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Commentary on **Steven Rose (1999). Précis of *Lifelines: Biology, freedom, determinism*, by S. Rose; The Penguin Press, 1997. [Reprinted as *Lifelines: Biology beyond determinism*. Oxford University Press] BBS 22(5):871–921.**

Abstract of the original article: There are many ways of describing and explaining the properties of living systems; causal, functional, and reductive accounts are necessary but no one account has primacy. The history of biology as a discipline has given excessive authority to reductionism, which collapses higher level accounts, such as social or behavioural ones, into molecular ones. Such reductionism becomes crudely ideological when applied to the human condition, with its claims for genes "for" everything from sexual orientation to compulsive shopping. The current enthusiasm for genetics and ultra-Darwinist accounts, with their selfish-gene metaphors for living processes, misunderstand both the phenomena of development and the interactive role that DNA and the fluid genome play in the cellular orchestra. DNA is not a blueprint, and the four dimensions of life (three of space, one of time) cannot be read off from its one-dimensional strand. Both developmental and evolutionary processes are more than merely instructive or selective; the organism constructs itself, a process known as autopoiesis, through a lifeline trajectory. Because organisms are thermodynamically open systems, living processes are homeodynamic, not homeostatic. The self-organising membrane-bound and energy-utilising metabolic web of the cell must have evolved prior to so-called naked replicators. Evolution is constrained by physics, chemistry, and structure; not all change is powered by natural selection, and not all phenotypes are adaptive. Finally, therefore, living processes are radically indeterminate; like all other living organisms, but to an even greater degree, we make our own future, though in circumstances not of our own choosing.

Race, brain size, and IQ: The case for consilience

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Abstract: Data from magnetic resonance imaging (MRI), autopsy, endocranial measurements, and other techniques show that: (1) brain size correlates 0.40 with cognitive ability; (2) average brain size varies by race; and (3) average cognitive ability varies by race. These results are as replicable as one will find in the social and behavioral sciences. They pose serious problems for Rose's claim that reductionistic science is inadequate, inefficient, and/or unproductive.

Rose (1999) clearly doesn't like much of today's behavioral and brain sciences, which he characterizes as filled with "reductionism," "reification," "arbitrary agglomeration," "ultra- Darwinism," and "neurogenetic determinism." However, his proposed alternatives, autopoiesis and homeodynamic lifelines – inasmuch as they actually involve anything different – are unlikely to generate testable predictions the sine qua non of science. That is why I associate myself with those commentators (like Alcock 1999) who argued that, based on its long track record of success, to assume some sensible degree of reductionistic determinism *is* the way of science. That is also the view of E. O. Wilson (1998, pp. 30–31), in whose "sociobiological footsteps" I am proud to follow, and who is one of those "ultra-Darwinists" that Rose dismisses. Still, I was surprised that only one of the commentators (Martindale 1999) brought up the relationship between brain size and IQ, and he made mention of a review by Jensen and Sinha (1994) only in passing. No one referred to the remarkable Magnetic Resonance Imaging (MRI) studies showing a correlation of 0.40 existing between brain size and IQ among humans. There are now well over a dozen MRI studies (e.g., Gur et al. 1999; Tan et al. 1999; see Rushton 1995 and Jensen 1998 for reviews). The MRI brain-size/IQ correlation provides a challenge to Rose's anti-reductionism. Brains have evolved via natural selection for behavioral complexity (i.e., intelligence), they show substantial heritable variance and, worst of all from Rose's perspective, they show racial variation at birth, 4 months, 1 year, 7 years, and adulthood (see Fig. 1; Rushton 1997).

Rushton's (1997) study, based on the enormous (N = 35,000)

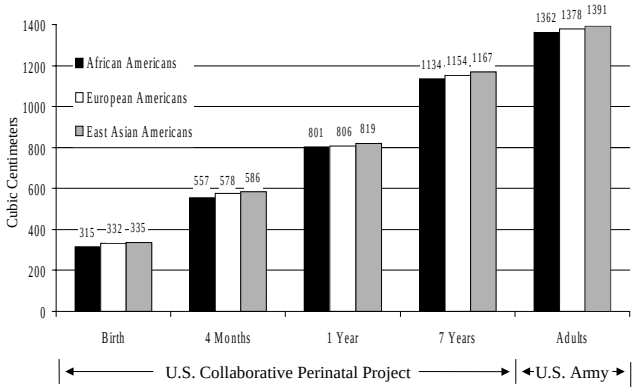

Figure 1 (Rushton). Population Differences in Brain Size. Mean cranial capacity (cm^3) for African Americans, European Americans, and Asian Americans at birth, 4 months, 1 year, 7 years, and in adulthood. From Rushton (1997, p. 15, Fig. 2). Copyright 1997 by Ablex Publishing Corporation. Reprinted with permission.

Collaborative Perinatal Project, also found that at age 7, brain volume estimated from external head size measures correlated 0.20 with IQ scores in the East Asian subsample, just as it had earlier been shown to do in the white and black subsamples (Broman et al. 1987). Although the more accurate MRI measure of brain size yields correlations much higher than the 0.20 in other samples, the head circumference correlation *r* of 0.20 is still significant. Moreover, the Asian subsample in the study averaged a higher IQ (110) at age 7 than did the white (102) or the black subsamples (90).

The pattern of increasing mean brain size from Africans to Europeans to East Asians is not based on a single isolated study or two. It has been corroborated many times in modern studies using four different techniques: wet brain weight at autopsy, volume of empty skulls using filler, volume estimated from external head sizes, and MRI. Consider the following statistically significant comparisons (sexes combined) from recent studies. Using brain mass at autopsy, Ho et al. (1980) summarized data for 1,261 individuals and reported a mean brain weight of 1,323 grams for white Americans and 1,223 grams for black Americans. Using endocranial volume, Beals et al. (1984) analyzed about 20,000 skulls from around the world and found that East Asians, Europeans, and Africans averaged cranial volumes of 1,415, 1,362, and 1,268 cm^3 respectively. Using external head measurements from a stratified random sample of 6,325 U.S. Army personnel, Rushton (1992) found that Asian Americans, European Americans, and African Americans averaged 1,416, 1,380, and 1,359 cm^3, respectively. An MRI study of 100 people in Britain confirmed the white-black difference in brain size, though no details were provided about whether the samples were matched for age, sex, or body size (Harvey et al. 1994).

A parallel gradient from Africans to Europeans to East Asians is found in mean IQ scores. Although Rose (1999, pp. 207, 318) cited my 1995 book reviewing the literature on race differences in brain size and IQ, he obscurely cited it for the heritability of social attitudes. It was cited accurately by Jensen (1998, pp. 442–43) who extended my results by calculating an "ecological" correlation (used in epidemiological studies) of +0.998 between median IQ and mean cranial capacity across the three populations of "Mongoloids," "Caucasoids," and "Negroids." It is only reasonable to expect that brain size and cognitive ability are related. Haug (1987, p. 135) found a correlation of 0.479 ($N = 81$, $P < 0.001$) between number of cortical neurons (based on a partial count of representative areas of the brain) and brain size in humans. His sample included both men and women. The regression equation relating the two measures is: number of cortical neurons (in billions) = 5.583 + 0.006 (cm^3 brain volume). Thus, a person with a brain size of 1,400 cm^3 has, on average, 600 million fewer cortical neurons than an individual with a brain size of 1,500 cm^3. The difference between the low end of the normal distribution for adult brain size (1,000 cm^3) and the high end (1,700 cm^3) works out to be 4.2 billion neurons. That amounts to 27% more neurons for a 41% increase in brain size. The best estimate is that the human brain contains about 100 billion 1,011 neurons. Even storing information at the low average rate of one bit per synapse, which would require two levels of synaptic activity (high/low; on/off), the structure as a whole would contain 1,014 bits of information. Contemporary supercomputers, by comparison, typically have a memory of about 109 bits.

Increasing neurological complexity has increased in invertebrates and vertebrates alike over 700 million years of evolutionary history. This increase entailed metabolic and life-history costs, and the tradeoffs would not have occurred without an adaptive advantage. In the competition to find and fill new niches, there has always been (and likely always will be) "room at the top." Linear theorizing of the observed data lights the path to greater understanding. Rose's approach is a slide into obfuscation.

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Steven Rose has declined to respond to the above Continuing Commentary.