

## Timing of Pubertal Maturation in Girls: An Integrated Life History Approach

Bruce J. Ellis  
University of Arizona

Life history theory provides a metatheoretical framework for the study of pubertal timing from an evolutionary-developmental perspective. The current article reviews 5 middle-level theories—energetics theory, stress-suppression theory, psychosocial acceleration theory, paternal investment theory, and child development theory—each of which applies the basic assumptions of life history theory to the question of environmental influences on timing of puberty in girls. These theories converge in their conceptualization of pubertal timing as responsive to ecological conditions but diverge in their conceptualization of (a) the nature, extent, and direction of environmental influences and (b) the effects of pubertal timing on other reproductive variables. Competing hypotheses derived from the 5 perspectives are evaluated. An extension of W. T. Boyce and B. J. Ellis's (in press) theory of stress reactivity is proposed to account for both inhibiting and accelerating effects of psychosocial stress on timing of pubertal development. This review highlights the multiplicity of (often unrecognized) perspectives guiding research, raises challenges to virtually all of these, and presents an alternative framework in an effort to move research forward in this arena of multidisciplinary inquiry.

Pubertal maturation is a dynamic biological process—punctuated by visible changes in stature, body composition, and secondary sexual characteristics—that culminates in the transition from the pre-reproductive to the reproductive phase of the human life cycle. The timing of this transition is variable and has substantial social and biological implications. An extensive body of research in Western societies now indicates that early pubertal maturation in girls is associated with a variety of negative health and psychosocial outcomes. In particular, early-maturing girls are at greater risk later in life for unhealthy weight gain (e.g., Adair & Gordon-Larsen, 2001; Wellens et al., 1992), breast cancer (e.g., Kelsey, Gammon, & John, 1993; Sellers et al., 1992), and a variety of other cancers of the reproductive system (e.g., Marshall et al., 1998; McPherson, Sellers, Potter, Bostick, & Folsom, 1996; Wu et al., 1988); have higher rates of teenage pregnancy, spontaneous abortion and stillbirths, and low-birth weight babies (reviewed below); and tend to show more disturbances in body image, to report more emotional problems such as depression and anxiety, and to engage in more problem behaviors such as aggression and substance abuse (e.g., Caspi & Moffitt, 1991; Dick, Rose, Viken, & Kaprio, 2000; Ge, Conger, & Elder, 1996; Graber, Lewinsohn, Seeley, & Brooks-Gunn, 1997). Given this sobering array of outcomes, it is critical to understand the life experiences and pathways that place girls at increased risk for early pubertal maturation.

Life history theory (Charnov, 1993; Roff, 1992; Stearns, 1992) provides a metatheoretical framework for the study of timing of

pubertal maturation from an evolutionary-developmental perspective. It attempts to explain the timing of reproductive development and events across the life span in terms of evolved strategies for distributing metabolic resources between the competing demands of growth, maintenance, and reproduction. Life history theory constitutes a set of widely held basic assumptions that have shaped how evolutionary scientists generate and test middle-level theories of pubertal timing. In the current article, I review five middle-level theories—energetics theory, stress-suppression theory, psychosocial acceleration theory, paternal investment theory, and child development theory—each of which applies the basic assumptions of life history theory to the question of environmental influences on timing of pubertal maturation in girls. These middle-level theories are consistent with and subsumed by life history theory but in most cases have not been directly deduced from it (i.e., the middle-level theories are mostly inductions rather than deductions from the metatheory). Each middle-level theory reviewed in this article provides a different translation of the higher-order principles of life history theory into specific hypotheses and predictions that are tested in research. The current review demonstrates how these theories compete to achieve the best operationalization of the core logic of life history theory as it applies to variation in pubertal timing (see Ketelaar & Ellis, 2000, for further discussion of metatheoretical research programs).

The first section below discusses neurophysiological processes underlying pubertal development, defines pubertal timing, and reviews how it is measured. The second section discusses sources of variation in pubertal timing and critically reviews behavior genetic work in this area. Both genotypic and environmental sources of variation in pubertal timing are important and in need of explanation. The third section provides an overview of life history theory and its application to pubertal timing. The fourth and fifth sections review energetics theory (e.g., Ellison, 2001) and stress-suppression theory (e.g., Cameron, 1997; MacDonald, 1999), which posit that adverse physical or social conditions, whether

---

I am indebted to Ronald Dahl, for a series of conversations that influenced the ideas upon which this article is based; to Jay Belsky, Judy Cameron, Garth Fletcher, and Robert Quinlan, for comments on an earlier version of this article; and to Rochelle Ellis, Myron Friesen, and Jacqui Tither, for their research assistance.

Correspondence concerning this article should be addressed to Bruce J. Ellis, Division of Family Studies and Human Development, University of Arizona, P.O. Box 210033, Tucson, AZ 85721-0033. E-mail: bjellis@email.arizona.edu