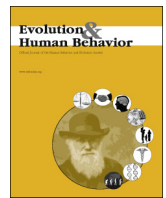




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# Childhood environmental harshness predicts coordinated health and reproductive strategies: A cross-sectional study of a nationally representative sample from France<sup>☆</sup>

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## ABSTRACT

There is considerable variation in health and reproductive behaviours within and across human populations. Drawing on principles from Life History Theory, psychosocial acceleration theory predicts that individuals developing in harsh environments decrease their level of somatic investment and accelerate their reproductive schedule. Although there is consistent empirical support for this general prediction, most studies have focused on a few isolated life history traits and few have investigated the way in which individuals apply life strategies across reproductive and somatic domains to produce coordinated behavioural responses to their environment. In our study, we thus investigate the impact of childhood environmental harshness on both reproductive strategies and somatic investment by applying structural equation modeling (SEM) to cross-sectional survey data obtained in a representative sample of the French population ( $n = 1015$ , age: 19–87 years old, both genders). This data allowed us to demonstrate that (i) inter-individual variation in somatic investment (e.g. effort in looking after health) and reproductive timing (e.g. age at first birth) can be captured by a latent fast-slow continuum, and (ii) faster strategies along this continuum are predicted by higher childhood harshness. Overall, our results support the existence of a fast-slow continuum and highlight the relevance of the life history approach for understanding variations in reproductive and health related behaviours.

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## 1. Introduction

People engage in numerous behaviours that bear a high cost to the individual and to society: smoking, poor engagement in health-promoting behaviours, overconsumption of high calorie foods, teen-pregnancy, etc. In OECD countries, for instance, “lifestyle” conditions linked to tobacco use, excessive diets and physical inactivity are now responsible for most years of lost life (Hurst & Sassi, 2008). Adolescent childbearing has also been a major concern for policy makers because of the potential health costs and loss of education and labor opportunities for teenage mothers (Hoffman, Foster, & Furstenberg, 1993; Miller, 2000). Therefore, identifying the determinants of health and reproductive decisions is of vital importance. Here, we argue that behavioural diversity for health and reproductive decisions should not come as a surprise and should be construed as the predictable outcome of humans' evolutionary make-up.

Specifically, we investigate the idea that health and reproductive decisions are adjusted during development to the way individuals perceive the harshness of their environment. Harshness here refers to extrinsic morbidity-mortality, which encompasses all external sources of death and disability that are largely beyond the individual's control (Ellis, Figueredo, Brumbach, & Schlomer, 2009). Put simply, the hypothesis is that focusing on one's health or delaying reproduction to invest in other areas of life might be less beneficial in environments where mortality is high than in environments where mortality is low. The degree of environmental harshness experienced during childhood may therefore place individuals on a reproductive and health path that is calibrated to their ecology. While previous studies have already highlighted such effects of harshness on reproduction and health behaviours independently, we go further by integrating variation in both domains to take into account the coordinated nature of people's allocation strategies.

Life History Theory (Roff, 2002; Stearns, 1992) provides a general framework to investigate variation in allocation decisions. It states that the life history strategy of any organism is the product of the interaction between tradeoffs among traits and environmental factors that affect mortality and fertility rates (Stearns, 2000). Drawing on these fundamental insights, evolutionary psychologists started to investigate

<sup>☆</sup> The raw data and R script used in this study are available through the Open Science Framework at: <https://osf.io/8k5y4/>.

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how specific adversity events occurring during ontogeny, could be used by individuals as cues to adjust their strategies (Belsky, Steinberg, & Draper, 1991; Chisholm et al., 1993). This led to a fruitful body of research often designated by the name “psychosocial acceleration theory” (Nettle, Frankenhuys, & Rickard, 2012). Specifically, it predicts that individuals living in harsh environments should exhibit overall “fast” strategies, whereas individuals living in favorable environments are expected to show overall “slow” strategies (Ellis et al., 2009). The “fast” end of this fast-slow continuum is generally characterized by a shortened period of growth associated with an early onset of reproduction (early sexual maturation and first reproductive event), a higher number of offspring with a lower investment per offspring, lower body maintenance and a reduced lifespan; whereas the slow end of the continuum has the opposite characteristics (Ellis et al., 2009). According to this theory, having a faster strategy in harsh environments increases an individual's chances to reproduce before dying, whereas a slow strategy in favorable environments would allow for a longer growth period, which in turn, would lead to larger future reproductive benefits. In many species, the level of environmental harshness in which mature individuals will reproduce is uncertain. Adaptive mechanisms of phenotypic plasticity might therefore have evolved to orient individuals' life history strategy based on the level of harshness experienced during the juvenile period. There are two main reasons why life history strategies should be conditioned on early life harshness. First, if early harshness is reliably correlated with post-juvenile harshness, cues of harshness gathered during development should be used as a ‘weather forecast’ to trigger a faster strategy (this is the so-called ‘external-PAR’ hypothesis; see Rickard, Frankenhuys, & Nettle, 2014). Second, if stressful events in early life cause irreversible damage to an organism's soma, the individual should also pursue a faster life history strategy since the probability of early death or disability is increased (this is the so-called internal-PAR hypothesis; see Rickard et al., 2014). Both pathways are not mutually exclusive and they predict that childhood adversity events that might serve as cues of later harshness or that directly impair the individual's somatic state should lead to faster life history strategies. Various features of an individual's socioecology have been argued to provide potential cues of harshness to guide life history decisions (see Ellis et al., 2009 for an extensive discussion). Socioeconomic status (SES) is one important dimension since virtually all forms of morbidity and mortality decrease linearly with SES in western countries (Chen, Matthews, & Boyce, 2002). Personal knowledge of deaths and exposure to violence should also directly affect individuals' estimates of environmental harshness. In addition, level of parental investment might also convey useful information about harshness in the parents' environment.

Although the theoretical link between harshness and fast strategies is not straightforward (Baldini, 2015), empirical studies have repeatedly found associations between proxies of harshness and fast reproductive strategies. For instance, fertility at the country level is predicted by disease diversity, which is a strong indicator of extrinsic morbidity and mortality, even after controlling for various economic, cultural and sociodemographic factors (Guégan, Thomas, Hochberg, de Meeûs, & Renaud, 2001). At the individual level, high socioeconomic deprivation and low parental care during childhood are associated with earlier reproduction (Nettle, 2011), with an earlier onset of puberty (Belsky, Steinberg, Houts, Friedman, DeHart, Cauffman, Roisman, Halpern-Felsher, Susman, and NICHD Early Child Care Research Network, 2007; Belsky, Steinberg, Houts, Halpern-Felsher, and NICHD Early Child Care Research Network, 2010; Ellis, 2004; Ellis & Essex, 2007; Moffitt, Caspi, Belsky, & Silva, 1992; Tither & Ellis, 2008) and more sexual partners (Simpson, Griskevicius, Kuo, Sung, & Collins, 2012). Internal features such as lower birthweights, also predict early reproduction in a longitudinal study of the British population, even after controlling for other socioecological variables (Nettle, Coall, & Dickins, 2009). Hence, people coming from harsher backgrounds

develop overall faster reproductive strategies that manifest in a coherent manner for various sexual traits.

In parallel to these effects on reproduction, exposure to harsh environments also influences resource allocation to body maintenance (Cabeza de Baca & Ellis, 2017; Del Giudice, 2014a). There is indeed a well-documented social gradient in preventive health behaviours (Stringhini, 2010) and part of the disinvestment in health observed in people with lower SES could be due to initial disparities in life expectancies (Nettle, 2010). Indeed, subjective socioeconomic standing is associated with reported effort in looking after one's health in a cross-sectional sample of the American population, and the effect of subjective socioeconomic position is fully mediated by perceived extrinsic mortality risks (Pepper & Nettle, 2014). Inter-individual differences in risky behaviours such as risky sexual behaviours, alcohol or drug use, which are in part predicted by early exposure to harsh environments in longitudinal studies of adolescent behaviours (Belsky, Schlomer, & Ellis, 2012; Belsky, Steinberg, Houts, Halpern-Felsher, and NICHD Early Child Care Research Network, 2010; Brumbach, Figueredo, & Ellis, 2009; Hartman, Li, Nettle, and Belsky, in press; Simpson et al., 2012), could also be interpreted as a disinvestment in body maintenance in response to higher extrinsic mortality risks.

Overall, there is therefore consistent empirical support for the application of Life History Theory principles to the study of allocation strategies in human populations. Nevertheless, most studies have focused on the impact of harshness on a few life history traits restricted to one of the two allocation domains previously highlighted, i.e. reproductive or somatic efforts. Yet, based on psychosocial acceleration theory, we actually expect clusters of correlated traits across these domains, reflecting functional suites of multiple traits that aim toward short-term returns in harsh conditions and long-term returns in favorable environments (Belsky et al., 1991; Figueredo et al., 2006, 2005; Griskevicius, Delton, Robertson, & Tybur, 2011; Reale et al., 2010). Indeed, if the fast-slow continuum is a broad axis of variation relevant to human life history strategies, all else being equal, individuals who adopt fast reproductive strategies should also exhibit lesser investments in their embodied capital (Kaplan, Lancaster, & Robson, 2003). To our knowledge, only one study (Brumbach et al., 2009) explicitly assessed life history strategies with traits related to both reproductive and somatic investments in a single sample and showed that exposure to harsh events during adolescence predicted faster strategies across domains in young adulthood. In the current paper, we further test the existence of coordinated fast-slow strategies by analyzing data from a cross-sectional survey of a nationally representative sample of the French population specifically designed to test the existence of such a fast-slow continuum. We used structural equation modeling to test the prediction that part of the variation in reproductive and somatic effort is predicted by individual differences in exposure to harsh events during childhood. Specifically, we predicted that: 1) It is possible to identify a latent construct reflecting individuals' Life History Strategies which influences decisions pertaining to both reproductive and health choices; 2) Individuals' Life History Strategies fall along a fast-slow continuum. 3) Childhood environmental harshness has an influence on Life History Strategies, such that increased harshness leads to faster behaviours on the fast-slow continuum. In addition, we also tested whether specific harsh events were better predictors of individuals' future life history strategy.

Lastly, it should be stated that despite our nationally representative sample, the cross-sectional design of the study does not allow us to make causal inferences about the reported relationships and it constrained us to use retrospective measures of environmental harshness, which are known to be error prone (Hardt & Rutter, 2004). The use of retrospective measures also prevents us from disentangling the effects of more refined dimensions of harshness that are thought to affect life history strategies independently, such as the mean level of extrinsic morbidity-mortality (harshness per se) vs. the variation across space and time around that mean (Belsky et al., 2012; Ellis et al., 2009; Frankenhuys, Panchanathan, & Nettle, 2016).

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