

The Influence of Prenatal Hormone Exposure on Life Course Discontinuity

Extended abstract prepared for the European Population Conference, Budapest 2014

Anette Fasang¹ & Sebastian Schnettler²

¹Humboldt University Berlin, ²University of Konstanz

Background

Life history theory applies principles of biological evolution to behavioral strategies over the life cycle that are related to mating and reproduction [1]. With regard to our own species, the theory predicts that humans face a number of trade-offs when maximizing reproductive success in response to varying environmental conditions. These are most generally the trade-offs between current and future reproduction (allocating energy to own survival or fertility) and between the quality and quantity of offspring. The degree of adversity and stability in an environment predicts which strategies are optimal with regard to reproductive success. The influence of environment on development is assumed to be strongest at certain developmental “switch points” in the life cycle, e.g., in-utero, early post-partum period, or during the juvenile phase [2,3]. Although humans have evolved a certain degree of developmental plasticity in the sense that life history strategies may be adapted to changing environmental conditions across the life course [4], the influence is particularly large very early in development, particularly in-utero: According to the organizational hypothesis in behavioral endocrinology, early exposure to androgens has permanent, organizational effects on brain and behavior [5,6]. These are distinct from activational effects of circulating hormone concentrations. Whereas organizational effects link early environment with behavioral outcomes later in life by eliciting different developmental strategies, activational effects orchestrate behavior in a more immediate way and in response to changes over the life course.

In the strict sense, life history theory applies to behavior in the realm of mating and reproduction only and distinguishes fast and slow life history strategies. The first one is characterized through early maturation and reproduction, quantity over quality of offspring and higher mating than parenting efforts. The latter is characterized by the opposite pattern and individuals can be on a continuum between these two strategies [4]. These predictions from life history theory and behavioral endocrinology have important implications for life course sociology. The environment mediated by biological processes, has lasting impact on

human development and is thus assumed to shape patterns of family trajectories. But although life history theory relates first and foremost to behaviors in the mating and reproductive sphere, a number of behaviors in other spheres of the life course are affected as well, as they are linked to mating and reproduction. These involve behaviors in the domains of status-seeking strategies, risk-taking and aggression, and personality characteristics like cooperation, altruism and time perspective.

High exposure with testosterone during the second trimester is thought to be associated with fast reproductive and mating strategies whereas low exposure with testosterone (relative to estrogen) is thought to make slow reproductive strategies more likely. In this paper, we examine if different levels of exposure to androgens in-utero are predictive of the degree of instability and discontinuity in subsequent life course trajectories. In particular, fast vs. slow strategies from life history theory predict differences in the timing and frequency of events in family trajectories, and higher risk-taking behavior in the fast strategy also predicts more instability in educational and occupational trajectories. Therefore, overall we predict higher disorder in the life course of individuals with high exposure to testosterone during pregnancy, but higher order in the life courses of individuals with low exposure to testosterone. We examine instability in early-mid adult employment and family trajectories. These differences should be particularly pronounced for men as compared to women, as the selective pressures are assumed to be highest for men, given that they have in evolutionary history shown a higher variance in reproductive success than women [4].

Data & Methods

The difficulty and costs of direct measurement in embryos and the lag between measurement and later life outcomes has resulted in the need for indirect measurement of organizational hormonal effects [5]. The length ratio of the second and fourth digits (2D:4D) (dividing the length of the index finger on the right hand by the length of the ring finger) has been found to be a stable marker of prenatal steroid hormone exposure with high validity [5,7,8]. As known from a large and growing number of laboratory experiments, 2D:4D is associated with a variety of health-related, physiological, personality and behavioral traits [9–15], with important between- and within-gender differences [10–12,16]. There are outcome implications of these traits in various life-course domains such as occupational careers, partnership, reproduction, and adolescent risk behavior. Existing studies often have few participants and limited information on later-life outcomes. Therefore, they don't allow

assessing the external validity of perinatal hormone exposure for life-course outcomes and the hormone and social context interplay throughout the life-course.

For our project we use 2D:4D data collected as part of the 6th wave of the Innovation Panel (IP6) of the British *Understanding Society* study. IP6 provides the first 2D:4D implementation worldwide in a large, representative and longitudinal social survey. It provides a depth of information on social status, occupational, and family histories, and regional variation of contextual factors that is unprecedented in 2D:4D research. Data collection administered to about 1500 households is underway and data are expected to be delivered in November 2013.

References

1. Shanahan MJ, Hofer SM, Shanahan L (2003) Biological models of behavior and the life course. In: Mortimer JT, Shanahan MJ, editors. *Handbook of the life course*. New York: Kluwer Academic Publishers.
2. Del Giudice M, Angeleri R, Manera V (2012) Juvenility and the juvenile transition. In: Levesque RJR, editor. *Encyclopedia of Adolescence*. New York: Springer, Vol. 12. pp. 1534–1537. Available: http://bsb-lab.org/site/wp-content/uploads/DelGiudice_etal_2012_juvenility_juvenile-transition_chapter.pdf. Accessed 9 November 2013.
3. Del Giudice M, Angeleri R, Manera V (2009) The juvenile transition: A developmental switch point in human life history. *Developmental Review* 29: 1–31. doi:10.1016/j.dr.2008.09.001.
4. Del Giudice M, Belsky J (2011) The development of life history strategies: Toward a multi-stage theory. In: Buss DM, Hawley PH, editors. *The evolution of personality and individual differences*. New York: Oxford University Press.
5. Breedlove SM (2010) Minireview: Organizational Hypothesis: Instances of the Fingerpost. *Endocrinology* 151: 4116–4122. doi:10.1210/en.2010-0041.
6. Nelson RJ (2011) *An introduction to behavioral endocrinology* (4th edition). Sinauer. 670 p.
7. Manning JT, Scutt D, Wilson J, Lewis-Jones DI (1998) The ratio of 2nd to 4th digit length: A predictor of sperm numbers and concentrations of testosterone, luteinizing hormone and oestrogen. *Hum Reprod* 13: 3000–3004. doi:10.1093/humrep/13.11.3000.
8. Hönekopp J, Bartholdt L, Beier L, Liebert A (2007) Second to fourth digit length ratio (2D:4D) and adult sex hormone levels: New data and a meta-analytic review. *Psychoneuroendocrinology* 32: 313–321. doi:10.1016/j.psyneuen.2007.01.007.
9. Voracek M, Loibl LM (2009) Scientometric analysis and bibliography of digit ratio (2D:4D) research, 1998–2008. *Psychological Reports* 104: 922–956. doi:10.2466/pr0.104.3.922-956.

10. Grimbos T, Dawood K, Burriss RP, Zucker KJ, Puts DA (2010) Sexual orientation and the second to fourth finger length ratio: A meta-analysis in men and women. *Behavioral Neuroscience* 124: 278–287.
11. Voracek M, Pietschnig J, Nader IW, Stieger S (2011) Digit ratio (2D:4D) and sex-role orientation: Further evidence and meta-analysis. *Personality and Individual Differences* 51: 417–422. doi:10.1016/j.paid.2010.06.009.
12. Hönekopp J, Watson S (2011) Meta-analysis of the relationship between digit-ratio 2D: 4D and aggression. *Personality and Individual Differences* 51: 381–386.
13. Hönekopp J, Voracek M, Manning JT (2006) 2nd to 4th digit ratio (2D:4D) and number of sex partners: Evidence for effects of prenatal testosterone in men. *Psychoneuroendocrinology* 31: 30–37. doi:10.1016/j.psyneuen.2005.05.009.
14. Voracek M, Tran US, Dressler SG (2010) Digit ratio (2D:4D) and sensation seeking: New data and meta-analysis. *Personality and Individual Differences* 48: 72–77. doi:10.1016/j.paid.2009.08.019.
15. Voracek M, Pum U, Dressler SG (2010) Investigating digit ratio (2D:4D) in a highly male-dominated occupation: The case of firefighters. *Scandinavian Journal of Psychology* 51: 146–156. doi:10.1111/j.1467-9450.2009.00758.x.
16. Hönekopp J, Watson S (2010) Meta-analysis of digit ratio 2D:4D shows greater sex difference in the right hand. *Am J Hum Biol* 22: 619–630. doi:10.1002/ajhb.21054.
17. James WH (2001) Finger-length ratios, sexual orientation and offspring sex ratios. *J Theor Biol* 212: 273–274. doi:10.1006/jtbi.2001.2376.