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The environment and life history strategies: neighborhood and individual-level models

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ABSTRACT

Life history trajectories have been shown to be sensitive to local environmental conditions. Using English census data (2001), Copping, Campbell, and Muncer (2013) demonstrated that ecological indicators affect life history strategies (affecting levels of criminal violence and teenage conceptions). We replicated the original study using recently published census data (2011) to validate the model. We also examined whether census data from 2001 predict criminal violence and teenage pregnancy outcomes ten years later. Results demonstrated that the proposed model is applicable to both census periods. Predictions of violence and pregnancy rates in 2011 were higher when ecological estimates from 2001 rather than 2011 were modeled. Individuals' perceptions of ecological variables included in the models were also collected from 738 participants. There was a striking concordance between census and individual level data; all but five of the original pathways remained significant. Results highlight the importance of examining different units of analysis and implications are discussed from a life history perspective.

1. Introduction

Research has demonstrated strong correlations between behaviors considered to be socially problematic, particularly between aggression and early reproduction (Celio, Karnik, & Steiner, 2006; Pickett, Mookherjee, & Wilkinson, 2005). Developments in human behavioral ecology and evolutionary psychology suggest that social 'pathologies' can be seen as rational, adaptive choices contingent on ecological circumstances. The conceptualization of local ecologies is often neglected however. This study aimed to empirically validate existing work on how ecological conditions affect behavioral trajectories. A brief discussion of the theoretical background follows.

Draper and Harpending (1982) demonstrated the significance of stable family functioning, highlighting how later reproductive strategy could be contingent on the earlier presence or absence of a father figure. Belsky, Steinberg, and Draper (1991), developing this model, suggested that father absence per se was not the trigger to later reproductive strategy, but the associated stress caused by that absence. Father absence represents one of many stressors that may disrupt parent-child attachment processes (Bowlby, 1969), conveying information to developing children that their environment is unstable. Children with less secure attachments are expected to develop a mistrustful and opportunistic view of the world, and furthermore, reach puberty earlier. Belsky et al. uniquely predicted that the early social experiences of children would contribute to determining the end point of somatic growth. This foreshortening of childhood would be associated with expectations of a harsher future, a tendency to act in a mistrustful, opportunistic way and sexually precocious behavior. This theory is now often referred to as Psychosocial Acceleration Theory.

Chisholm (1993) advanced psychosocial acceleration theory by integrating it with principles drawn from behavioral ecology and life history theory. Life history theory is an evolutionary grounded framework which suggests that organisms optimize investment of resources between somatic and reproductive development within finite parameters, necessitating a series of trade-offs. Trade-offs create variation in the phenotype which translate into variation in reproductive fitness (Roff, 1992; Stearns, 1992). While life history theory initially focussed on between-species variation, human behavioral ecologists and evolutionary psychologists have also applied life history principles to the study of variation within humans (see Cronk, 1991; Kaplan & Gangestad, 2005). For example, organisms can begin reproduction early despite being in a sub-optimal state in terms of somatic, physical or social resource availability. Doing so increases the length of their reproductive window and their potential number of offspring. Alternatively, organisms can delay reproduction and favor growth, allocating time to acquire resources for parenting but reducing the reproductive window. The switching point between growth and reproduction is often referred to as the general life history problem (Schaffer, 1983). Chisholm proposed that assays of one's mortality determine this switching point. Parents rearing children in difficult or 'uncertain' environments (e.g. single parenthood) are subject to stresses that disrupt parent-child attachments. Attachment disruption is internalized in the child as an expectation of an uncertain future with high mortality risks, causing developing children to advance their reproductive schedules and adopt strategies consistent with living fast and dying

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young. This increases the propensity for the expression of behaviors such as sexual precocity and aggression. Chisholm proposed that "uncertainty" in the environment was the ultimate cause of violence and teenage pregnancy and that these behaviors are adaptive survival responses aimed at avoiding lineage extinction in sub-optimal conditions.

Incorporating work on father absence and attachment dysfunction into his concept of environmental uncertainty, Chisholm claimed "ultimately, universal sources of parental stress are the routine social and environmental causes and correlates of high mortality rates—poverty, exploitation, hunger, disease, and war and their accompanying fear and hopelessness" (Chisholm, 1993:7). Many studies have demonstrated links between early stress, family breakdown, life expectancy, aggression, earlier sexual debut and earlier menarche (Belsky, Schlomer, & Ellis, 2012; Chisholm, Quinlivan, Peterson, & Coall, 2005; Ellis & Essex, 2007; Gibson & Tibbetts, 2000; Wilson & Daly, 1997). The role of the family unit as a mediator between environmental stress and expressed behavior is well supported. Ellis, Figueredo, Brumbach, and Schlomer (2009), while supporting the pivotal role of family environments, emphasized the importance of direct perception of environmental stressors. They argued that evolved sensitivities to ecological mortality cues uniquely contribute to behavioral outcomes alongside the influence of familial stress. Individuals internalize ecological information about the relative predictability of local conditions and organisms within it as statistical composites (Wilson & Daly, 1997). This composite is then used to regulate future strategic behavior. Because environmental cues are intercorrelated and operate on multiple levels, organisms consider environments holistically; knowing one facet alone cannot predict strategy development. Ellis et al. (2009) suggested that factors such as exposure to conspecific violence, low socioeconomic status, poor parental investment and poor heath represent cues potentially forecasting premature death or disability, thus impacting on strategy development. Many studies have supported this multi-level perspective on the environment (Belsky et al., 2012; Brumbach, Figueredo, & Ellis, 2009).

Copping, Campbell, and Muncer (2013) used structural equation modeling (SEM) to compare two models. One model was based on the family as a mediator between the environment and an individual's strategy, while the other model incorporated direct environmental effects as well as indirect effects via the family. England and Wales National Census (2001) were used to represent environmental factors potentially impacting upon local crime rates and teenage conceptions. The study demonstrated that a model with multiple levels of impact (on the family, overall strategy and specific behaviors) was the best predictor of crime and pregnancy rates at the level of the environment (indexed by local authorities). They concluded that, while the family unit was undoubtedly crucial (supporting Belsky et al., 1991; Chisholm, 1993), strategy could be influenced directly by environmental cues (supporting Ellis et al., 2009). Levels of overt behavior (aggression in particular) were susceptible to the direct effects of certain environmental factors, particularly those regulating exposure to conspecifics, such as the number and density of the youthful population (termed "local enabling circumstances").

1.1. Current studies

This model was useful in identifying relationships between environmental factors and behaviors of interest, and provided a basis for exploring perceptible environmental cues at the individual level. There were however several avenues for further investigation and some methodological limitations. This study aimed to expand on the original work by addressing the following issues.

The 'snapshot' nature of the original data limits interpretation. All relationships represented localities at a single point in time. Psychosocial acceleration theory however predicts that stress throughout early development (specifically around age 5) should affect the expression of strategy across adolescence (10-15 years later); the onset of adrenarche and the transition to adolescence being the key developmental milestone (Del Giudice, 2009). Without data from two time points, the predictive validity of the model cannot be established. The release of the 2011 census data afforded the opportunity to replicate the original model on comparable data while demonstrating predictive validity in forecasting strategy behaviors in 2011 from data in 2001. The original model specification should demonstrate comparable statistical parsimony using the new data. In addition, if this model validly expresses trajectory development, environmental indicators from 2001 should be more predictive of strategy related behaviors in succeeding years rather than concurrent years. The analysis of these two waves of census data is presented in Study 1.

Furthermore, relationships demonstrated at neighborhood levels, while informative, cannot be translated automatically to the individual as correlations studied at group level are not necessarily reflected at the individual level (the "ecological fallacy"; Robinson, 1950). Mapping environmental correlates to individual strategies therefore requires a study that can mirror these variables at an individual level. Our original model was constructed on the premise that the local ecology causes behavior because elements of it are perceived and processed by an as-yet-unknown psychological mechanism. These perceptions then affect the development of life history trajectories (Chisholm, 1993; Ellis et al., 2009; Wilson & Daly, 1997). While studies have proposed factors that contribute to stressful environments, there is one crucial gap in the literature. Little effort has been made to explore individuals' actual sensitivity to local environmental factors. While our earlier model supported previous findings that sex ratios, density and high youthful populations significantly affect strategy-driven behaviors, do individuals consciously detect this information (particularly, subtle factors such as sex ratio)? Only the study of individuals can determine whether and how such information is perceived and this should be an important research direction. Study 2 moves from macro to micro level analysis regarding key model components. Data were therefore collected to examine individual perception of key variables from the Copping et al. (2013) model and how they affect self-reported strategy based behavior.

2. Study 1

2.1. Method

Data were taken from the England and Wales National Census (2001, 2011). Local authorities are responsible for administering local education, health and government services, representing the smallest unit of analysis available to gather all necessary data while sensitively representing local environments. In the original study, 339 such authorities were analyzed.[1] Between census periods however, local authorities were reorganised in areas of England. Consequently, only 291 local authorities were available for analysis from the 2011 census. Data were merged from authorities in 2001 and recalculated making them comparable with authorities in 2011.

2.1.1. Census measures

Variables from the original study were implemented in this replication (see Copping et al., 2013 for conceptual justifications). Where calculation changes were made, they are described. The following independent variables were measured.

Number of Youths	The number of 15–29 year old males and females were summed and calculated as a rate per 1000 of the local authority population.
Youth Sex Ratio	The ratio of reproductively fit males to females was calculated as the number of males per 100 females in the age range of 15-29.

[1] Thirteen authorities excluded from the original work remain so owing to differences in administration.