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Consilience and Life History Theory: From genes to brain to reproductive strategy

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Abstract

We describe an integrated theory of individual differences that traces the behavioral development of life history from genes to brain to reproductive strategy. We provide evidence that a single common factor, the K-Factor, underpins a variety of life-history parameters, including an assortment of sexual, reproductive, parental, familial, and social behaviors. We explore the psychometrics and behavioral genetics of the K-Factor and offer a speculative account of the proximate mediation of this adaptive patterning of behavior as instantiated in well-established functions of specific areas of the human brain, including the frontal lobes, amygdala, and hippocampus. We then apply Life History Theory to predict patterns of development within the brain that are paedomorphic (i.e., development begins later, proceeds at a slower rate, and has an earlier cessation) and peramorphic (i.e., development begins early, proceeds at a faster rate, and has a later cessation).

Keywords: Consilience; Life History Theory; Reproductive strategy; Social deviance; Brain development; Heterochrony

We describe and extend a research program (Figueredo, Sefcek, Vasquez, et al., 2005; Figueredo et al., 2005c) which, using latent variable modeling, has identified a single common factor, the K-Factor, that underlies a variety of life-history parameters. We first describe Life

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History Theory and derive some testable predictions, including the existence of the K-Factor, as indicated by the positive associations among an assortment of sexual, reproductive, parental, familial, and social behaviors. We then relate the K-Factor to an observed positive manifold or "cluster" of comorbid and socially problematical behaviors as reported in the literature. We go on to explore the psychometric validation and multivariate behavioral genetics of the K-Factor, reviewing much of our own recent empirical work on this topic. Finally, we examine the proximate mediation of this adaptive patterning of behavior as instantiated in brain function and propose an integrated theoretical model that traces the behavioral development of individual life history from genes to brain to reproductive strategy.

Life History Theory as a unifying principle

Life History Theory is a mid-level theory from evolutionary biology that describes the strategic allocation of bioenergetic and material resources among different components of fitness (e.g., calories and nutrients devoted to growth vs. reproduction). Somatic Effort anchors one end of the first dimension of this trade-off whereas Reproductive Effort anchors the other. *Somatic Effort* refers to resources devoted to continued survival of the individual organism whereas *Reproductive Effort* refers to resources devoted to production of new organisms as vehicles for survival of the individual's genes. The second dimension of this trade-off further partitions Reproductive Effort. Mating Effort anchors one end of this continuum whereas Parental Effort and Nepotistic Effort jointly anchor the other. *Mating Effort* refers to resources devoted to obtaining and retaining sexual partners whereas *Parental/Nepotistic Effort* refers to resources devoted to enhancing the survival of existing offspring and other genetic relatives. Thus, a life-history strategy allocates an individual's bioenergetic and material resources among the competing demands of survival and reproduction (Shennan, 2002).

Life History Theory is the basis of a number of studies describing consistent correlations among pace of maturation, length of lifespan, encephalization (i.e., relatively large brains), reproductive effort, and degree of social cohesion (Barash, 1982; Eisenberg, 1981; Rushton, 2004; Wilson, 1975). The r/K continuum proposed by Life History Theory represents a covarying range of reproductive behavior patterns inversely relating life-history traits such as fecundity and parental investment (Bogaert & Rushton, 1989; Mac Arthur & Wilson, 1967). The endpoints of this continuum range from extreme r (e.g., maximum egg output and no parental care) to extreme K (e.g., minimal birth rate and elaborate parental care).

According to Pianka (1970), Life History Theory predicts that, all things being equal, species living in unstable (e.g., fluctuation in food availability) and unpredictable (e.g., high predation) environments tend to will evolve clusters of "r-selected" traits associated with high reproductive rates, low parental investment, and relatively short intergeneration times. In contrast, species living in stable and predictable environmental conditions tend to evolve clusters of "K-selected" traits associated with low reproductive rates, high parental investment, and long intergeneration times. In reference to human evolution, Geary (2005) emphasizes whether the environment is relatively unexploited and resource-rich and can therefore facilitate rapid population expansion, which favors r-selection and entails the production of numerous but inexpensive offspring. In contrast, when the environment is relatively saturated (has reached a high conspecific population density) and therefore occasions more intraspecific competition for limited resources, this favors K-selection and entails sufficient parental investment to produce less numerous but more competitive