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Editorial

Placing intelligence into an evolutionary framework or how *g* fits into the *r–K* matrix of life-history traits including longevity

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Abstract

First, I describe why intelligence (Spearman's *g*) can only be fully understood through *r–K* theory, which places it into an evolutionary framework along with brain size, longevity, maturation speed, and several other life-history traits. The *r–K* formulation explains why IQ predicts longevity and also why the gap in mortality rates between rich and poor has *increased* with greater access to health care. Next, I illustrate the power of this approach by analyzing a large data set of life-history variables on 234 mammalian species and find that brain size correlates $r=.70$ with longevity (.59, after controlling for body weight and body length). A principal component analysis reveals a single *r–K* life-history factor with loadings such as: brain weight (.85), longevity (.91), gestation time (.86), birth weight (.62), litter size ($-.54$), age at first mating (.73), duration of lactation (.67), body weight (.61), and body length (.63). The factor loadings remain high when body weight and length are covaried. Finally, I demonstrate the theoretical importance of this approach in restoring the concept of "progress" to its proper place in evolutionary biology showing why, over the last 575 million years of evolutionary competition of finding and filling new niches, there has always been (and likely always will be) "room at the top."
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1. Introduction

In both vertebrates and invertebrates, the increments in neural complexity and brain size over the last 575 million years of evolutionary history (Fig. 1) are related not only to increasing behavioral

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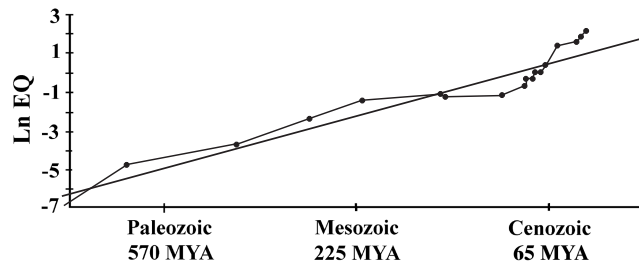*E-mail address:* rushton@uwo.ca.

Fig. 1. Average EQ (natural log), a measure of neural tissue corrected by body size, plotted against elapsed geologic time in millions of years (after Russell, 1983).

complexity (i.e., intelligence) but also to a matrix of life-history traits. For example, across 21 primate species, Smith (1989) found that brain size correlates .80 to .90 with life span, length of gestation, age of weaning, age of eruption of first molar, age at complete dentition, age at sexual maturity, interbirth interval, and body weight. As large brains evolved, they required more prolonged and complex life histories to sustain them. Large brains are also metabolically expensive, representing 2% of body mass but consuming 5% of basal metabolic rate in rats, cats, and dogs, 10% in rhesus monkeys and other primates, and 20% in humans.

Are these merely disparate facts or do they reflect some unifying principle? The answer from evolutionary biology is that brain size and intelligence evolved as part of a "life history"—a genetically organized suite of traits that evolved together to allocate developmental resources to the goals of survival, growth, and reproduction. Traditionally, life-history theory compares the reproductive strategies of different species: *r*-selected species (e.g., fish) have many offspring and invest little or no parental care in any one whereas *K*-selected species (e.g., elephants) have fewer offspring and invest heavily with parental care and other resources in each. Most of the offspring of *r*-strategists die young, but because there are so many of them, enough reach maturity to assure their parents' genetic survival. Although *K*-strategists produce fewer offspring, they have a larger proportion surviving.

The value of placing *g* within the *r–K* matrix is illustrated by its ability to explain puzzling questions, such as the one posed by Gottfredson and Deary (2004): "Intelligence predicts health and longevity, but why?" It also explains the paradox raised by Gottfredson (2004) of why, in spite of increased access to health care (especially in countries with socialized medicine, such as the UK), the gap in mortality rate between rich and poor is *increasing* rather than decreasing (see below). Moreover, placing *g* within the *r–K* matrix provides a theoretical, not just empirical basis for the Aristotelian restoration, returning the concept of "progress" to its rightful place in evolutionary biology.

2. The *r–K* matrix of life-history traits

For over 20 years, I have been applying Harvard University biologist E. O. Wilson's *r–K* Life History Theory to human individual and group differences (Rushton, 1985, 2000; Wilson, 1975). The terms *r* and *K* come from the equation for population growth:

$$\mathrm{d}N/\mathrm{d}t = rN[(K - N/K)]/K$$