

DO *r-K* STRATEGIES UNDERLIE HUMAN RACE DIFFERENCES? A REPLY TO WEIZMANN ET AL.

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ABSTRACT

Data are tabulated showing that on diverse traits including brain size and intelligence, maturational delay, sexual restraint, quiescent temperament, and social organization, the Caucasoid average falls between those of Mongoloids and Negroids. The *r-K* continuum of reproductive strategies, based on macro-scale comparisons across species, can be used to help explain this micro-scale of human differences. Although democratic ideals are compatible with Darwinian theory, they do not compel us to believe in biological uniformity.

There is no reason to assume that K-selection...will lead to the evolution of altruism, however defined.
(Weizmann et al., 1990, p. 4.)

Characteristic of K-Selection....Altruism.
(Barash, 1982, p. 307.)

In general, higher forms of social evolution should be favoured by K selection...promoting...the multifarious social bonds that require longer life in more predictable environments.
(E.O. Wilson, 1975, p. 101.)

Although the topic of race differences abounds with ideological minefields, it is possible to rise above them. Imagine that a team of extra-terrestrial biologists arrived on earth to study humans. Would they not quickly observe that like many other species, humans showed considerable geographical variation in morphology? Surely three major geographical populations or "races" would be identified immediately and investigation mounted into how many others existed. Questions about the origin of the body types would be asked and also whether they covaried with behaviour traits. If these scientists had a solid understanding of evolutionary biology, they would also investigate if these populations differed in life history variables including reproductive tactics in particular, for example with respect to parental investment and social organization and, if they did, how these differences might have evolved. Such an approach has proved very fruitful for population biologists studying other animals, particularly since E.O. Wilson's (1975) synthesis of sociobiology. If we are as interested in gaining knowledge as would be these "extra-terrestrials", then we should apply similar procedures to our study of *Homo sapiens*.

For several years I have been actively engaged in applying a sociobiological research program to the analysis of human differences, including human racial group differences (e.g. Rushton, 1984, 1985, 1987, 1988a, 1988b; Rushton & Bogaert, 1987, 1988, 1989; see also Jensen, 1985; Ellis, 1987; R. Lynn, 1987). These efforts have generated an enormous amount of scholarly criticism and debate (e.g. Cain & Vanderwolf, 1990; Flynn, 1989; Leslie, 1990; M. Lynn, 1989a, 1989b; Roberts & Gabor, 1990; Silverman, 1990; Zuckerman & Brody, 1988).

This paper presents a response to another critique of this same work by Weizmann, Wiener, Wiesenthal and Ziegler (1990). I divide the reply into two main sections: (1) data and (2) theory. Although the division is not perfect, the convenience is immense. If the data are not in the direction I perceive them to be, then issues of explanation are void. Also, the best way to decide between alternative approaches (or models within broad approaches) is to scrutinize their goodness of fit with the total array of assembled data.

Correlates of Race

Following a review of the published literature, I claimed to have found, with data from Africa and Asia as well as from Europe and North America, that on multifarious variables a distinct pattern emerges with Mongoloids and Negroids at opposite ends of the spectrum, and Caucasoids occupying an intermediate position, with a great deal of intraracial variability within each broad grouping. A summary of my results is shown in Table 1 (after Rushton, 1989a). Perhaps never before had so many variables been collated in such a comprehensive fashion, thus so clearly

TABLE 1
Relative Ranking of Races on Diverse Variables

	Mongoloids	Caucasoids	Negroids
Brain weight and intelligence			
Cranial capacity	1448 cc	1408 cc	1334 cc
Brain weight at autopsy	1351 g	1336 g	1286 g
Millions of "excess neurons"	8900	8650	8550
IQ test scores	107	100	85
Maturation rate			
Gestation time	?	Medium	Early
Skeletal development	?	Medium	Early
Age of walking	Late	Medium	Early
Age of first intercourse	Late	Medium	Early
Age of first pregnancy	Late	Medium	Early
Life-span	Long	Medium	Short
Personality and temperament			
Activity level	Low	Medium	High
Aggressiveness	Low	Medium	High
Cautiousness	High	Medium	Low
Dominance	Low	Medium	High
Impulsivity	Low	Medium	High
Sociability	Low	Medium	High
Reproductive effort			
Multiple birthing rate	Low	Medium	High
Size of genitalia	Small	Medium	Large
Secondary sex characteristics	Small	Medium	Large
Intercourse frequencies	Low	Medium	High
Permissive attitudes	Low	Medium	High
Sexually transmitted diseases	Low	Medium	High
Androgen levels	Low	Medium	High
Social organization			
Law abidingness	High	Medium	Low
Marital stability	High	Medium	Low
Mental health	High	Medium	Low

revealing a pattern not previously appreciated. Numerous sources of error are to be found in the data sets summarized in Table 1, as I have discussed elsewhere (Rushton, 1988a; 1017). For example, the estimates of brain size did not control for variables considered important such as nutritional state in early life, source of sample, and cause of death. Some of the measures of sexuality may have been influenced by unconscious biases in self or observer. Identification errors may have occurred in determining ethnicity as on death certificates when assessing mortality rates or in court records when assessing crime. Statistical corrections may further distort data, as when crime and health figures are adjusted for differences in age structure between comparison groups.

I have also addressed the possibility of selective bias and concluded that, while many studies finding an *absence* of differences between the races have necessarily been omitted, that I am unaware of major studies demonstrating results *opposite* to those reported. Two possible exceptions to the pattern, however, are that on some measures of physical growth, Mongoloids are faster than Caucasoids, and on the personality scale of sensation-seeking, blacks have been reported as scoring lower than whites. In conclusion, I judged that explanations based on errors of measurement were unlikely to account for so consistent a pattern as that shown in Table 1; the data that I had reported reflected real differences.

The construct validity of race

In their critique, Weizmann et al. (1990) claimed that the tripartite racial classification I had used had been "widely discredited as a biological concept". In order to test the construct validity of the racial classification scheme, I recently examined its capacity to predict a known criterion, the crime statistics reported to INTERPOL, the International Police Organization (Rushton, 1990a). I grouped nearly 100 countries by primary racial composition and found, for both 1983-1984 and 1985-1986, that Middle-Eastern and European countries reported significantly more rape and serious assault than did countries in the Pacific, but they reported significantly less assaultive behaviour than did African and Caribbean countries. For example, in 1983-1984, reported rapes per 100,000 population was less for Mongoloid countries ($\bar{x} = 3.7$, $SD = 2.6$, $N = 9$), than for Caucasoid countries ($\bar{x} = 6.3$, $SD = 6.5$, $N = 40$), than for Negroid countries ($\bar{x} = 15.3$, $SD = 110.8$, $N = 22$). The unit of analysis with the highest explanatory power, therefore, is the higher order concept of race, within which cluster the different countries, ethnic groups and, ultimately, individuals.

Needless to say, the analysis of the INTERPOL data does not mean that the racial groupings represent in any sense "pure types" and there is enormous racial and ethnic variation within almost every country; moreover, each country undoubtedly differs in the procedures it used to collect and disseminate the crime figures. Certainly, within each racial grouping are to be found countries reporting both high and low crime rates. The Philippines, for example, a country grouped as Mongoloid, reported one of the highest murder rates in the world, 43 per 100,000 in 1984; Togo, a country grouped as Negroid, had the lowest reported crime rate in the world, a "rounded down" 0 per 100,000 in 1984 for each of 3 crime categories: murder, rape, and serious assault.

The above outliers illustrate a crucial methodological point regarding the validation of constructs: the *principle of aggregation* (Rushton, Brainerd & Pressley, 1983). This principle states that the sum of a set of multiple measurements is a more stable and unbiased estimator than any single measurement from the set because, and notwithstanding Weizmann et al.'s (1990) brief statement to the contrary, aggregation typically

leads both specificity and error variance to cancel out, leaving true score variance to cumulate. If more systematic error is suspected, it can be dealt with using converging operations; the data in Table 1 are based on several independent conceptual replications. What is needed now are additional tests of the classification scheme, with even better data.

If finer grain analyses did reveal subgroups not conforming to the general pattern this would be interesting, and would require explanation. However, it is not sensible to allow particulars to obscure the general. Nihilists can always deconstruct phenomena so that *any* general proposition is defeated. Thus aggregated measures are preferable when assessing the validity of constructs. To ignore the concept of race is not only to obscure higher level conceptual order of internationally based data, but also to neglect the approach of population biologists studying other species (Mayr, 1970: 186-204). With these issues in mind, let us now examine more fully some of the additional criticisms of the data.

Reproductive effort

Weizmann et al. (1990) provided a gross caricature of Bogaert and my scholarly reviews of race differences in sexual behaviour implying our reliance on "anthroporn". They ignored our extensive re-analyses of the Kinsey data, our reviews of the international surveys carried out by the World Health Organization, and the surveys carried out within the USA since Kinsey, all of which showed that in reproductive activities, Orientals were more restrained than whites who, in turn, were more restrained than blacks. The measures made included intercourse frequencies, developmental precocity, physiological responsivity, and sexual attitudes (Rushton & Bogaert, 1987). Moreover, the differences did not appear to be due to social class, although social class differences were found on many of the variables (Rushton & Bogaert, 1988).

Some of my critics have been even handed, able to recognize those elements of value. For example, regarding the data on human sexuality, Silverman (1990) noted that "...Rushton has performed a novel synthesis in pulling together an array of anatomical, physiological, maturational, and behavioral differences among races, converging on the same pattern, which seems unquestionably rooted in evolutionary processes" (p. 6). Not so Weizmann et al. (1990). They seized on one of our references to the

ethnographic record (only cited by us to show the congruence with the systematic studies done today) and then attempted to dismiss our entire effort using *ad hominem* arguments ("Rushton manifests a 'strange naivete' in his attitude toward sex"), sarcasm ("Of course a 100-year-old volume of tall tales about the semi-civilized peoples should not be criticized for methodological flaws and internal inconsistencies."), and outlandish examples ("It even contains a recipe for do-it-yourself penis enlargement employing an eggplant and hot peppers!"). This style of argument is completely unworthy of them and should have no place in a scholarly journal.

A French Army Surgeon (1898/1972), the author denigrated by Weizmann et al. (1990), had spent 30 years as a specialist in genito-urinary diseases in the French Foreign Legion stationed in Africa, the Middle-East, the Caribbean, and French Indo-China. He wrote the book on retirement and in a Preface hoped that one day the scientific world would be more enlightened than it then was about the study of human sexuality. Some of the observations claimed by the French Army Surgeon were previously unknown to us but were confirmed in our analysis of the Kinsey data. For example, although it was a very minor item, Weizmann et al. focussed on the issue of "erectile angle" but incorrectly stated that the Army Surgeon was our only source. In fact, we also observed it in our Kinsey data (Rushton & Bogaert, 1987, Table 3, Item 74). Other ethnographic sources confirm the race differences in genitalia, intercourse frequencies, sexual attitudes and (to modern views) unusual belief systems (Ford & Beach, 1951; Baker, 1974).

It is counterproductive of Weizmann et al. to ignore the race differences in sexual behaviour, for there are sobering consequences. The world-wide prevalence of sexually transmitted diseases, such as syphilis, gonorrhea, and herpes, is Mongoloid less than Caucasoid less than Negroid. Since this is also the pattern for the deadly AIDS pandemic, both among and within countries, the implications of the racial differences in sexual behaviour should not be underestimated (Rushton & Bogaert, 1989). When calculations are made on a per capita basis, for example, it is clear that Afro-Caribbeans have as big an AIDS problem as do Africans and Afro-Americans (Rushton, 1990b). The three most affected countries in the world are in the Caribbean — Bermuda, the Bahamas, and French Guiana. In this region AIDS is transmitted primarily through

heterosexual intercourse and there is relatively little intravenous drug use.

With respect to human fertility, there can be no doubt that rates vary enormously from generation to generation and subgroup to subgroup, suggesting extreme sensitivity to changing conditions. This does not, however, invalidate genetic analyses, as will be discussed later. Weizmann et al. cite the example of the high birth rate of the Hutterites as providing a "dramatic illustration of the absurdity of Rushton's linking of race or population differences in fertility" (p. 6). Again, however, with more aggregation, outliers and situational effects become averaged. Internationally, Third World countries are reproducing so rapidly that in 50 years, if present trends continue, their population will be 10 times that of the West (Wattenberg, 1987). Among these developing nations the birth rate is Negroid (Africa) > Caucasoid (India) > Mongoloid (China).

With humans, because of the importance of culture and social learning, birth rates may not be the best indicators of reproductive effort; underlying physiology is probably better. For example, human groups are known to differ in egg production. While the monozygotic twinning rate is nearly constant at about 4 per 1,000 in all groups, the rate of dizygotic twinning per 1,000 births is less than 4 among Mongoloids, 8 among Caucasoids, and 16 or greater among Negroids, with some African populations having rates as high as 57 per 1,000 (Bulmer, 1970). Once again, the efficient unit of conceptual analysis is the higher order category of race, within which cluster the different ethnic groups and, ultimately, individuals. Weizmann et al. (1990) misleadingly suggest that the world-wide data on racial group differences in multiple-birthing are unreliable, but many subsequent surveys have confirmed the racial pattern (Allen, 1987, 1988). The pattern is due to the tendency to double-ovulate being inherited largely due to the race of the mother, independently of the race of the father, as observed in Mongoloid-Caucasoid crosses in Hawaii and Caucasoid-Negroid crosses in Brazil (Bulmer, 1970).

Moreover, and perhaps as a result of matching evolutionary processes, the size of the testes is twofold lower in Mongoloids than in Caucasoids (9 g vs 21 g), too large a difference to be accounted for in terms of body size (Short, 1979, 1984). Although the data are less conclusive,

Negroids have been found to have larger scrotal circumferences than Caucasoids (Short, 1979; Ajmani, Jain, & Saxena, 1985).

Another way to increase the female's egg production is to increase the speed of the menstrual cycle. As shown in Item 90 of Table 1 in Rushton and Bogaert (1988), the percentage of respondents reporting an average cycle length of "28 days or less" is, for the black college-educated sample, 83%; for the white non-college-educated sample, 72%; and for the white college-educated sample, 68%; all the differences being significant. Similarly, in Item 91 with measurement made of the average length of the menstrual flow, the percentage of respondents reporting their flow as "4 days or under" is 54, 40, and 35%, respectively, with all the differences again being significant.

Brain size and intelligence

It is unfortunate how widely believed it is that Tobias (1970) and Gould (1981) "discredited" the racial group differences in brain size known since the 19th Century. It may be an indicator of the intellectual poverty of the Zeitgeist on this issue that their conclusions have been so widely accepted. All these critics did was to take a subset of the data, deconstruct it into particulars and provide artifactual explanations for the scattered elements. If these critics' own "corrected" summary tables are consulted and re-aggregated, however, significant racial differences in brain size are to be observed (Rushton, 1990c).

Many new data have come to my attention since my 1988 reviews. Weizmann et al. (1990) make much of the work of Herskovits (1930) who reported that American blacks had larger head sizes than did Swedish whites, an observation that has also impressed some of my other critics, including Cain and Vanderwolf (1990) and Zuckerman and Brody (1988). Seizing on "facts" like this, however, sheds no light on the issue. Herskovits (1930) actually presented head size data for 36 different male populations collected by different investigators. By selectively choosing among the samples, almost any racial ranking can be made. It is better, therefore, to use the principle of aggregation and average across the numerous exemplars. Rushton (1990c) aggregated the Herskovits (1930) data and showed statistically significant average differences in brain size with non-parametric analyses confirming the trend of Mongoloids (\bar{x} =

1651 cm³, SD = 20, N = 6), larger than caucasoids (\bar{x} = 1621 cm³, SD = 49, N = 13), larger than Negroids (\bar{x} = 1495 cm³, SD = 44, N = 17). While these estimates based on external head measurements from male samples are on the high side of the sex-combined estimates made from internal measures shown in Table 1, the rank ordering is as predicted by Rushton (1988a).

A comprehensive analysis of internally measured cranial capacity has also come to my attention. Beals, Smith and Dodd (1984) computerized the entire world database of 20,000 crania gathered before 1940 (after which data collection virtually ceased because of its presumed association with racial prejudice), grouped them by continental area, and found statistically significant differences. Sex-combined brain cases from Asia averaged 1380 cm³ (SD = 83), Europe averaged 1362 cm³ (SD = 35), and Africa averaged 1276 cm³ (SD = 84). The difference between these estimates and those reported in Table 1 based on Rushton (1988a) is due in part to Beals et al. (1984) making a standard 6% reduction for the data gathered using Broca's method of filling the crania with shot so as to make them comparable to the more numerous data gathered using mustard seed. When this 6% reduction is taken into account, the confirmation of the pattern seems striking.

Examining wet brain weight at autopsy for 1261 adult subjects aged 25–80 after excluding those brains obviously damaged, Ho et al. (1980) avoided most of the problems cited by Tobias (1970) in his supposed debunking of the literature. These authors reported a highly significant sex-combined mean difference of 100 g between American whites (\bar{x} = 1323 g, SD = 146, N = 811) and American blacks (\bar{x} = 1223 g, SD = 144, N = 450). This difference remained after controlling for age, stature, body weight, and total body surface area.

The human brain is a metabolically expensive organ, using 20% of the body's supply of energy while representing only 2% of its body mass. Unless large brains substantially contribute to fitness, therefore, they would not have evolved. One view is that increasing encephalization adds fitness by increasing the efficiency with which information is processed, including as measured using conventional IQ tests. Despite Weizmann et al.'s (1990) denigration of Van Valen's (1974) review estimating a +0.30 correlation between intelligence and brain size, several subsequent studies have

confirmed the relationship including two by Bogaert and me (Rushton, 1990c). Ours were carried out on university students with intelligence measured by Jackson's (1984) *Multidimensional Aptitude Battery* and with maximum horizontal head circumference measured by tape. After controlling for the effects of sex and stature, the correlations between IQ and head circumference were $r_s = 0.18$ and 0.20 ($p_s < 0.01$). R. Lynn (1990a) has reported similar relationships ($r = 0.20$) in 3 independent samples of 8–10 year old children in the United Kingdom, and in a sample of thousands of 7 year old black and white children in the United States. In this last sample, the black children were also found to have smaller head circumferences and lower IQs than the white children.

Especially strong evidence for the relation between brain size and IQ is the recent study by Willerman et al. (1989) who used magnetic resonance imaging to determine brain size in university students. They found an overall correlation of $r = 0.35$ between brain size and IQ score after controlling for many potential confounding variables. Thus, a very strong case exists for a positive correlation between brain size and intelligence in man.

***r-K* Reproductive Strategies**

As the quotations leading into this article indicate, Weizmann et al. (1990) may not be the most reliable guides to *r-K* theory. I will return to consider their criticisms of me shortly. First, however, I present a fuller documentation of my own perspective, based on standard texts, with specific page numbers provided, to help readers to decide for themselves whether the model I erected to synthesize the disparate parts of the database is sound, being adapted in a straightforward way from well documented principles of *r-K* selection in biology.

A whole new canon of theory came into being with MacArthur and Wilson's (1967) *r-K* analysis of how species colonize islands and become equilibrated. Their models emphasized birth rates, death rates and population size (r is a symbol for the maximum rate of increase in a population and is aided by prolific breeding; K is a symbol for the carrying capacity of the environment, or the largest number of organisms of a particular species that can be maintained indefinitely in a given part of the environment). Shortly thereafter, Pianka (1970) generalized the models to codify the life-history traits hypothe-

sized to be selected for, and to covary with, the *r*- and *K*-reproductive strategies produced by *r*- and *K*-selection.

Following these seminal works, the symbols *r* and *K* have been used to designate two ends of a continuum involving trade-offs between offspring production and parental care. To illustrate on a macro-scale, oysters, producing 500 million eggs a year but providing no care, exemplify the *r*-strategy, while the great apes, producing one infant every 5 or 6 years and providing lavish care, exemplify a *K* one. Reproductive characters correlate with and select for other features of the life history (Wilson, 1975). As Table 2 shows, these can be categorized into *family characteristics*, *individual characteristics*, and *population and social system characteristics* (see Barash, 1982: 307; Daly & Wilson, 1983: 201; Eisenberg, 1981: 438ff; Pianka, 1970: 593; Wilson, 1975: 101).

Primates are all relatively *K*-strategists, and humans may be the most *K* of all. Indeed, as depicted in Figure 1, the order primates display a natural scale going from lemur to macaque to gibbon to chimpanzee to humans, in which there is a consistent trend toward *K* with progressive prolongation of gestation period and life phases. Note the proportionality of the four indicated phases. The postreproductive phase is restricted to humans. With each step in the scale, populations devote a greater proportion of their reproductive energy to subadult care, with increased investment in the survival of offspring. As a species, humans are at the *K*-selected end of the continuum. Indeed, it has been proposed that the unique suite of characters that makes up human life histories (central place foraging, with females remaining stationary, and males cooperating to bring food, a strategy that involved bipedality, pairbonding, and reduced male-male competition) came into being as a result of *K*-selection (Johanson & Edey, 1981; Lovejoy, 1981).

Sociobiologists focus primarily on between-species differences. Yet the theory of evolution requires that there be analogous within-species variation, and the *r-K* continuum was initially developed to apply both within- and among-species (MacArthur & Wilson, 1967; see especially Chapter 4 and Glossary). Moreover, several studies of plants, insects, fish and non-human mammals (some reviewed by Rushton, 1985) suggest that not only are life-history variables found to covary within-species as theoretically expected but in some cases to be genetic in origin. For example, Gadgil and Solbrig (1972)

TABLE 2
Some Life History Differences Between *r* and *K* Strategists

<i>r</i> -STRATEGIST	<i>K</i> -STRATEGIST
<i>Family Characteristics</i>	
Large litter size	Small litter size
Short birth spacing	Long birth spacing
Many offspring	Few offspring
High infant mortality	Low infant mortality
Little parental care	Much parental care
<i>Individual Characteristics</i>	
Rapid maturation	Slow maturation
Early sexual reproduction	Delayed sexual reproduction
Short life	Long life
High reproductive effort	Low reproductive effort
High energy utilization	Efficient energy utilization
Low encephalization	High encephalization
<i>Population Characteristics</i>	
Opportunistic exploiters of the environment	Consistent exploiters of the environment
Dispersing colonizers	Stable occupiers
Variable population size	Stable population size
Lax competition	Keen competition
<i>Social System Characteristics</i>	
Low social organization	High social organization
Low altruism	High altruism

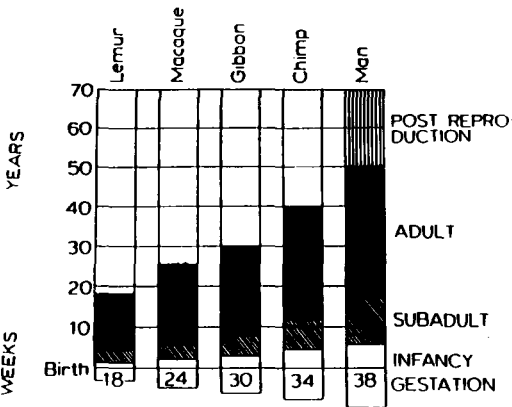


Figure 1. Progressive prolongation of life phases and gestation in primates. From C.O. Lovejoy "The origin of man", *Science*, 1981, 211, 341-350. Copyright by the American Association for the Advancement of Science.

examined within-species differences in plants; specifically the common dandelion. Compared to *r*-strategy dandelions, *K*-dandelions bloomed a year later and devoted more energy to leaf biomass than to reproductive tissue (seed production) thus gaining a competitive advantage in conditions of high density through their capacity to shade out the *r*-types. In a 5-year study of the fluctuating population cycles of field mice, Krebs et al. (1973) found that compared to the *r*-strategists, *K*s bred more slowly, dispersed less readily, and under conditions of high density, competed more successfully. More recent evidence from snow geese is found in Lessells, Cooke and Rockwell (1989) and from ground squirrels in Zammuto and Millar (1985).

Is Rushton's application of *r-K* theory incorrect?

Criticisms of and refinements to the MacArthur and Wilson (1967) and Pianka (1970) formulations began immediately. While some claimed that Pianka's extension was an inappropriate overgeneralization (Stearns, 1977; Boyce, 1984), others found it useful, including

E.O. Wilson (1975), the co-founder of the r - K formulation under discussion (see citations, with page numbers, above). Some argued that r - and K -strategies are not properly organized as bipolar ends of a continuum but, rather, describe orthogonal axes in a multidimensional space where additional strategies also operate (e.g., alpha-strategies, based on extreme competitiveness). "Bet-hedging" theory and other possibilities were also proposed as alternative explanations for patterns in life-history variation (Boyce, 1984; Stearns, 1984). As Dawkins (1982) wrote after describing the extended version: "Ecologists enjoy a curious love/hate relationship with the r - K concept, often pretending to disapprove of it while finding it indispensable" (p. 293).

Weizmann et al. (1990) claim that "the r - K model is frequently misinterpreted and over-generalized" (Abstract) and that I inappropriately relied on an "extended and oversimplified version of the r - K model, with its rigid specification of traits" (p. 3). These statements imply not only that Weizmann et al. and I have different perspectives on the r - K literature, but also that we differ in our understanding of the way science operates. For me, theories are only more or less useful in explaining data.

The power of a theory is in its predictions. I am convinced that simple models provide the best place to begin. Alternative models can then be tested to see if they have greater predictive value. The pervasiveness of the pattern of data in Table 1 suggests that the underlying mechanisms are powerful. When they are evaluated against the attributes of Table 2, I suggest that, on average, Mongoloids are more K -selected than are Caucasoids, who in turn are, on average, more K -selected than are Negroids. My view of r - K theory is precise enough to generate new research and to throw anomalies into relief. For example, from Table 2 it would be predicted that Mongoloids would be larger in body size than Caucasoids, who, in turn, would be larger than Negroids and yet, in the United States at least, the opposite appears to be true (Eveleth & Tanner, 1976).

Two separate reviewers of this rejoinder sided with Weizmann et al.'s view that it was baseless of me to claim that covariation of life history traits *within* human populations should reflect the r - K dimension. This is an empirical question, however, which animal studies cited above already suggest is supported by the evidence. If one generalizes from Table 2 and Figure 1 and

the literature on other animals to a micro-scale of human differences, the more K the family, the greater should be the spacing between births, the fewer the offspring, the lower the rate of infant mortality, the more stable the family system, and the greater the parental care. The more K the person, the longer should be the period of gestation, the higher the birthweight, the more delayed the onset of sexual activity, the older the age at first reproduction, the longer the life, the larger the final body size, the more physiologically efficient the use of energy, the higher the intelligence, the more social-rule-following the behaviour, and the greater the altruism.

Two studies have examined whether this predicted covariation occurs within Caucasian populations. The first contrasts the characteristics of the mothers of dizygotic twins who, because they ovulate more than one egg at a time can be considered to represent the r -strategy, with the mothers of singletons representing the more K -strategy. Predictably, the former mothers were found to have, on average, a lower age of menarche, a shorter menstrual cycle, a higher number of marriages, a higher rate of coitus, a greater fecundity, more wasted pregnancies, an earlier menopause, and an earlier age of death (Rushton, 1987). The second contrasted the characteristics of criminals who, because they are lower in altruism and social organization, can be considered to represent the r -strategy. Predictably, the criminals were found to have shorter gestation periods (more premature births), a more rapid development of sexual functioning, a great copulatory rate outside of bonded relationships (or at least a preference for such), less stable bonding, a lower parental investment in offspring (as evidenced by higher rates of child abandonment, neglect, and abuse), and an earlier age of death (Ellis, 1987).

Are Rushton's r - K predictions arbitrary?

Weizmann et al. (1990) claim that "the predictions that Rushton derives from the r - K model are arbitrary" (Abstract). Because non-scrambling competitiveness tends to be K -selected (see Table 2), they argue that K -selection "would place a premium on selfishness... [and, hence] black crime... is more strongly K - than r -selected" (p. 4). Similarly, Silverman (1990, p. 5) predicted that race differences in crime would be "in the opposite direction than Rushton proposes". My view, however, is that the nature of successful

competition in humans is based on status in a system of social stratification based in large part on intelligence, rule-following, and reciprocal altruism, and that strong intra-specific competition does not lead to anarchy, quite the opposite. Consider, for example, the increase in fighting ability that occurs as a mob evolves into an army. In addition, criminality can be conceptualized as the opposite of altruism, traditionally having been viewed as causing social harm and a disruption to society (Rushton, 1980).

One analysis of the evolution of "rule-following" behaviour was provided by Ellis (1986) who demonstrated their non-legal equivalents, and compensatory policing strategies, in non-human primates. Of crucial importance is the subsequent work of Ellis (1987, 1989) directly applying *r-K* theory to crime including rape, with forced copulation conceptualized as an *r*-reproductive strategy because it emphasizes mating rather than parenting effort. Regarding race differences, Ellis theoretically derived the prediction that "blacks should have higher rape rates than whites, and whites in turn should have higher than Orientals" (p. 94). As we observed earlier, analyses of the data from INTERPOL supported this prediction (Rushton, 1990a).

Also relevant is the work of Draper and Harpending (1988) and Blain and Barkow (1988) who discuss the partitioning of human reproductive strategies into "mating effort" (the *r*-strategy) and "parenting effort" (the *K*-strategy) and review some of the correlates of the former and its culmination in the father-absent child: poor school performance, anti-authoritarianism, aggressiveness, sexual precocity, and criminality. As Draper and Harpending (1988) distinguish: "Father-present societies are those where most males act like dads and father-absent societies where most males act like cads" (p. 349). Although both family systems involve competition in the struggle to replicate genes, the methods by which this is achieved clearly differ.

Heritability and epigenetic rules

That some of the racial group differences in behaviour is genetic is likely from several lines of reasoning. First, all the data in Table 1 are explained by a gene-based evolutionary and therefore genetic theory of racial differentiation. More generally, from an evolutionary perspective, geographically diverse populations living in very different environments predictably will evolve anatomical, physiological and behavioural

differences. For humans, such population differences are indisputable; what remains is to better describe them and to better understand the selective forces that produce them.

A second line of evidence comes from generalizing the 50% heritability found *within* populations to the between-group differences. While it is often thought that heritabilities are specific to particular populations, recent evidence shows they are generalizable across distinct ethnic and national groups. For example, genetic estimates of cognitive ability calculated within Korean families significantly predict similar estimates from Japanese-American and European-American families, and heritabilities calculated for personality from Australian twins significantly correlate with those calculated from British twins (Rushton, 1989b). Genetic estimates in Japan for Wechsler IQ-subtests predict the magnitude of the black-white differences on the same subtests in the United States (Rushton, 1989c). Put another way, blacks and whites are more different on genetically loaded subtests than they are on environmentally loaded subtests (see also Jensen, 1985). This directly implies that racial differences in intelligence are partly due to the genes; if the differences are due to environmental factors, the black-white differences would be least on the more genetically loaded items and subtests. Results such as these, showing the generalizability of genetic estimates, also demonstrate the substantial relatedness of the populations.

Weizmann et al. (1990) insist that "One cannot generalize heritabilities...., a point disputed to our knowledge only by Rushton" (p. 4). They go on to state, however, that "if substantial changes within a population are due to *environmental* changes, then similar explanations may also apply to differences between groups" (p. 5, emphasis added). This is not logical; they cannot have it both ways. If poverty and racial discrimination correlate with under-achievement in New York City, it is right to expect similar relationships in London, England and Toronto, Canada. It is a narrowly conceived argument to expect "environmental" relationships to generalize and "genetic" ones not to. In any case, the evidence from non-human species is also that similar characters tend to have similar heritabilities. Two extensive literature surveys of this question were conducted by Roff and Mousseau (1987) for *drosophila* and by Mousseau and Roff (1987) for non-*drosophila* and both showed, for example,

that morphological traits are consistently more heritable than physiological variables. Curiously, Weizmann et al. cite the latter reference (inappropriately) against me in a different context but failed to note this other component of the paper.

No one believes genes code for social behaviour directly. Rather, genes code for enzymes which, under the influence of the environment, lay down tracts in the brains and neurohormonal systems of individuals, thus affecting people's minds and the choices they make about behavioural alternatives. In regard to aggression, for example, people may inherit nervous systems that differentially predispose them to anger or irritability, or impulsivity, or a lack of conditionability. Several authors have cited independent evidence that testosterone, or its derivative estradiol, may underlie many of the *r/K* traits, including sexuality (Ellis, 1989; R. Lynn, 1990b; Nyborg, 1987; Rushton & Bogaert, 1987). There are many plausible routes from genes to behaviour, and collectively these routes may be referred to as epigenetic rules.

Because cultural practices and social learning play such an important role in human behaviour, epigenetic rules may explain how social influences are genetically channelled. Weizmann et al. (1990) cited the sociobiological work of Lumsden and Wilson (1981) linking genetics with learning. Such formulations also apply to complex social behaviour within the family and can affect the structure of society (Rushton, Littlefield & Lumsden, 1986). For example, studies show that monozygotic and dizygotic twins raised apart for many years in complex environments grow to be significantly similar to each other in a variety of behavioural traits; their degree of similarity is predicted by the number of genes they share (Tellegen et al., 1988). Also, the environmental factors influencing development are typically not shared by siblings but are unique to each; that is, the important environmental variance turns out to be *within* a family, not *between* families (Plomin & Daniels, 1987). Such factors as social class, family religion, parental values, and child-rearing styles are generally found to have only a small effect on siblings. This is true even of traits such as altruism and aggression which parents are expected to socialize heavily. For example, studies of altruism and aggression in adult twins estimate that $\approx 50\%$ of the variance is associated with direct genetic inheritance, virtually 0% with the twin's common family environment, and the remainder with each twin's

specific environment (Rushton, Fulker, Neale, Nias & Eysenck, 1986).

Because variables such as social class and parenting styles account for so little within-race differences in behaviour, they are also unlikely to explain the between-race differences. Instead, if individuals are biased to acquire the cultural patterns that are maximally compatible with their genotypes, then dissimilarities in cultural patterns among groups may be a result of their genes. Dovetailing the above analysis is the transracial adoption study by Scarr et al. (1987). With respect to both social deviancy and IQ, preliminary data indicate that black children adopted into white families are found to not resemble the adoptive siblings with whom they were raised for 17 years. When the children were 7 years of age the results had shown that black IQ was comparable to white IQ, but a 10-year follow up indicates that black IQ and educational achievement has significantly declined while social deviance and psychopathology has increased.

Temporal trends

Generational changes occur on many of the traits and behaviours documented in Table 1, including rate of dizygotic twinning and birthing, IQ scores, educational achievement, sexuality, crime, age of menarche, marital stability, longevity, and even brain size. Why some attributes have altered in the *K* direction and others have moved in the *r* direction, and why they have occurred in some groups more than others is unknown, but these changes can hardly be used to explain away the consistent mean differences found across the swim of tendencies. Nor do they pose quite the insurmountable difficulties for genetic explanations that Weizmann et al. (1990) claim they do; indeed, such a claim demonstrates a poor understanding of genetic processes.

Genetic "influence", not genetic "determinism" is the appropriate catchphrase when it comes to social behaviour. Genetic dispositions affect people's thresholds for activation; for some, a small stimulus is needed to produce behaviour while for others a greater stimulus is required. For all people some situations provide greater stimulation than others. Consider the field of health. Those with a genetic disposition for a disease may never catch it in a benign environment while even those resistant may suffer in a hostile environment. As environments become less impeding and more equal across people, genetic contributions may become larger. For example,

over the last 50 years the heritability of both academic attainment (Heath, Berg, Eaves, Solaas, Corey, Sundet, Magnus & Nance, 1985) and longevity (Scriver, 1984) has increased. The increases in crime witnessed over the last 50 years may similarly be due to the easing of social constraints on underlying genotypes.

The threshold model has great generality, offering a unifying principle to wide areas of psychology (Kimble, 1990). It also explains how genetically organized life-histories can be remarkably sensitive to environmental conditions (Crawford & Anderson, 1989). For example, one recent study revealed how the presence of predatory crayfish in the water dramatically alters life-history characteristics of freshwater snails. In a predator-free environment, snails reproduce when their shells are about 4 millimeters long; the life-spans of such snails are 3 to 5 months. If, however, the stream is also inhabited by crayfish, the snails grow bigger (to double the normal size), live longer (11 to 14 months), and reproduce later (Crowl & Covich, 1990). Allocation of the snail's resources away from reproduction and toward growth shows that these snails can be phenotypically plastic in response to environmental cues (in this case a water-borne chemical).

With human life-histories, work has hardly begun. It is only very recently that it has become accepted that human social development is at least moderately heritable (Plomin, 1990); the application of sociobiology to social development is still novel. For example, the question of why resource abundance should correlate with, or even trigger, a demographic decline in humans to the point of many people producing *no* offspring, provides a fascinating theoretical problem for a sociobiological perspective that people are gene-replicators. Few are addressing or even acknowledging such questions (Barkow, 1989; Vining, 1986).

Human origins

But why would Mongoloids have ended up the most *K*-selected? One possible answer is that as populations moved north, they encountered more predictable environments, including the ice ages which ended only about 10,000 years ago. As Weizmann et al. (1990) recognize, predictable environments are an ecological precondition for *K*-selection. What they have apparently misunderstood, however, is that sub-tropical savannahs, where humans evolved, because of sudden droughts and devastating viral, bacterial, and parasitic diseases, are generally less predic-

table for long lived species than are temperate and especially Arctic conditions. Although the Arctic climate varies greatly over 1 year, it is highly predictably harsh among years. Thus Weizmann et al.'s (1990) aside to readers that due to their tropical ancestry, "blacks, should be more *K*-selected than other human groups" (p. 2) is unlikely. Although tropical rainforests are thought to be stable environments, there is no evidence that humans either evolved in such habitats or have ever been common in them. Further, such unpredictable factors as droughts and disease, which still characterize much of Africa, would have strongly selected for *r*-traits.

We might conjecture that, in order to survive in the predictable Arctic climates, much more forward planning, social organization, and temperamental restraint would be necessary than in unstable environments and these attributes would have been needed most by Mongoloid populations (see also R. Lynn, 1987). The people of Northeast Asia would have found themselves between the encroaching ice from the Himalayas in the south and from the Arctic region in the north. The Siberian cold which existed in this region was more severe than even that experienced by other pale-skinned populations in Northern Europe, who were relatively close to the sea and had no southern ice barrier equivalent to the Himalayas. In response to this extreme cold, distinctive physical adaptations evolved, including the epicanthic fold and the narrow eyes that afford protection against the cold and the glare of the sunlight on the snow, and the flattened face and shortened limbs that reduce heat loss. Thus we might speculate that survival under such predictably harsh conditions pushed the Oriental populations furthest in *K*. There is increasing data to suggest that plants, lizards and mammals become more *K*-selected with increasing elevation and latitude (Zammuto & Millar, 1985).

The phased linearity of the suite of racial-group differences shown in Table 1 focuses attention on many intriguing questions. It may be used, for example, to question alternative reconstructions of human evolution. Data from molecular biology now joins that from paleontology to suggest a recent origin for modern humans with an African beginning, perhaps even as recently as 140,000 to 290,000 years ago, an African-non African split about 110,000 years ago, and a European-Asian split about 41,000 years ago (Stringer & Andrews, 1988).

Thus, the sequence in which the races may have emerged in evolutionary history appears to parallel the behavioural and morphological data shown in Table 1.

Discussion

In discussing ethnic and racial groups it is very difficult not to cause offense. For humanitarian reasons many scientists believe such treatments are inappropriate, given our current state of knowledge. Political sensitivities abound in ways that do not apply to other areas of scientific investigation. Particularly as a result of Hitler's "racial" policies and the aftermath of World War II, the scientific study of race has become as taboo a topic as sexuality was for the Victorians. From the mid 1930s onwards, scarcely anybody outside of Germany and its allies dared to suggest that groups of individuals might be in any biological respect different from any other lest it should appear that the author was excusing the Nazi cause. Those who believed in the biological equality of people were free to write what they liked without fear of contradiction. They made full use of their opportunity in the decades that followed. Politically fuelled also by European decolonization and the U.S. civil rights movement, the idea of a genetically based core to human nature on which individuals (and social classes, sexes, nations, races, and even age-groups) might differ has been consistently derogated.

Of course, nobody actually argues that we should never study racial group differences. However, controversy only occurs when research attributes the differences to genetics. If observed differences in brain size, cognitive ability, sexuality and crime are hypothesized to be due to environmental differences in nutrition or to "white racism", objections are seldom made; if evolutionary and genetic hypotheses are suggested, *ad hominem* attacks are launched. This double-standard is unbecoming to professional scientists. Not to study *all* sources of variance within the human species is neither scientifically nor socially responsible behaviour.

Weizmann et al. derogated some implicit beliefs in Western thought that they alleged culminated in Nazi racial doctrines. This exploitation of the victims of World War II for current political purpose is quite inappropriate. I wonder if someone who lambasted "environmental determinists" for advocating positions leading to

Stalin's gulags, or the tyrannical aristocide of a French Revolution, would be favorably reviewed? Also inappropriate is Weizmann et al.'s questioning of "whether the study of [racial] differences should command any of our limited resources" (p. 11). I have learned the chilling effects of selective intolerance in the academy first hand since my January 1989 presentation to the AAAS (Rushton, 1989d; see Gross, 1990). The wanton splicing of political with scholarly criticism, along with *ad hominem* argument, should have no place in the scientific enterprise.

Weizmann et al. conclude that it is "logically impossible to prove that there are no fundamental genetically based differences....Propositions of human equality, therefore, always remain fragile..." (p. 11). This is a misleading sentiment. While it may not be possible to prove the null hypothesis, it is quite possible to test whether genetically based differences occur when these are predicted in the pattern shown in Table 1, which generates numerous opportunities for refutation.

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