

COMMENT

The Adaptive Basis of Psychosocial Acceleration: Comment on Beyond Mental Health, Life History Strategies Articles

Daniel Nettle
Newcastle University

Willem E. Frankenhuis
University of California, Los Angeles

Ian J. Rickard
Sheffield University

Four of the articles published in this special section of *Developmental Psychology* build on and refine psychosocial acceleration theory. In this short commentary, we discuss some of the adaptive assumptions of psychosocial acceleration theory that have not received much attention. Psychosocial acceleration theory relies on the behavior of caregivers being a reliable cue of broader ecological conditions and on those ecological conditions being somewhat stable over the individual's lifetime. There is a scope for empirical and theoretical work investigating the range of environments over which these assumptions hold, to understand more deeply why it is that early life family environment exerts such reliable effects on later life-history strategy.

Keywords: psychosocial acceleration theory, developmental plasticity, evolutionary developmental psychology, father absence

The articles in this special section by Belsky, Schlomer, and Ellis (2012); James, Ellis, Schlomer, and Garber (2012); Simpson, Grikevicius, Kuo, Sung, and Collins (2012), and, to a lesser extent, by Dishion, Ha, and Verónneau (2012) all draw heavily on psychosocial acceleration theory, as originally proposed by Belsky, Steinberg, and Draper (1991). Psychosocial acceleration theory has been highly influential in evolutionary developmental psychology, and an impressive literature has built up confirming its central prediction, which is that people who have been exposed to psychosocial stress in the early years of life tend to develop, as adolescents and young adults, a life-history strategy oriented toward early rather than delayed reproduction, as evidenced by early puberty (e.g., Belsky et al., 2007), increased interest in infants (Maestripieri, Roney, De Bias, Durante, & Spaepen, 2004), early onset of sexual activity (e.g., Ellis, Figueredo, & Schlomer, 2009), and relatively early conception (e.g., Nettle, Coall, & Dickins, 2011), among other things. Although the studies supporting the predictions of psychosocial acceleration theory are correlational in nature, they have become increasingly sophisticated in their control for potential alternative explanations, for example by using

genetically informative designs and experiments of nature (Jones et al., 2008; Pesonen et al., 2008; Tither & Ellis, 2008). There is also direct experimental evidence from animal models demonstrating the causal link between adverse early experience and aspects of accelerated life history (Cameron, Fish, & Meaney, 2008; Maestripieri, 2005; Roitberg, Sircom, Roitberg, van Alphen, & Mangel, 1993).

The articles in this section extend and corroborate the central ideas of psychosocial acceleration theory in the following ways. Belsky et al. (2012) builds on the distinction made by Ellis et al. (2009) between the *harshness* of the early environment and its *unpredictability*. Harshness is the average level of psychosocial adversity, whereas unpredictability is the extent to which conditions fluctuate across the life span of individuals. Ellis et al. (2009) predicted that each of these two features of the early environment, which had been conflated in some earlier human studies, should exert unique and independent influences on life-history development. Belsky et al. operationalize *harshness* as low socioeconomic position and *unpredictability* as the number of changes over the first 5 years of life in household composition, place of residence, and parental employment. In their study, as predicted, harshness and unpredictability each exerted unique effects on sexual activity at age 15. The results concur with those of a recent study of ours, in which we found unique and largely additive effects of childhood socioeconomic position on the one hand, and childhood disruptions such as separations from mother or household moves on the other, on age at first conception in a large cohort of British women (Nettle et al., 2011). These findings expand our understanding of the range of early life factors that are important, but caution is needed in the interpretation because it could be that measures of

Daniel Nettle, Centre for Behaviour and Evolution and Institute of Neuroscience, Newcastle University, Newcastle-on-Tyne, England; Willem E. Frankenhuis, Department of Anthropology, University of California, Los Angeles; Ian J. Rickard, Department of Animal and Plant Sciences, University of Sheffield, Sheffield, England.

Correspondence concerning this article should be addressed to Daniel Nettle, Henry Wellcome Building, Newcastle University, Framlington Place, Newcastle NE2 4HH, United Kingdom. E-mail: daniel.nettle@ncl.ac.uk

socioeconomic status and of childhood disruptions are simply capturing different components of harshness (different things that contribute additively to the mean environment experienced) rather than reflecting something about unpredictability (the variance in the environment) *per se*. Subsequent work will be needed to carefully tease these possibilities apart.

The article by James et al. (2012) also confirms a longitudinal association between measures of ecological and psychosocial stress and early sexual debut and risk taking. This article begins its measurements around the time of puberty, which is unusual given the emphasis in the psychosocial acceleration theory literature on the first 5–7 years of life as particularly important for the calibration of life-history strategy. Of course, families experiencing ecological and psychosocial stress when a child is age 12 are likely to have also been experiencing it earlier, a point to which we return later. Dishion et al. (2012) enrich the set of mechanisms usually considered in studies of psychosocial acceleration by examining how deviant peer clustering mediates the relationship between harsh family environment and early sexual activity and childbearing.

Simpson et al. (2012), like Belsky et al. (2012), also focus on the predictive value of uncertainty for accelerated life history, but, in contrast to James et al., their measurements begin in the very early years and stretch right through childhood and adolescence. This allows them to tease apart the unique contributions of environmental experience at different ages. Their data show that, just as Belsky et al. (1991) had originally argued, the experiences in the first 5 years or so of life seem to be uniquely important. The patterns set up in this period will be, as Chisholm (1993) put it, resistant to change, whatever happens in the subsequent environment.

This brings us to the main issue we would like to discuss in this commentary. Most of the literature arising from psychosocial acceleration theory has been empirical, testing for the predicted longitudinal associations and trying to exclude competing causal accounts of them, such as those based on genetic transmission. This is understandable, since developmental psychology is by and large an empirically motivated business, and the great appeal of psychosocial acceleration theory is the “uncanny” empirical predictions it has made concerning the acceleration of pubertal timing. There has been rather less theoretical discussion of the evolutionary assumptions implicit in the original theory: Just why would it be adaptive to speed up life history in response to early psychosocial conditions? Can we say anything about the types of conditions under which such a mechanism could possibly have evolved?

Psychosocial acceleration theory is a hypothesis about developmental plasticity, which is the ability of the same genotype to produce multiple phenotypes depending on the environment in which it develops. It is also an adaptive hypothesis; that is, it specifically makes the claim that genetic variants that lead to individuals who are responsive to their environment in this particular way attain higher fitness than those that make for unresponsive individuals or individuals who respond in some other way. There has been quite a lot of general theorizing in evolutionary biology about when plasticity can evolve, and a set of key conditions that need to be met for plasticity to be favored by natural selection can be identified (see Frankenhuis & Del Giudice, 2012, this issue). These can be roughly summarized as follows (drawing from Nettle, 2009).

1. The lineage must have encountered a range of different environmental conditions over its evolutionary history.
2. There must have been different optimal phenotypes (i.e., phenotypes leading to the highest average reproductive success) for those different conditions.
3. The mapping between environmental conditions and optimal phenotype must have been consistent over evolutionary time; that is, the same phenotype must have recurrently been optimal in a given environmental state.
4. There must be reliable cues available to the organism to what state the environment is in (in this context, *cues* are features of the environment that allow individuals to discriminate between different environmental conditions, and *reliable* means that there has been a consistent relationship over evolutionary time between the state of the environment and the cue received by the organism).
5. The environment must show some degree of temporal autocorrelation. If this is not the case, then investing energy responding to the conditions at Time *t* will be energy wasted, since the conditions at the next point in time bear no relation to the current ones.

For the current case, Condition 1 applies uncontroversially. All species encounter variation in prevailing conditions, and this will be especially true for a widely dispersed, generalist animal such as ourselves. Condition 2 also applies. Imagine a population in which some individuals spend a long time developing and, as a consequence, produce very high quality offspring when they do reproduce, whereas other individuals reproduce earlier but with offspring who are less well set up in terms of parental investment. In an environment in which the rate of mortality and morbidity through early life is very low, almost all individuals of either type will survive to reproduce. Given this, the overall fitness advantage will go to the type whose offspring have a quality advantage. Now imagine that the rate of mortality and morbidity is very high. Now, many individuals will not make it as far as reproducing at all, and, because mortality risk cumulates over time, this will be especially true of the type that delays reproduction. Thus, in this scenario, the representation in the next generation will be skewed toward the offspring of early reproducers. In general, the higher the rate of mortality and morbidity through early life, the greater early reproduction is favored relative to late (Stearns, 1992). This is a general principle that holds across many species (Ellis et al., 2009; Promislow & Harvey, 1990), and so Condition 3 is also met.

Conditions 4 and 5 are more interesting and require some discussion. The contention inherent in the original formulation of psychosocial acceleration theory was that investment from caregivers serves as a valid cue of broader ecological conditions. There is certainly evidence that patterns of parental behavior vary with the harshness of the ecology. This can be seen both in cross-cultural studies of traditional societies (Quinlan, 2007) and studies of the social gradient within developed societies (Nettle, 2010, 2012). However, parental behavior will rarely be a perfect cue of prevailing ecological conditions. A child might grow up with parents who are idiosyncratically unresponsive in a broader ecol-

ogy that is in fact quite benign. In the study by Belsky et al. (2012), for example, environmental conditions do predict maternal sensitivity, but there is plenty of variation in maternal sensitivity not accounted for by environmental harshness or unpredictability, at least as measured in the study. It could be the case that relationships between parental behavior and prevailing ecology tend to be stronger in situations more typical of our evolutionary history. Monkeys and rats appear to use parental investment as a cue in a very similar way to humans (Cameron et al., 2008; Maestripieri, 2005). Thus, it is an intriguing question to ask why, when there are other ways we might imagine young animals obtaining information about their environment, it seems to be sensitivity to parental behavior that is so important. One way of investigating this question would be to explicitly study the predictive power of parental behavior for the outcomes that befall young people and compare this with the predictive power of other putative cues (e.g., exposure to the death or illness of peers).

Condition 5 is the requirement for temporal autocorrelation of the environment. This is a particularly important condition for a case such as that of human sexual development, where there is a time lag of many years between the influential cues and the behavioral phenotype (as the article by Simpson et al. (2012) makes clear). What matters for the optimal choice of life-history strategy is the total morbidity and mortality risk cumulated over the whole of the period from birth to the end of reproduction. The central idea of psychosocial acceleration theory is that conditions in the early years give a “weather forecast” of that cumulated risk (Bateson et al., 2004). But weather forecasts are worth attending to only if they accurately predict the future. Thus, for psychosocial acceleration to be adaptive, it is not just that early childhood psychosocial conditions have to be decent cues of the early childhood ecology, but also early childhood ecology has to be a decent predictor of ecology through the rest of childhood, adolescence, and young adulthood.

The mechanisms posited by psychosocial acceleration theory could thus evolve only if, in the typical environments our ancestors experienced, relevant ecological parameters tended to be at least moderately stable, for a given individual, over timescales of a decade or more. If this were not the case, then there would be no fitness benefit to using early experience to calibrate later life-history strategy. Given that there is strong empirical evidence for life-history acceleration associated with childhood psychosocial stress, there is a theoretical need to use models to examine what evolutionary ecologies are likely to result in developmental mechanisms that tailor reproductive schedules on the basis of early cues.

What could provide ecological stability of the required kind? One possibility that has been discussed is the fact that pre-Holocene climates were characterized by dramatic climate oscillations that were very rapid over evolutionary timescales but rather slow over individual lifetimes, often lasting hundreds or thousands of years (Potts, 1998; Richerson, Boyd, & Bettinger, 2001). Thus, being born into a time of food stress and desperation would generally have predicted a lifetime of such conditions, for whole groups.

Another possibility relates to social status. We are prone to thinking of the great intragroup variation in social status in human societies as a modern phenomenon. However, consider the very stable multigenerational status differences between families that are found in baboons, for example (Cheney, 1977). Here, an

individual's final status in life is strongly predicted by the status of its mother, particularly for females. Thus, whatever relative conditions the maternal generation is going through when the offspring are small are likely to be fairly valid indicators of what the next generation in that family will experience. The extent to which baboons constitute a model for ancestral human states is debatable. However, the mechanisms discussed by psychosocial acceleration theory may be phylogenetically widespread, and the stability of rank is a feature of many kinds of primate societies, so we may be dealing with the vestiges of a more general primate (or mammalian) pattern. Consistent with this view, people are highly attuned to indicators of social status, and infants readily learn about social dominance relations at a very young age (Thomsen, Frankenhuis, Ingold-Smith, & Carey, 2011).

In summary, the evidence for psychosocial acceleration theory continues to build, and the theory continues to be refined, as exemplified by the four articles discussed here. Psychosocial acceleration theory will continue to benefit from its synergy with the life sciences, serving as a model for other studies of human development. Our flexible human nature depends on a rich array of evolved developmental mechanisms, which adapt individuals to local conditions. Many of these mechanisms have received less attention than has psychosocial acceleration theory, and some remain to be uncovered. We may, therefore, expect continued progress in the years to come, as research sheds light on the intricate relationship between evolved developmental mechanisms and the environments experienced by young humans now and stretching back into the evolutionary past.

References

- Bateson, P., Barker, D., Clutton-Brock, T., Deb, D., D'Udine, B., Foley, R. A., . . . Sultan, S. E. (2004). Developmental plasticity and human health. *Nature*, *430*, 419–421. doi:10.1038/nature02725
- Belsky, J., Schlomer, G. L., & Ellis, B. J. (2012). Beyond cumulative risk: Distinguishing harshness and unpredictability as determinants of parenting and early life history strategy. *Developmental Psychology*, *48*, 662–673. doi:10.1037/a0024454
- Belsky, J., Steinberg, L., & Draper, P. (1991). Childhood experience, interpersonal development, and reproductive strategy: An evolutionary theory of socialization. *Child Development*, *62*, 647–670. doi:10.2307/1131166
- Belsky, J., Steinberg, L. D., Houts, R. M., Friedman, S. L., DeHart, G., Cauffman, E., Roisman, G. I., . . . Susman, E. (2007). Family-rearing antecedents of pubertal timing. *Child Development*, *78*, 1302–1321. doi:10.1111/j.1467-8624.2007.01067.x
- Cameron, N. M., Fish, E. W., & Meaney, M. J. (2008). Maternal influences on the sexual behavior and reproductive success of the female rat. *Hormones and Behavior*, *54*, 178–184. doi:10.1016/j.yhbeh.2008.02.013
- Cheney, D. L. (1977). Acquisition of rank and development of reciprocal alliances among free-ranging immature baboons. *Behavioral Ecology and Sociobiology*, *2*, 303–318. doi:10.1007/BF00299742
- Chisholm, J. S. (1993). Death, hope, and sex: Life-history theory and the development of reproductive strategies. *Current Anthropology*, *34*, 1–24. doi:10.1086/204131
- Dishion, T. J., Ha, T., & Véronneau, M.-H. (2012). An ecological analysis of the effects of deviant peer clustering on sexual promiscuity, problem behavior, and childbearing from early adolescence to adulthood: An enhancement of the life history framework. *Developmental Psychology*, *48*, 703–717. doi:10.1037/a0027304
- Ellis, B. J., Bates, J. E., Dodge, K. A., Fergusson, D. M., Horwood, L. J.,

- Pettit, G. S., & Woodward, L. (2003). Does father absence place daughters at special risk for early sexual activity and teenage pregnancy? *Child Development, 74*, 801–821. doi:10.1111/1467-8624.00569
- Ellis, B. J., Figueredo, A. J., & Schlomer, G. L. (2009). Fundamental dimensions of environmental risk: The impact of harsh versus unpredictable environments on the evolution and development of life history strategies. *Human Nature, 20*, 204–268. doi:10.1007/s12110-009-9063-7
- Frankenhuis, W. E., & Del Giudice, M. (2012). When do adaptive developmental mechanisms yield maladaptive outcomes? *Developmental Psychology, 48*, 628–642. doi:10.1037/a0025629
- James, J., Ellis, B. J., Schlomer, G. L., & Garber, J. (2012). Sex-specific pathways to early puberty, sexual debut, and sexual risk-taking: Tests of an integrated evolutionary-developmental model. *Developmental Psychology, 48*, 687–702. doi:10.1037/a0026427
- Jones, M. E., Cockburn, A., Hawkins, C., Hesterman, H., Lachish, S., Mann, D., . . . Pemberton, D. (2008). Life history change in disease-ravaged Tasmanian devil populations. *PNAS: Proceedings of the National Academy of Sciences, USA, 105*, 10023–10027. doi:10.1073/pnas.0711236105
- Maestripieri, D. (2005). Effects of early experience on female behavioural and reproductive development in rhesus macaques. *Proceedings of the Royal Society B-Biological Sciences, 272*, 1243–1248. doi:10.1098/rspb.2005.3059
- Maestripieri, D., Roney, J. R., De Bias, N., Durante, K. M., & Spaepen, G. M. (2004). Father absence, menarche and interest in infants among adolescent girls. *Developmental Science, 7*, 560–566. doi:10.1111/j.1467-7687.2004.00380.x
- Nettle, D. (2009). *Evolution and genetics for psychology*. Oxford, England: Oxford University Press.
- Nettle, D. (2010). Dying young and living fast: Variation in life history across English neighborhoods. *Behavioral Ecology, 21*, 387–395. doi:10.1093/beheco/arp202
- Nettle, D. (2012). Behaviour of parents and children in two contrasting urban neighbourhoods: An observational study. *Journal of Ethology, 30*, 109–116.
- Nettle, D., Coall, D. A., & Dickins, T. E. (2011). Early life conditions and age at first pregnancy in British women. *Proceedings of the Royal Society B: Biological Sciences, 278*, 1721–1727. doi:10.1098/rspb.2010.1726
- Pesonen, A.-K., Räikkönen, K., Heinonen, K., Kajantie, E., Forsén, T., & Eriksson, J. G. (2008). Reproductive traits following a parent–child separation trauma during childhood: A natural experiment during World War II. *American Journal of Human Biology, 20*, 345–351. doi:10.1002/ajhb.20735
- Potts, R. (1998). Variability selection in hominid evolution. *Evolutionary Anthropology, 7*, 81–96. doi:10.1002/(SICI)1520-6505(1998)7:3<81::AID-EVAN3>3.0.CO;2-A
- Promislow, D. E. L., & Harvey, P. H. (1990). Living fast and dying young: A comparative analysis of life-history variation amongst mammals. *Journal of Zoology, 220*, 417–437. doi:10.1111/j.1469-7998.1990.tb04316.x
- Quinlan, R. J. (2007). Human parental effort and environmental risk. *Proceedings of the Royal Society B-Biological Sciences, 274*, 121–125. doi:10.1098/rspb.2006.3690
- Richerson, P. J., Boyd, R., & Bettinger, R. L. (2001). Was agriculture impossible during the Pleistocene but mandatory during the Holocene? A climate change hypothesis. *American Antiquity, 66*, 387–411. doi:10.2307/2694241
- Roitberg, B. D., Sircom, J., Roitberg, C. A., van Alphen, J. J. M., & Mangel, M. (1993). Life expectancy and reproduction [Letter to the editor]. *Nature, 364*, 108. doi:10.1038/364108a0
- Simpson, J. A., Griskevicius, V., Kuo, S. I.-C., Sung, S., & Collins, W. A. (2012). Evolution, stress, and sensitive periods: The influence of unpredictability in early versus late childhood on sex and risky behavior. *Developmental Psychology, 48*, 674–686. doi:10.1037/a0027293
- Stearns, S. C. (1992). *The evolution of life histories*. Oxford, England: Oxford University Press.
- Thomsen, L., Frankenhuis, W. E., Ingold-Smith, M., & Carey, S. (2011, January 28). Big and mighty: Preverbal infants mentally represent social dominance. *Science, 331*, 477–480. doi:10.1126/science.1199198
- Tither, J. M., & Ellis, B. J. (2008). Impact of fathers on daughters' age at menarche: A genetically and environmentally controlled sibling study. *Developmental Psychology, 44*, 1409–1420. doi:10.1037/a0013065

Received January 4, 2012

Accepted January 9, 2012 ■