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Commentary on Rushton's Mongoloid–Caucasoid Differences in Brain Size

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Rushton's article claiming that Mongoloids have *relatively* greater brain size than Caucasoids is reanalyzed The results reveal that the use of means across 24 military samples rather than individual values within each sample grossly inflates the influence of body weight on relative brain size The Caucasoids in this sample have larger *absolute* cranial capacity and body weight than the Mongoloids Only after applying an inappropriate statistical correction for body weight does the relative brain-size advantage in Mongoloids emerge The lighter North American Caucasoids, in comparison to the heavier Caucasoid samples, also have significantly greater relative cranial capacity Because the relative brain-size pattern can be reproduced *within* the Caucasoids simply by dividing them according to body weight, there is no justification for claiming a relative brain-size difference *between* races

Rushton (1991) uncovered what would initially seem to be interesting data bearing on a Mongoloid–Caucasoid difference in *relative* cranial capacity Closer examination, however, reveals that Rushton's conclusion of greater relative cranial capacity in Mongoloids depends more on a racial difference in body weight than on a racial difference in cranial capacity The racial difference in body weight is very substantial, the 4 Mongoloid samples averaging 34 pounds less than the 20 Caucasoid samples, prompting the three critical points to be made here These points are

1 Body weight differences across the samples account for most of the variance in cranial capacity
2 Body weight is a better predictor of relative cranial capacity than is absolute cranial capacity
3 Caucasoids have greater *absolute* cranial capacity than Mongoloids, and only after correcting for body weight is cranial capacity relatively greater in Mongoloids

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Obviously, interpretation of these data hinges on the legitimacy of using body weight, or more precisely, a function of body weight, to construct the index of relative cranial capacity

Rushton's index of relative cranial capacity is the encephalization quotient (EQ), which equals cranial capacity − ([body weight ^{67}] [12]), the entire denominator meant to reflect expected cranial capacity In theory, the EQ indexes "extra" brain tissue not dedicated to physiological housekeeping and therefore available for higher cognitive processing Because body weight and cranial capacity both enter into the ratio, EQ differences could arise from either of these variables A reanalysis of the data in Rushton's Table 1 (pp 356–357) indicates that the higher EQ in Mongoloids is largely a result of their lower body weight Indeed, using only weight variability *within* the Caucasoids reproduces the *between*-race EQ pattern Thus, there is no need to posit a racial difference in EQ

Results of one reanalysis are represented in Figure 1 Cranial capacity was regressed on body weight across the total sample of 24, as well as in each of three subsamples All regressions show that body weight strongly predicts cranial capacity Panel A of Figure 1 uses all 24 samples and shows an R = 904 between average body weight and average cranial capacity, with a slope of 008 and a standard error of ± 001 The regression in Panel B uses only the 4 Mongoloid samples, with a resulting R of 85 and a slope of 008 ± 004 Panel C includes only the 10 North American samples (presumably racially and environmentally less heterogeneous than all 20 Caucasoid samples combined), obtaining an R = 85 with a slope of 009 ± 002 Finally, Panel D uses only the 10 samples that are neither Mongoloid nor U S , obtaining an R = 76 and a slope of 008 ± 002 These four slopes are equivalent, suggesting *no* racial difference in the regression of cranial capacity on body weight

As Rushton noted, the use of mean rather than individual values produces a grossly inflated correlation of r = 90 between body weight and absolute cranial capacity across samples, in contrast to an expected true correlation of $r \leq$ 25 across individuals Yet, he did not seriously consider the implications of this inflated and ecologically fallacious correlation for the racial difference in EQ observed here Moreover, Jerison (1990) unambiguously stated that his ⅔ exponent (Rushton's 67 power) of body size used in the calculation of EQ, although appropriate for between-species comparisons, cannot be applied within *Homo*, a conclusion that Rushton should not have ignored

Thus far, the analysis says nothing about racial differences in relative cranial capacity (EQ), but merely indicates that slopes predicting cranial capacity from body weight are the same for Mongoloids and Caucasoids A more direct inquiry into the cause of the putative racial difference in EQ is to test the relative potency of body weight and cranial capacity as predictors of EQ because, after all, they both figure in its calculation For the entire sample, Body Weight × EQ is r = − 82, and Cranial Capacity × EQ is r = − 51 A corresponding analysis for the 20 Caucasoid groups also shows that body weight predicts EQ better than does

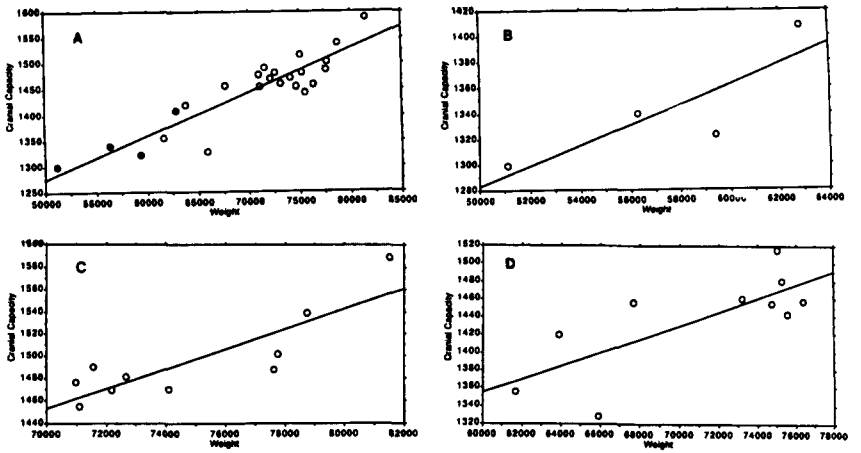

FIG. 1. Regression of cranial capacity on body weight across various military samples Panel **A** is the regression of cranial capacity on body weight for all 24 samples, the 4 Mongoloid samples being identified by filled circles, **B** is the corresponding regression for the 4 Mongoloid samples only, **C** is the regression for the 10 U S Caucasoid samples, and **D** is the regression for the 10 Caucasoid samples that are not from the U S

cranial capacity Body Weight × EQ is $r = -58$, and Cranial Capacity × EQ is $r = -02$ Among the Mongoloids, the Body Weight × EQ is $r = -84$, and the Cranial Capacity × EQ is $r = -42$ Within the 10 U S samples, the EQ × Body Weight correlation is $r = -63$, and the EQ × Cranial Capacity is $r = -13$

To demonstrate further the powerful influence of body weight on EQ, the 10 U S samples were dichotomized according to their weight This dichotomy of the five lightest and five heaviest U S groups yielded a difference in EQ $t(8) = 3\ 92$, $p < 01$, with no EQ overlap between them In short, body weight is better than cranial capacity in predicting EQ in each of the various subsamples Moreover, the between-race pattern of EQ results can be reproduced within the North American Caucasoids simply by dividing them according to body weight

Although unmentioned in Rushton's article, the Caucasoids have substantially greater *absolute* cranial capacity than the Mongoloids [$t(22) = 4\ 14$, $p < 001$], the difference in favor of the Caucasoids being more than two standard deviations The Caucasoid advantage in body weight is even greater, however about three standard deviations This larger racial difference in body weight reverses the direction of advantage when contrasting absolute and relative cranial capacities in the two races, and thus, is responsible for the mistaken claim from these data

Rushton noted an average 14 cm^3 difference in intercept favoring Mongoloids, which is interpreted to mean that, for any given body weight, the Mongoloids have brains that much larger But he did not indicate whether this intercept

difference is statistically significant Fortunately, a ready test of the difference is afforded by the analysis of covariance (ANCOVA) because the parallel regression slopes (as previously shown), make ANCOVA formally equivalent to a test of a difference in intercepts (Marascuilo & Levin, 1983, p 51) This analysis had body weight as the covariate, cranial capacity as the dependent variable, and race as the independent variable Results indicate that the intercepts do not differ significantly ($p > 70$), so little should have been claimed about the 14 cm^3 difference

This critique is confined to the data presented in Rushton's article Trustworthy studies already have demonstrated racial differences using direct measures of endocranial volume or brain size (Beals, Smith, & Dodd, 1984, Ho, Roessmann, Straumfjord, & Monroe, 1980) Normal variations in thickness and shape of the skull, moreover, may have produced erroneous estimates of cranial capacity here because only extracranial measurements were employed (i e , given equal perimeters, thicker and more elliptically shaped skulls overestimate cranial capacity) I could not locate modern reports on race and skull thickness, but the more globular shape of Mongoloid skulls (Beals et al , 1984) might have produced underestimates of their intracranial volume from these extracranial measures

Brain size may enjoy a privileged status relative to body size in the presence of undernutrition (e g , Winick, 1976), especially if the nutritional inadequacies occur outside certain critical periods Conversely, dietary excess (e g , high fat and carbohydrate intake) has more effect on body size than on brain growth Consequently, determining whether and how brain weight should be adjusted for body size remains problematic

REFERENCES

Beals, K L , Smith, C L , & Dodd, S M (1984) Brain size, cranial morphology, climate, and time machines *Current Anthropology, 25,* 301–330

Ho, K -C , Roessmann, U , Straumfjord, J V , & Monroe, G (1980) Analysis of brain weight II Adult brain weight in relation to body height, weight, and surface area *Archives of Pathology and Laboratory Medicine, 104,* 640–645

Jerison, H J (1990) Welcome light on a hot topic *Behavioral and Brain Sciences, 13,* 360–361

Marascuilo, L A , & Levin, J R (1983) *Multivariate statistics in the social sciences* Monterey, CA Brooks/Cole

Rushton, J P (1991) Mongoloid–Caucasoid differences in brain size from military samples *Intelligence, 15,* 351–359

Winick, M (1976) *Malnutrition and brain development* New York Oxford University Press