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Mongoloid–Caucasoid Differences in Brain Size From Military Samples

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Cranial capacities (cm^3) were calculated from external head measurements of male military personnel. For 24 international samples totalling 57,378 individuals collated in 1978, after adjusting for the effects of height, weight, and total body surface area, Mongoloids also averaged 1460 cm^3 and Caucasoids averaged 1446 cm^3. Another way of expressing the relationship is in terms of an "encephalization quotient" derived from the regression of cranial capacity on general body size, on which Mongoloids also averaged higher than Caucasoids.

The issue of whether human populations reliably differ in relative brain size, and whether brain size is correlated with intelligence, has a long and vexatious history. Many 19th-century scientists including Broca, Darwin, Galton, Lombroso, and Morton, applied a natural history perspective to human populations and concluded that there were racial differences in brain size. With notable exceptions, for example, American anthropologists, Boas and Mead, this view was probably dominant until World War II.

Following the war, the literature on brain size, intelligence, and race underwent vigorous critiques. Thus, with autopsy data, Tobias (1970) cited 14 potentially confounding variables that he argued made the data on black–white differences in brain weight highly problematic. With endocranial volume, Gould (1978) alleged that many data on racial differences were biased by "unconscious . . . finagling" (p. 503). Together, these authors claimed to have dismantled what some had called the "myth" of racial differences in brain size. Others (e.g., Kamin, 1974) attacked the data showing group differences in cognitive performance.

More recently, the results of several studies suggested that these critiques had gone too far. For example, with autopsy data, Ho, Roessmann, Straumfjord, and Monroe (1980a, 1980b) avoided most of the problems cited by Tobias (1970) and summarized wet brain weight for 1,261 adult subjects aged 25 to 80. They excluded those brains obviously damaged, and reported significant sex-combined differences in mean weights between 811 American whites (1323 g, *SD* = 146)

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and 450 American blacks (1223 g, *SD* = 144), a difference that held after controlling for age, stature, body weight, and total body surface area.

With endocranial volume, Beals, Smith, and Dodd (1984, p. 306, Table 2) computerized the world database of 20,000 crania mostly gathered by 1940, grouped them by continental area, and found statistically significant differences. Sex-combined brain cases from Asia averaged 1380 cm^3 (*SD* = 83), from Europe averaged 1362 cm^3 (*SD* = 35), and from Africa averaged 1276 cm^3 (*SD* = 84). Moreover, Michael (1988) remeasured a random sample of Gould's analysis of data on human crania to check Gould's charge that these had been "unconsciously" doctored to show Caucasian racial superiority. Michael found that, in fact, very few errors occurred and these were not in the direction Gould had asserted. Instead, errors were found in Gould's assessment. Michael concluded that the previous research "was conducted with integrity . . . Gould is mistaken" (p. 353).

After reexamining several published data sets, Rushton (1988) concluded that for sex-combined brain weight measured at autopsy, Mongoloids averaged 1351, Caucasoids 1336, and Negroids, 1286 g, and for cranial capacity measured inside the skull, Mongoloids averaged 1448, Caucasoids 1408, and Negroids 1334 cm^3. Although these racial rankings have been criticized for being of dubious validity (e.g., Cain & Vanderwolf, 1990), subsequent work estimating cranial capacity using external head measurements has confirmed the pattern based on endocranial volume and brain weight at autopsy (Lynn, 1990; Rushton, 1990).

With some measures of cognitive performance, analyses from international as well as U.S. samples suggest that a parallel exists with the brain-size data such that Mongoloid populations average higher than Caucasoid and Negroid populations (Jensen, 1985; Lynn, 1987; Steen, 1987). Moreover, several studies have demonstrated a positive within-race correlation between head perimeter measured by tape and scores on IQ tests, some after controlling for extraneous factors such as body size (Jensen & Sinha, in press; Rushton, 1990; Van Valen, 1974). One recent study used magnetic resonance imaging to measure brain size *in vivo* in a healthy, college-age, middle-class sample and found that larger brain size (corrected for body size) was associated with higher IQ scores (Willerman, Schultz, Rutledge, & Bigler, 1991).

This article provides new data on racial differences in cranial capacity (and by inference, brain size) using external head measures. Lee and Pearson (1901) carried out what may have been the earliest investigation of whether internally measured skull capacity could be estimated from head length, breadth, and height by entering cranial capacities and skull dimensions for 941 men and 516 women of various "races" (p. 246, Table XX) into regression equations. Although the authors repeatedly emphasized the need for caution, the amount of error involved, and the difficulties of generalizing from one local race to another, they concluded that owing to "the personal equation" (error) in other methods, their "panracial" equation (1901, p. 252, No. 14) provided estimates of cranial capacity (CC) that were comparable in accuracy to the direct method of estimating endocranial volume using sand, seed, or shot; for males:

$$CC\ (cm^3) = 0.000337\ (L - 11\ mm)(B - 11\ mm)(H - 11\ mm) + 406.01$$

where L, B, and H are length, breadth, and height in millimeters and 11 mm is subtracted for fat and skin around the skull. I use this equation to estimate cranial capacities from external head measures taken on large samples of military personnel.

METHOD

Cranial capacities were calculated for 4 Mongoloid and 20 Caucasoid samples from summary statistics based on anthropometric surveys of 91 military and civilian populations, constituting what is probably the most comprehensive source of summarized head- and body-size data currently in existence (U.S. National Aeronautics & Space Administration, 1978). The data were obtained and tabulated from many original sources, both published and unpublished. Some samples had incomplete data on head measurements and were not included in the analysis. The remaining 24 samples, grouped by presumed primary race of sample, are listed in Table 1 (pp. 356–357) by the identification number, name, and date when the survey was conducted. In some cases, the original survey populations had been divided into subsamples. For example, Survey Number 19, U.S. Air Force Survey 1956, includes officers, enlisted, and trainee subsamples (Survey Nos. 20, 21, and 23, respectively), and Survey Number 48, Nato Military Survey 1960/1961, includes Turkish, Greek, and Italian subsamples (Survey Nos. 49, 50, and 51, respectively). The largest data sets were chosen for analysis. Because there were only 4 female subsamples with full data, this study was limited to men.

The measurement descriptions and data were taken from the NASA Sourcebook and include: ***head length*** (441, the maximum length of the head as measured from glabella to the back of the head); ***head breadth*** (427, the maximum breadth of the head); ***head height*** (882, the distance from tragion to the level of the top of the head); ***stature*** (805, the height of the top of the head); ***weight*** (957, the nude, or essentially nude, weight). A measure of the total ***body surface area*** was calculated from the equation m^2 = weight in $kg^{0.425}$ × height in $cm^{0.725}$ × 0.007184.

Another way of expressing brain-weight data is with an encephalization quotient (EQ; Jerison, 1973), an index of "excess" brain tissue in various species measured from the regression of brain weight on body weight, for example,

$$EQ = \text{Cranial capacity } (cm^3)/(0.12)(\text{body weight in gms})^{0.67}$$

Numerous technical debates surround the mathematical derivation of the EQ including the possibility that the exponent varies from 0.20 for comparisons across similar species to 0.75 for comparisons across different ones (Pagel & Harvey, 1989). Nonetheless, they are all intended to index the degree of development of the neocortex, especially that part of the brain that serves complex behavioral capacities over and above the neural mass, which is associated with general functions and is closely related to overall body size.

RESULTS

The unadjusted cranial capacity estimates for 4 Mongoloid samples averaged 1343 cm^3 and 20 Caucasian samples averaged 1467 cm^3 (Table 1). The stature, weight, and total body surface area of the Mongoloid samples were all significantly less than for the Caucasoid samples. When the racial differences were reexamined using analysis of covariance (ANCOVA) the least-squares means adjusted for the body size variables showed the Mongoloids averaged 1460 cm^3, a larger cranial capacity than the Caucasian average of 1446 cm^3, although the difference failed to reach statistical significance. However, the power of the test was low given that $N = 24$, rather than the $N = 57{,}378$ it would have been had the raw data been available. In terms of EQs, using Jerison's (1973) equation, Mongoloids averaged 7.26 and Caucasoids averaged 6.76, $t\,(22) = 3.46$, $p < .05$.

One reviewer suggested that body weight may be confounding these data because he calculated a correlation of $r = .91$ between body weight and average cranial capacity from the data in Table 1. Normally, this correlation would be about $r = .30$. However, it should be noted that the data in Table 1 are based on group means. If individual scores in each sample had been obtained, the relation between body weight and cranial capacity would be expected to have been about .30. Although mean body weight predicts mean cranial capacity across the racial subsamples and the slopes of the subsamples are the same, the intercepts vary. The intercept for Caucasoids was 827 cm^3, and for Mongoloids, 841 cm^3, which means that for any given weight, and on average, Mongoloids have 14 cm^3 more brain volume than Caucasoids.

DISCUSSION

Previous examinations of racial differences in brain size have focused primarily on Negroid–Caucasoid differences using internally measured cranial capacity and brain weight at autopsy. The current study broadened the data base by using external head measurements to estimate endocranial volume and, by inference, brain size, and by examining Mongoloids who were found to average relatively larger cranial capacities than Caucasoids. It must be emphasized that the results reported here were not statistically powerful and much more research is required before any firm conclusions can be reached. Nor is there any indication of how representative the data in Table 1 are of the global racial distribution. Nonetheless, if brain size correlates positively with IQ within populations (Willerman et al., 1991), and if the relationship is generalizable across populations, then racial differences in brain size may mediate some of the differences on measures of cognitive performance.

But why would Mongoloid populations have the largest brains? Interpreting their impressive collation of the worldwide data on endocranial volume, Beals et al. (1984) eschewed any attribution of racial significance to brain size and instead advanced a thermoregulatory model, arguing that it is easier to keep large brachycephalic heads warm and small dolichocephalic heads cool. Their regression analyses showed increments of about 2.5 cm^3 in cranial capacity per degree of distance from the equator. Altogether, temperature explained 30–40% of the variance in their data. It is not clear whether their perspective can account for within-group differences, or the threefold increase in hominid brain size over the last 3 million years. Furthermore, the causal relation between head size and climate may be spurious because, although it is *relatively* easier to keep large heads warm, large heads still are *absolutely* more difficult to keep warm, that is, large heads lose more heat than small heads.

The human brain is a metabolically expensive organ, using nearly 20% of the body's basal metabolic rate while representing only 2% of body mass. It could be argued, therefore, that unless large brains substantially contributed to fitness, they would not have evolved. One view is that big brains add fitness by increasing the speed and efficiency with which information is processed. Support for this view comes from studies showing that IQ scores behave like a Darwinian fitness character, demonstrating genetic dominance in studies of inbreeding depression in cousin marriages in Japan (Jensen, 1983) and hybrid vigor in Caucasoid–Mongoloid crosses in Hawaii (Nagoshi & Johnson, 1986).

Across species, brain size seems to have evolved as part of a package of life-history characteristics. Building a bigger brain demands a more stable environment, a longer gestation, a higher offspring survival, a lower reproductive output, and a longer life (Pagel & Harvey, 1988). I proposed that it is within such a life-history context that we should seek the explanation for the relationships among race, brain size, and intelligence (Rushton, 1988, 1991).

I examined published data, from Africa and Asia as well as from Europe and North America, on some 60 variables for each of the three vast racial groups: Mongoloids, Caucasoids, and Negroids. On all traits, not only brain size and intelligence, but also speed of maturation, temperament and personality, reproductive effort, and social organization, the Caucasoid average falls between those of Mongoloids and Negroids (Rushton, 1988, 1991). For example, regardless from which country the samples are taken, the rate of dizygotic twinning

TABLE 1
Anthropometric Variables for Male Military Samples from NASA (1978)

No.	Sample Size		Head Length (mm)	Head Breadth (mm)	Head Height (mm)	Stature (cm)	Weight (gms)	Surface Area[a] (m^2)	Cranial Capacity[b] (cm^3)	Encephalization Quotient (EQ)[c]
MONGOLOIDS										
84.	2950	Thai Military, 1963	179.0	152.0	128.0	163.40	56 300	1.60	1340	7.33
85.	2129	Vietnam Military, 1964	181.9	149.0	123.3	160.43	51 100	1.52	1299	7.58
86.	264	South Korean Air Force, 1961	184.1	154.9	130.4	168.66	62 840	1.72	1408	7.16
87.	3747	South Korean Military, 1965	179.0	153.0	125.0	165.20	59 400	1.65	1323	6.98
M			181.0	152.2	126.7	164.42	57 410	1.62	1343	7.26
SD			2.5	2.5	3.2	3.38	4 983	0.08	47	0.26
CAUCASOIDS										
18.	4063	US Air Force, 1950	197.0	154.1	129.7	175.56	74 100	1.90	1471	6.69
19.	3827	US Air Force, 1965	196.2	153.1	131.8	175.28	70 980	1.86	1477	6.92
24.	1549	US Navy Fliers, 1965	198.3	155.6	131.1	177.64	77 760	1.95	1502	6.62
25.	2420	US Air Force, 1967	198.7	156.0	134.5	177.34	78 740	1.96	1539	6.72
30.	6682	US Army, 1966	194.7	152.7	132.3	174.52	72 160	1.87	1470	6.81
31.	4095	US Navy, 1966	194.2	152.3	135.4	175.33	71 560	1.87	1491	6.95
32.	100	US Navy Divers, 1972	197.5	154.0	142.6	176.22	81 520	1.98	1589	6.78
33.	2008	US Marines, 1966	194.3	152.8	133.8	174.56	72 650	1.87	1482	6.83
34.	500	US Army Aviators, 1959	197.3	155.4	126.7	176.52	71 100	1.87	1455	6.81
36.	1482	US Army Aviators, 1970	197.0	152.6	132.9	174.56	77 630	1.93	1488	6.56
48.	3356	Nato Military, 1961	189.7	155.5	131.8	170.22	67 660	1.79	1457	7.05
59.	1465	German Air Force, 1975	191.6	156.8	129.2	176.66	74 730	1.91	1455	6.58
65.	500	British Soldiers, 1972	197.8	155.1	127.3	174.05	73 190	1.88	1461	6.70
66.	2000	British Air Force, 1971	199.0	157.8	130.3	177.44	75 040	1.92	1516	6.84
68.	314	Canadian Air Force, 1961	193.5	152.9	131.5	177.44	76 410	1.94	1458	6.50
69.	290	Canadian Air Force, 1961	193.8	152.9	129.7	176.68	75 550	1.92	1444	6.49
70.	238	New Zealand Air Force, 1973	197.1	152.1	132.5	176.95	75 280	1.92	1481	6.67
75.	1985	Latin American Forces, 1972	186.0	152.0	122.0	167.00	65 900	1.74	1329	6.54
77.	2000	French Young Men, 1967	195.0	154.5	125.1	171.99	63 850	1.76	1421	7.14
90.	9414	Iranian Military, 1969	187.4	148.6	127.1	166.85	61 630	1.69	1356	6.98
M			195.3	153.9	130.9	174.66	72 872	1.88	1467	6.76
SD			3.7	2.1	4.4	3.21	5 114	0.09	58	0.20

[a] Body Surface Area (m^2) = [wt(kgms)$^{0.425}$ × ht(cm)$^{0.725}$ × 0.007184].
[b] Cranial Capacity (cm^3) = 0.000337 (L − 11 mm) (B − 11 mm) (H − 11mm) + 406.01.
[c] Encephalization Quotient (EQ) = Observed Cranial Capacity (cm^3)/Expected Cranial Capacity, i.e., (0.12) (Body weight in gms)$^{0.67}$.

per 1,000 births is less than 4 among Mongoloids, 8 among Caucasoids, and 16 or greater among Negroids. Thus, populations that produce the fewest gametes average the largest brains.

There is no known environmental variable capable of producing this inverse relationship between gamete production and brain size, or of causing so many diverse variables to correlate in so comprehensive a fashion. There is, however, a genetic one: evolution. The racial ordering may correspond to what is familiar to evolutionary biologists as the r–K scale of reproductive strategy. At one end of this scale are "r strategies," which emphasize high reproductive rates, and, at the other, "K strategies," which emphasize high levels of parental investment; this bioenergetic tradeoff has been postulated to underlie cross-species differences in numerous life-history characteristics (Wilson, 1975). The animal literature was succinctly summarized by Johanson and Edey (1981): "More brains, fewer eggs, more 'K' " (p. 326). I suggested that Mongoloids are more K-selected than Caucasoids, who in turn are more K-selected than Negroids.

I also mapped the r–K scale of reproductive strategies onto human evolution using studies of genetic distancing drawn from molecular biology, including the analysis of DNA sequencing. I suggested that groups that are more K-selected in their reproduction strategy emerged later in the evolutionary process than groups that are less K-selected. Archaic versions of the three races are envisaged as emerging from the ancestral hominid line in the following order: Negroids about 200,000 years ago, Caucasoids about 110,000 years ago, and Mongoloids about 41,000 years ago (Stringer & Andrews, 1988). Such an ordering fits with and helps to explain the way in which the variables I studied are found to cluster: Negroids, the earliest to emerge, were the least K-selected; Caucasoids, emerging later, were next-least K-selected; and Mongoloids, emerging latest, were the most K-selected.

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