative brain size and intelligence.

Evolutionary hypotheses for why European and Asian populations have the largest brains have been provided (Lynn, 1987, 1991b; Miller, 1993, 1994; Rushton, 1988, 1995; Rushton & Ankney, 1993). From an African origin, groups migrating into Eurasia and evolving there into the Caucasoids and Mongoloids encountered the problems of survival in winter. These problems consisted principally of securing a food supply by hunting large animals and of keeping warm by making fires, clothing, and shelters. Survival of offspring in these conditions acted as a pressure favoring enhanced intelligence along with more intensive

parenting and complex social organization. Northeast Asia, where Mongoloids evolved, presented the selection pressures at their most extreme partly because of the intenser cold that prevailed.

It may be worth calling attention to the weak prediction of mental ability from knowledge of the group difference in average cranial capacity. For example, because relative brain size, that is, brain size corrected for body size, is only a weak predictor of intelligence ($r = .40$) and group membership is only a weak predictor of head size (in this study, a 13% difference between men and women and a 7% difference between Asians and Africans), it is clearly problematic to generalize from a group average to any particular individual. However, because there is about a .40 correlation between brain size and intelligence test scores, and because the analyses presented here confirm other recent reports, these systematic and possibly causal relationships are of great scientific interest.

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