ATTACHMENT AND TIME PREFERENCE

Relations between Early Stress and Sexual Behavior in a Sample of American University Women

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This paper investigates hypotheses drawn from two sources: (1) Belsky, Steinberg, and Draper's (1991) attachment theory model of the development of reproductive strategies, and (2) recent life history models and comparative data suggesting that environmental risk and uncertainty may be potent determinants of the optimal tradeoff between current and future reproduction. A retrospective, self-report study of 136 American university women aged 19–25 showed that current recollections of early stress (environmental risk and uncertainty) were related to individual differences in adult time preference and adult sexual behavior, and that individual differences in time preference were related to adult attachment organization and sexual behavior. These results are consistent with the hypothesis that perceptions of early stress index environmental risk and uncertainty and mediate the attachment process and the development of reproductive strategies. On this view individual differences in time preference are considered to be part of the attachment theoretical construct of an internal working model, which itself is conceived as an evolved algorithm for the contingent development of alternative reproductive strategies.

KEY WORDS: **Attachment theory; Early stress; Environmental risk and uncertainty; Life history theory; Reproductive strategies; Sexual behavior of young women.**

Received: October 3, 1997; accepted February 1, 1998.

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Human Nature, Vol. 10, No. 1, pp. 51–83. **1045-6767/99/$1.00+.10**

Evolutionary theory is fundamentally a theory of optimal design. Its central justification is the working hypothesis that organisms are "designed" by natural selection to allocate resources in ways that produce the greatest possible number of copies of an individual's genes transmitted as far as possible into future generations. This is the essence of "optimality thinking" (Dennett 1995; Parker and Maynard Smith 1990). As we have known since Lack's (1947, 1966) work on optimal clutch size, however, the best strategy for achieving this goal is much more complicated than simply producing the greatest possible number of offspring at every possible reproductive opportunity. This is especially the case for humans, among whom wealth and social position are typically unequally distributed in space and time, yet typically also have a great impact on the number of offspring produced and their reproductive value. The purpose of this article is to demonstrate how an organism's optimal reproductive strategy is determined by its *future* as well as its current conditions, and thereby to suggest why human reproductive strategies so often seem developmentally contingent on current indicators of future risk and uncertainty.

I begin with a brief sketch of life history theory, focusing on the "ecology of time," especially (1) environmental risk and uncertainty and the critical tradeoff between current and future reproduction, (2) the reasons why life history research is turning increasingly to the developmental psychobiological mechanisms that actually produce alternative reproductive strategies, and (3) why contingent individual differences in time preference are likely to be part of these mechanisms. I turn next to Jay Belsky and Pat Draper's attachment theory model of the development of alternative reproductive strategies (Draper and Harpending 1982; Draper and Belsky 1990; Belsky et al. 1991), then review my own understanding of the attachment process as a developmental psychobiological mechanism for optimizing the tradeoff between current and future reproductive success contingent on the amount of environmental risk and uncertainty encountered during early development (Chisholm 1993, 1995a, 1995b, 1996). The remainder of the article reports on a study derived from this model about the relations between early stress, attachment history, sexual behavior and attitudes, and time preference in a large sample of young American university women. Bivariate analyses show that a number of early stressors, including strained relations in the family, are correlated not only with adult attachment, but also with adult sexual behavior and time preference. Multivariate analyses support the proposition that individual differences in time preference play a role in the allocation of adult reproductive effort. In closing I argue that understanding the effect of risk and uncertainty on human reproduction shows why "optimality thinking" leads to a stance of relativity: because it shows how superficially *sub*optimal reproductive strategies—construed by some as irresponsible, irrational, or immoral—may in fact often be optimal.

LIFE HISTORY THEORY: THE ECOLOGY OF TIME

Current vs. Future Reproduction

At the heart of life history theory is the "principle of allocation" (Levins 1968; see also Darwin 1871; Fisher 1930; Lack 1947). According to this principle, organisms always have limited resources of energy, nutrients, security, information, and time—but also always face unremitting demands for greater fitness (i.e., continued survival, more or better growth and development, and, ultimately, more descendants). Life history theory assumes, therefore, that selection will tend to favor phenotypic mechanisms that allocate limited resources to survival, growth and development, and reproduction in the way that is optimal for maximizing number of descendants. This necessarily involves tradeoffs among the components of fitness, because resources allocated to one component cannot be allocated to another. Resources allocated to survival, for example, cannot be allocated to growth and development as well, nor can those allocated, say, to the production of offspring also be allocated to their rearing. Among the several tradeoffs studied in life history research (e.g., survival vs. growth, survival vs. reproduction, quantity vs. quality of offspring, growth vs. reproduction), the one between current and future reproduction is emerging as one of the most important or prevalent. The "general life history problem" (Schaffer 1983), as it is known, is a model that predicts the optimal allocation of resources to reproduction at a given age based on the assumption that there is a tradeoff between current and future reproduction (Stearns 1992). This means simply that beyond some threshold, increased reproduction in the short term (current reproduction) is expected to *decrease* number of descendants in the long term (future reproduction). This can happen for two reasons: (1) because resources consumed for current reproduction would have had greater fitness returns if they had been consumed in the future, or (2) because current reproduction reduces parents' probability of survival into the future.

Evolutionary theory therefore does not expect selection always to favor phenotypic mechanisms that simply maximize number of offspring in the short term, or even in each generation. This is because (everything else being equal), over a period of generations, consistently producing a small number of high-quality offspring who survive to reproduce results ultimately in more descendants than having a larger number of lower-quality offspring whose chances of producing grandchildren are low or unpredictable. In risky or uncertain environments, for example, where extrinsic mortality rates are high or unpredictable, or where the flow of material resources necessary for the production or rearing of offspring is low or uncertain, it is often simply beyond parents' wealth or power to increase their offsprings' reproductive value. Under such conditions the short-term reproductive strategy of maximizing current reproduction may be the optimal strategy, because by maximizing the probability of having *some* offspring who survive and reproduce, one minimizes the probability of lineage extinction. On the other hand, in environments where parental investment is limited but parents can still make a significant difference in offspring reproductive value, the long-term strategy of consistently producing fewer, high-quality offspring may be optimal because (*ceteris paribus*), for logical reasons, such a "less is more" reproductive strategy maximizes descendants in future generations. Contrary to a great deal of popular wisdom, therefore, under some conditions producing offspring at an early age and/or a high rate and investing minimally in each one *can* be an adaptive strategy. Even for mammalian females (who by virtue of numerous anatomical and physiological adaptations are often characterized as the "nurturant" sex) it is not always true that reproductive success depends exclusively on the resources a mother is able to accrue for her offspring—sometimes it depends instead on her producing *more* offspring, or producing them earlier (Borgerhoff Mulder 1992; Charnov 1990, 1991, 1993; Charnov and Berrigan 1993; Gillespie 1977; Harpending et al. 1990; Hill 1993; Kaplan 1994; Promislow and Harvey 1990; Purvis and Harvey 1995; Rogers 1990, 1994; Rubenstein 1982; Seger and Brockmann 1987; Stearns 1992).

The Search for Mechanisms

If risk and uncertainty (e.g., in mortality regimes and resource flows) are important determinants of the optimal tradeoff between current and future reproduction, then under life history theory's assumption of optimality we would expect selection to have favored phenotypic mechanisms for assessing such risk and uncertainty and for altering reproductive strategies accordingly. What are these mechanisms? Do they exist? Without some knowledge of these mechanisms we cannot adequately test life history models nor fully comprehend the process of adaptation (e.g., Dennett 1995; Oyama 1985). To understand what selection *should* favor it is necessary to test optimality models against the qualities of real organisms (the so-called "phenotypic gambit" [e.g., Grafen 1984; Smith and Winterhalder 1992]). To understand what selection *can* favor, however, we must understand how these organisms work—which means understanding how gene × environment interactions generate the phenotypic mechanisms that actually produce adaptations. Bernardo phrased the problem this way:

> The most significant difficulty with current [life history] models is the assumption that the analysis of patterns of phenotypic variation can identify the underlying biological mechanisms responsible for generating or maintaining the variation. . . . [W]hile optimal control and other phenotypic opti-

> mization models may implicate potential sources of phenotypic variation, they cannot predict whether organisms are capable of producing such phenotypes, or how that variation is generated (1993:172).

And as Emlen (1995) recently argued in his evolutionary theory of the family, the kinds of phenotypic variation in which we ought to be interested are those involved in decision making:

> The condition-dependent expression of many social behaviors in no way precludes them from genetic influence. The work of researchers such as Maynard Smith [1982] and Parker [1989] has clarified the relationship between conditionality and the evolution of behavior. Indeed, the last decade has seen a marked shift toward viewing organisms as "decision makers," selected to accurately assess the consequences of different behavioral options available to them and to express those behavioral variants that maximize their fitnesses (1995:8092).

The task, then, is to identify psychobiological mechanisms that are capable of representing environmental risk and uncertainty and using that information to adjust (i.e., "make decisions" about) reproductive strategies accordingly.

As mentioned, Belsky and Draper (Draper and Harpending 1982; Draper and Belsky 1990; Belsky et al. 1991) have proposed that the attachment process is an evolved mechanism for entraining adaptive alternative reproductive strategies. Although their model is not based on the tradeoff between current and future reproduction, and does not make explicit use of the evolutionary ecological concept of risk and uncertainty, it is an elegant, compelling model that helps organize a great many otherwise disparate findings about attachment and the allocation of reproductive effort, and it can easily be assimilated to recent advances in life history theory (e.g., Belsky 1997; Chisholm 1993, 1996; Hill et al. 1994). Before reviewing their model, however, it will be useful first to introduce the concept of time preference. This will lay the foundation for the central working hypothesis guiding the pilot study reported here that individual differences in time preference are related to individual differences in attachment organization and are functions of the psychobiological mechanisms or algorithms[1] that are involved in the development of alternative reproductive strategies.

Risk, Uncertainty, and Time Preference

An individual's time preference is the degree to which he or she expects or prefers (consciously or not) to receive benefits, rewards, or consequences of action now, immediately—or later, sometime in the future.

Known as the discount rate in economics, time preference is also known as impatience, impulsiveness, self-control, intertemporal choice, or ability to defer gratification. The origin and nature of individual differences in time preference are critical areas of study, for two reasons. The first is that such individual differences are known to have important effects on behavior in many species, including humans. Impulsiveness, for example, has been implicated in such pressing individual and social concerns as drug addiction, HIV infection, young male violence, teenage pregnancy, high infant mortality, crime, and low educational attainment (e.g., Ainslie 1975, 1992; Gardner 1993; Gardner and Herman 1990; Gottfredson and Hirschi 1990; Green et al. 1994; Lawrence 1991; Loewenstein and Elster 1992; Logue 1988; Maital and Maital 1977; O'Rand and Ellis 1974; Rogers 1994; Vila 1994; Wilson and Daly 1985, 1997; Wilson and Herrnstein 1985). Moreover, individual differences in time preference are heavily influenced by environmental risk and uncertainty. When the future is objectively risky and uncertain it is not necessarily wise to take the long view—because when the future is uncertain the value of future consumption decreases relative to that of current consumption (e.g., Clark 1990, 1991; Gardner 1993; Hill et al. 1997; Kacelnik and Bateson 1996; Krebs and Kacelnik 1991; Mangel and Clark 1988; Rogers 1994; Seger and Brockmann 1987; Stephens 1990). For example, in a pioneering study of the source of individual differences in time preference Mischel (1958, 1961a, 1961b) reported that 7- to 9-year-old children from father-absent households were more likely to choose a small immediate reward than to wait a week for a promised larger one. More than ten years later children who had been able to delay gratification were judged more academically and socially competent (Mischel et al. 1988) and were better able to cope with frustration and stress and scored higher on the Scholastic Aptitude Test (Shoda et al. 1990). While it is not clear how much difference father absence per se makes in developmental outcome, it is abundantly clear that the political and economic conditions that give rise to father-absent households also typically give rise to greater environmental risk and uncertainty in general (Aber 1993; Bane and Ellwood 1989; Burbank 1988, 1995; Burton 1990; Draper and Harpending 1982; Lancaster 1989; Luker 1991; Marris 1991; Mencher and Okongwu 1993; Phoenix 1993; Scheper-Hughes 1992). If it is generally adaptive or rational to discount the future when it is risky and uncertain then it may make sense for father-absent children to have a short time preference.

The second reason that the nature and origin of individual differences in time preference are such critical areas of study is that the psychobiology of time preference is a likely candidate mechanism for optimizing the current-future tradeoff. In a formal, life history sense, time preference can be construed as the payoff in fitness at some future date that would be required for an individual to forgo some immediate, current fitness payoff. To paraphrase a familiar metaphor, this is logically equivalent to saying that "a baby in hand is worth two in the future." As the general life history problem suggests (*ceteris paribus,* as always), when the future is dangerous or unpredictable the optimal strategy is (or was, in the environment of evolutionary adaptedness [EEA]) to discount or devalue it at a high rate. Doing so makes immediate, short-term payoffs more attractive (because they are now relatively more valuable). This in turn means that it would take impossibly high and guaranteed fertility in the future to compensate for forgoing some immediate opportunity to reproduce (which, simply by virtue of its immediacy, becomes more attractive). In other words, under conditions of high risk and uncertainty we might expect selection to favor psychobiological mechanisms that produce a motivational bias or taste for short-term payoffs. By this reasoning, as Elizabeth Hill and her colleagues (Hill et al. 1997) also argue, the degree to which individuals discount the future might reflect their optimal tradeoff between current and future reproduction (or what might have been optimal in the EEA).

The results of Arline Geronimus's pioneering work on the socioecology of early fertility are consistent with this model (Geronimus 1987, 1994, 1996). The crux of her argument is that many chronically poor women are already deeply disadvantaged well before they ever have children, and that early childbearing may in fact maximize reproductive opportunities whereas a delay in childbearing only allows the original stressors more time to work their deleterious effects. For Geronimus, early childbearing by chronically poor women does not reflect any inability to plan for the future but reflects instead their "strategic considerations" concerning objective (even if not entirely conscious) perceptions that they "face not simply a shorter, but a far more uncertain lifespan" (1996:346). She argues persuasively that in the face of such actuarial facts of life it is not entirely irrational for young women to fail to avoid pregnancy. As she put it, "By deciding to become teen mothers, young women in some persistently impoverished populations may be planning for the kind of future they have every reason to expect" (1996:346). Similarly, in their recent study of the relation between age-specific fertility and mortality in 77 Chicago neighborhoods, Wilson and Daly (1997) found that the highest rates of early childbearing were concentrated in those neighborhoods that had the highest mortality rates.

But in order for any internal, psychobiological mechanism to compute the optimal tradeoff point, the external, objective environmental contingencies that most closely determine what is optimal must be represented phenotypically—that is, literally embodied, as a state or trait, or even as subjective experience (e.g., Johnson 1987, 1993; Plotkin 1994). If the mind is in part adapted to solve the optimization problems that life history theory suggests are important, then to study the mind it is surely necessary to study nature—such as the nature and determinants of environmental risk and uncertainty. This is because adaptations are traits that are *patterned with respect to* nature; literally, they are "fit" (*aptus*) "to" (*ad*) some purpose or use in nature. An adaptation is thus environmental information that has been embodied in (or as Piaget put it, "assimilated to") the phenotype (see also Dennett 1995; Plotkin 1994). The psychobiological mechanisms that underlie the development of alternative reproductive strategies may thus also be involved in, or even work through, those that underlie the development of individual differences in the perception of environmental risk and uncertainty—that is, the mechanisms of gene × environment interaction that generate individual differences in time preference. Notwithstanding evidence for essentially life-long effects of innate differences in temperament (e.g., Kagan 1994), the best model that we have for the *contingent* development of alternative reproductive strategies in humans is the one proposed by Belsky, Steinberg, and Draper (1991).

THE DEVELOPMENT OF REPRODUCTIVE STRATEGIES

Building on the work of Draper and her colleagues (Draper and Harpending 1982; Draper and Belsky 1990), Belsky, Steinberg, and Draper (1991) have proposed that the allocation of reproductive effort in adults is at least partially contingent on the developmental effects of early psychosocial stress. Their model links (1) early family context, including relations with and between parents, with (2) parents' patterns and styles of interaction with children (e.g., sensitivity, responsiveness), (3) children's attachment organization (i.e., secure or insecure attachment), (4) children's age at sexual maturation, and (5) their adult "predispositions" to emphasize either the production (so-called mating effort), or rearing (parenting effort) of offspring. When the early family context is one of stress,[2] parents are more likely to be insensitive or unresponsive to their children, which places the children—especially those who are physically, temperamentally, or socially vulnerable—at risk for the development of insecure attachment. Following standard attachment theory (e.g., Ainsworth et al. 1978; Bowlby 1969, 1973, 1980; Bretherton and Waters 1985; Parkes et al. 1991), Belsky and colleagues hold that children with a history of insecure attachment relations are at risk for developing insecure internal working models (IWMs [Bowlby 1969]; i.e., negative images, schemata, or expectations) of themselves and attachment objects. The Belsky et al. model suggests that negative expectations about self and/or important others, in turn, will be associated in adulthood with what Skolnick (1986) has described as "aloof and detached" or "clingy and dependent" styles in close emotional relations, and with earlier and/or wider sexual/emotional involvement with others. In short, Belsky et al.'s model holds that the attachment process serves to register early stress and to entrain alternative reproductive strategies accordingly.

Noting points of contact between this model and recent advances in life history theory, I have argued that the ultimate reason why early stress might be expected to lead to early reproduction and/or a high reproductive rate is that early stress served to index environmental risk and uncertainty (Chisholm 1993). Because of its inherent sensitivity to environmental risk and uncertainty (i.e., mortality rates or "loss") and low or uncertain resource flows, it seems that the attachment process would have been exposed to novel selection pressures and that parental investment strategies themselves might come to function as an index of early environmental risk and uncertainty and as an evolved "switch" (or "rheostat") mechanism for the development of alternative reproductive strategies (Chisholm 1993, 1996).

Using Belsky et al.'s model to investigate the role of "childhood adversity and environmental risks" on adult romantic/sexual relations, Hill and her colleagues (1994) have shown empirically that a variety of measures of early stress (poverty, parental divorce, abusive punishment, etc.) were good predictors of adult attachment style (i.e., secure vs. insecure) and adult romantic/sexual behavior. They found, for example, that insecure adults were less likely than secure adults ever to have been in a love relationship—but that if they had ever married or cohabited, they did so at a younger age and after a shorter courtship. They also found that attachment history affected men's and women's love relationships differently: Secure men had *longer* love relationships than insecure men—but secure women entered love relationships when they were *older* and after a significantly *longer* courtship than insecure women. This is significant because while attachment theory makes no predictions about sex differences in patterns of attachment, life history theory expects them (e.g., Trivers 1972). Hill and her colleagues interpret their findings in explicit life history terms, arguing that their results are consistent with the proposition that early environmental risk and uncertainty "fosters short-term rather than long-term mating strategies" (1994:323).

SOME PREDICTIONS

The goal of the research reported here was to test predictions from a synthesis of life history theory and Belsky et al.'s model about the interrelations among early stress, attachment history, and time preference, and their effects on young women's reproductive strategies (indexed by age at first sexual intercourse and extent of sexual activity). For two reasons I was particularly interested in the relations between time preference and the other variables. First, if a major dimension of individual differences in reproductive strategies is along the axis between short-term (current) and long-term (future) reproduction, and if early perceptions of environmental risk and uncertainty are important determinants of these individual differences, then we might expect individual differences in time preference to vary with measures of early stress and young adult sexual behavior. Second, if children perceive early environmental risk and uncertainty through the social-emotional mechanism of the attachment process, then we might expect individual differences in time preference to be correlated with individual differences in adult attachment organization and adult romantic/sexual behavior. Evidence for this proposition would constitute support for a prediction from evolutionary theory about the content or function of the attachment theoretical construct of the internal working model—and thus support for the Belsky et al. early stress model in general. The overall model explored in this analysis is depicted below in Figure 1.

METHODS

Subjects

The data analyzed here were collected from 136 women between the ages of 19 and 25 (mean = 21.4 ± 1.5) who were enrolled in a large human development course at the University of California, Davis. Only 5 (3.7%) of these women were currently married, and none had ever been divorced or widowed. Most of them were white/Caucasian (63.2%), Asian (16.9%), and Latina (9.6%), with the remaining 10.3% identifying as African-American, Native American, Pacific Islander, and "other" in approximately equal numbers. While two-thirds of the sample (65.4%) identified with major Eastern or Western religions, a univariate ANOVA showed no significant difference among religions (including "no religion") in any of the primary dependant variables under study. As a sample of convenience these women are not representative of the larger U.S. society. The great

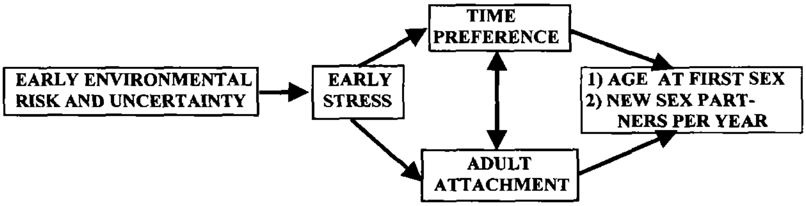

Figure 1. Model for analyzing the development of alternative reproductive strategies.

majority of subjects (87.6%) reported that they grew up in at least middle-class circumstances, with only 12.5% reporting "poor" or "working poor/lower-middle-class" backgrounds. Likewise, the great majority of their parents completed high school (mothers: 85.9%; fathers: 88.3%), and about half also completed university (mothers: 44.8%; fathers: 58.7%).

Measures

Participants completed an anonymous, not-for-credit questionnaire designed to elicit standard demographic and biographical data, as well as information about their relations with their parents and about their parents' relationship with each other, about other potential sources of early emotional stress, and about their sexual behavior, adult attachment history, and time preference. Because some questions dealt with highly personal and potentially troubling topics, it was emphasized repeatedly that participants were not obliged to answer each question, and that they could drop out of the study entirely at any time. Telephone numbers of various local counseling services were also appended to the questionnaire.

Relations with parents/parents' relationship. Internal working models of parents were assessed using Hazan and Shaver's (1987) adjective checklist—one for mother, one for father, and a third for relations between mother and father. Scores on the three scales were the sum of the positive and negative adjectives that subjects used to describe their parents (e.g., loving, attentive, confident vs. critical, intrusive, selfish) and their parents' relationships (e.g., affectionate, supportive vs. distant, troubled) "while [the subjects] were growing up." Scores ranged between –7 and 7 for mothers, –8 and 7 for fathers, and –3 and 2 for parents' relationship.

Other early stress. Additional indicators of the amount of early environmental risk and uncertainty (psychosocial stress) recalled by each subject were obtained from answers to questions about the presence or absence of the following experiences prior to age ten: (1) parents separate or divorce; (2) separation from mother "for what seemed like a long time"; (3) physical abuse (striking with closed fist or object, deprived of food or clothing, etc.); (4) sexual abuse (e.g., unwanted viewing or touching of body, attempted or actual sexual contact, including rape, through physical force or by virtue of authority); (5) death of parent; and (6) death of sibling or other close relative. There is good evidence that each of these early stressors is associated with increased risk of later social-emotional dysfunction (e.g., Herrenkhol et al. 1995; Wolkind and Rutter 1985). Subjects received one point for each type of early stress, and total stress scores ranged between 0 and 3. Just over half of the sample (56.6%) reported no early stress at all, 33.8% reported one stressor, 8.1% reported two, and only 1.5%

experienced as many as three early stressors. Further indicators of potential early stress included subjects' assessment of their own SES while growing up and years of parents' education—both ranked on five-point scales. However, because mothers' and fathers' years of education were highly correlated ($r = .73$; $p < .001$) (and none had zero years of school), maternal and paternal scores were multiplied to provide a single measure of parents' education.

Sexual behavior. These measures constituted the primary dependent variables. Subjects were asked how old they were (to the nearest year) when they first experienced consensual heterosexual vaginal sexual intercourse and how many different sexual partners they had had in their lives (Figure 2). From these figures, and the subject's present age, a rate variable, "sex partners per year since sexual activity commenced," was created. Subjects were also asked at what age (to the nearest year) they had first menstruated. Means and standard deviations for these variables are given in Table 1, for the sample as a whole and for each of the three main ethnic groups constituting the bulk of the sample (89.7%). While there were no ethnic group differences in age at menarche or age at first sex, Table 1 shows that the 15 Asian women in the sample took new sexual partners at approximately twice the rate of the white/Caucasian and Latina women. A univariate ANOVA, however, showed that the ethnic group means were in fact not significantly different ($F = 2.45$, $p = .09$).

Adult attachment. Participants' adult attachment history was assessed through Hazan and Shaver's (1987) Close Relationships Questionnaire (CRQ), which consists of two parts. In the first, subjects are requested to classify themselves as being (1) uncomfortable with emotional closeness in romantic relationships (conceptually analogous to insecure-avoidant attachment), (2) uncomfortable with others' failure to get sufficiently close in romantic relationships (analogous to insecure-anxious/ambivalent attachment), and (3) comfortable with mutual emotional closeness in romantic relationships (analogous to secure attachment). In the second part of the CRQ, subjects are asked to rank (on a seven-point scale) the *degree* to which they are uncomfortable with closeness, uncomfortable with others' failure to get close, and comfortable with mutual closeness. This interval measure of attachment *strength* proved more useful than the nominal measure of attachment *type,* and so will serve as my primary measure of adult attachment. Summary adult attachment data are provided in Table 2.

Time preference/perspective. Time preference was assessed using the Zimbardo Time Perspective Inventory (ZTPI; formerly the Stanford Time Perspective Inventory) (Zimbardo 1990, 1992a, 1992b). The ZTPI consists

Table 1. Dependent Variables: Maturation and Sexual Behavior (for full sample and three main ethnic groups constituting 89.7% of full sample)

	*Full sample**			*Asian*			*Caucasian*			*Latina*		
Measure	*n*	*mean*	*s.d.*	*n*	*mean*	*s.d.*	*n*	*mean*	*s.d.*	*n*	*mean*	*s.d.*
Age at menarche	134	12.65	1.54	22	12.77	1.97	86	12.67	1.47	13	12.31	1.60
Age at first sexual intercourse	96	17.01	1.72	15	17.07	1.87	59	17.08	1.65	10	16.30	1.70
Sex partners per year since first intercourse	95	.88	1.06	15	1.42	1.96	58	.77	.75	10	.67	.60

*includes Asian, Caucasian, Latina, and other ethnic groups. Sample sizes vary because of missing data.

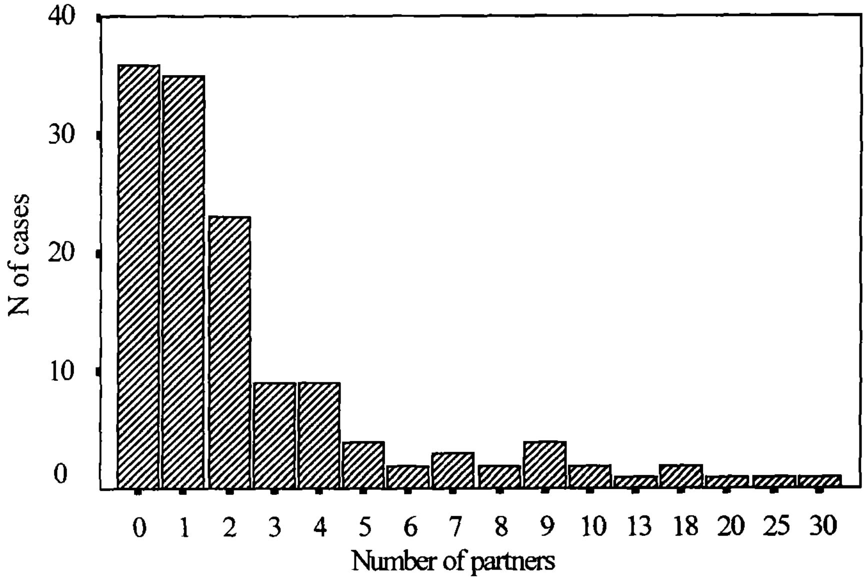

Figure 2. Lifetime number of sexual partners (mean = 2.91; *n* = 136 women age 19–25).

Table 2. Adult Attachment Scores

			Strength of identification with attachment type	
Measure	*n*	*Percent*	*Range*	*Mean*
Adult Attachment Type				
Avoidant	48	35.8	1–7	3.90
Anxious/ambivalent	21	15.7	1–7	3.08
Secure	65	48.5	1–7	4.67
	134	100.0		

of 38 questions on five-point self-rating scales relating to individuals' time preference, or the manner and degree to which they are oriented to the past, present, or future. Factor analyses of ZTPI scores typically yield four or five main "time preference types," of which I was interested in three: the future, present-hedonistic, and present-fatalistic perspectives (see Table 3). Following Zimbardo's scoring procedures, subjects were ranked on each of these time perspective types by summing their raw scores on the ZTPI items that Zimbardo used to define these factors (Zimbardo 1992b). In addition, because time preference is often related to school performance (e.g., Mischel et al. 1988; O'Rand and Ellis 1974) subjects were asked for their current grade point average (GPA).

Table 3. The Three "Time Preference Types" from Factor Analyses of the Zimbardo Time Perspective Inventory

Future orientation. "This person's decisions tend to be based less on concrete, empirical aspects of the current behavioral setting and relatively more on his or her anticipated, abstract imaginings of future consequences of alternative courses of action. . . . There is clear concern for the consequences of one's actions, attention to responsibility, liability, optimizing outcomes. This person accepts delays of immediate gratification to achieve longer-term goals. She or he is also willing to invest effort and resources in current activities that only have a distant payoff, and to endure unpleasant current situations that have the potential for positive future outcomes."

Present-hedonistic orientation. This person is "self indulgent, playful, enjoys all things that bring immediate pleasure and avoids those that involve much effort, work, planning or unpleasantness." This person "lives to consume the good life and takes many different kinds of risks in part because he or she does not fully consider the realities of negative consequences and at the same time seeks stimulation and excitement. Is vulnerable to addictions of all sorts, regardless of knowledge of potential negative consequences."

Present-fatalistic orientation. These people "believe it does not pay to plan since nothing works out for them as they envision. They feel their lives are externally controlled rather than internally orchestrated by them. Their self-image is largely as a passive pawn of fate, of higher spiritual authority, or ideological, political, structural forces in their environment."

Source: Zimbardo 1992a:2–4

Following Burton's (1990) lead I also assessed individual differences in a potentially critical dimension of time perspective—expected lifespan—through the questionnaire item: "If you had to take a guess about how long your life would be (how long you would live) what would your guess be?" Participants were offered a choice of ten answers at ten-year intervals, from "20 years old" up to "over 100 years old." Responses were scored as reported, i.e., at the beginning of the decade intervals rather than its midpoint (e.g., "50" instead of "55"). One hundred thirty-four subjects answered this question, yielding a mean expected lifespan of 81.46 years (± 10.00; range 50–100 years) (see Figure 3).[3]

RESULTS

Table 4 shows the correlations amongst the primary study variables, grouped according to the elements of the model shown in Figure 1. To explore further the interrelationships within and between these groups of variables I first conducted a number of bivariate analyses.

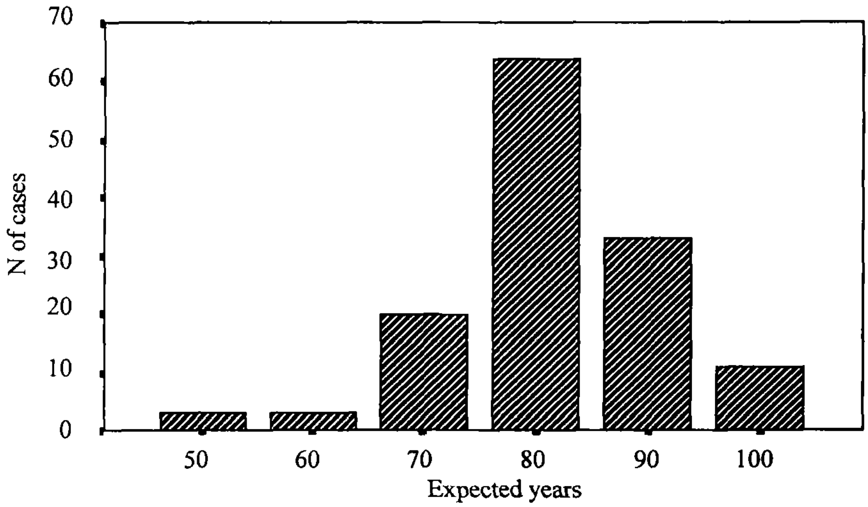

Figure 3. Expected years of life.

Early Stress and Adult Attachment Security

A series of *t*-tests showed that subjects who recollected higher levels of early stress were marginally more likely to characterize themselves as insecure in adult romantic relations. As Table 4 shows, on all measures (although only two were significant at $p < .05$) secure persons reported less early stress than insecures (avoidant and anxious/ambivalent attachment types combined). In correlational analyses of the determinants of adult attachment the raw number of early stressful events was unrelated to the degree to which subjects identified themselves as secure, avoidant, or anxious/ambivalent. However, as Table 4 shows, subjects' recollections of early family relations were significantly related to measures of their adult attachment style. Those who identified most with the secure style used the highest ratio of positive to negative adjectives to describe their mothers and their parents' relationship; those who identified most with the anxious/ambivalent style used the lowest ratio.

To unravel more completely the relationship between early stress and adult attachment, I compared the strength of identification with each attachment style of those subjects who had, and had not, experienced each of the components of my summary early stress measure (i.e., parents' separation/divorce, separation from mother, physical abuse, sexual abuse, death of parent, death of sibling or close relative—all before age 10). In the end, only early separation from mother was related to adult attachment. Those who had been separated from their mothers ("for what seemed like

Table 4. Correlation Matrix of Independent and Dependent Variables (r values shown only when $p \leq .05$, 2-tailed)

	Early Stressors						*Adult Attachment*			*Time Preference*				*Sexual Behavior*		
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
Early Stressors																
1. relationship with mother	•		.38	.19	–.23	.26	.17		–.25				.23			
2. relationship with father		•	.56	.28	–.21	.19							.25			–.26
3. parents' relationship			•				.23		–.29				.17			–.20
4. parents' education				•	–.20	.36						–.25	.41		.26	
5. number of early stressors					•								–.17			
6. SES while growing up																
Strength Adult Attachment						•										
7. secure							•	–.48	–.29				.25			
8. avoidant								•			.23	.25	–.26			.22
9. anxious/ambivalent									•		.18	.19	–.18			
Time Preference/Perspective																
10. ZTPI future										•	–.35	–.32				–.21
11. ZTPI present/hedonistic											•	.76				
12. ZTPI present/fatalistic												•				
13. expected lifespan													•	.18	.29	
Maturation/Sexual Behavior																
14. age at menarche														•	.24	.27
15. age at first sex															•	
16. sex partners per year																•

a long time"; $n = 13$) used a significantly higher ratio of negative adjectives to describe their mothers ($t(131) = 2.17$; $p = .016$, 1-tailed) and their parents' relationship ($t(131) = 2.27$; $p = .013$, 1-tailed). They were also significantly weaker in their identification with the secure attachment style than those who had not been separated ($t(133) = 2.48$; $p = .008$, 1-tailed), while also being significantly stronger in their identification with the anxious/ambivalent style ($t(129) = 2.75$; $p = .004$, 1-tailed). Early separation was unrelated to strength of identification with the avoidant style.

The degree to which subjects identified with each adult attachment type was only weakly related to their adult sexual behavior (see Table 4). After partialing out age at menarche (which is known to affect age at first intercourse [e.g., Presser 1978; Garn et al. 1986]) no measure of adult attachment identification was correlated with age at first sexual intercourse. However, subjects who identified strongly with the avoidant adult attachment style reported a significantly higher frequency of new sexual partners per year of sexual activity.

These data are generally consistent with a key working hypothesis of modern attachment theory, *viz,* that early psychosocial stress is related to security in adult attachment relations. In this generally well-off, well-educated sample of young women, the particular stressors that mattered most were separation from mother before age 10, strained relations between mother and daughter, and strained relations between parents. The evidence also suggests that individual differences in adult attachment (at least the avoidant type) are related to individual differences in the frequency of taking new sexual partners.

Early Stress and Adult Sexual Behavior

The same early stressors that were correlated with adult attachment were also correlated with adult sexual behavior. For example, as can be seen in Table 4, women who used relatively more negative adjectives to describe their fathers (but not their mothers) and their parents' relationship also took new sexual partners at the highest rate. In addition, women whose parents had the most education were significantly older when they had their first sexual intercourse (even with age at menarche partialed out). Similarly, subjects who were separated from their mothers for what "seemed like a long time" before they were 10 took new sexual partners at a higher rate than those who had not been separated ($t(130) = 1.84$; $p = .034$, 1-tailed).

Even in this well-educated, middle-class sample, then, recollections of early stress are correlated with aspects of adult sexual behavior. These results are consistent with predictions from Belsky, Steinberg, and Draper's (1991) attachment theory model of the effects of early emotional stress on adult sexual behavior and with predictions from life history theory about the effects of early environmental risk and uncertainty on adult reproductive strategies (Chisholm 1993, 1995a, 1995b, 1996; Hill et al. 1994, 1997).

Early Stress and Time Preference

To test the hypothesis that early environmental risk and uncertainty affect adult time preference I first correlated the sum of the positive and negative adjectives that subjects used to describe their parents and their parents' relationship with each of the subjects' three ZTPI scores and their expected lifespan (see Table 4). None of these measures of early family stress were related to any of the ZTPI scores—but each was strongly, positively related to life expectancy (positive scores = less stress = longer life). I looked next at the correlations between measures of subjects' time preference and the number of early stressors they recollected, their SES while growing up, their parents' years of education, and whether or not they had been separated from their mothers "for what seemed like a long time." There was no relationship between ZTPI scores or expected lifespan and either SES or separation from mother, but as Table 4 shows, parents' education was strongly correlated with subjects' expected lifespan but negatively correlated with their ZTPI present-fatalistic scores (i.e., subjects whose parents were well-educated were significantly less fatalistic). Parents' education, however, was not related to either future or present-hedonistic scores. Finally, the number of discrete early stressors that subjects reported was negatively related to their expected longevity.

Overall, then, the recollections of (1) strained relations with parents and between parents, (2) low educational level of parents, and (3) having several discrete early stressors are correlated with short expected lifespan—but are unrelated to ZTPI measures of time preference. This suggests that expected lifespan and ZTPI scores may be tapping different aspects of time preference or perspective. And indeed, as Table 4 also shows, expected lifespan is not correlated with any of the ZTPI measures of time perspective. However, while it is not clear precisely what the expected lifespan and ZTPI measures of time perspective are actually measuring, or why they differ, the general hypothesis that early stress is related to later time preference or perspective remains attractive.

Time Preference and Adult Sexual Behavior and Attachment

If time preference is part of an evolved psychological mechanism for allocating reproductive effort in adulthood contingent on the amount of environmental risk and uncertainty (early stress) perceived during development, then just as we found a relationship between early stress and time preference (i.e., expected lifespan), so might we expect to find a relationship between measures of time preference and adult sexual behavior and adult attachment (romantic) styles.

And indeed we do. First, as Table 4 shows, expected lifespan was related to age at first sex (even after partialing out the effect of age at menarche). Second, future orientation was negatively related to the rate at which women took new sex partners. Finally, there were strong and consistent correlations between ZTPI scores and adult attachment relations. Secure adult attachment was strongly related only to expected years of life. However, avoidant adult attachment was negatively related to life expectancy and positively related to both ZTPI present-time orientations (hedonistic and fatalistic), while anxious/ambivalent adult attachment was likewise negatively related to expected lifespan and positively related to both present-time orientations, albeit less strongly.

In sum, women who were older when they first had sex expected to have long lifespans. Women who took new sex partners at high rates were not oriented to the future. As hypothesized, then, not only is early stress related to adult time preference, time preference is related to adult sexual behavior. Furthermore, time preference is related to adult attachment—as would be expected if the attachment process (i.e., attachment history) was part of an evolved mechanism for allocating reproductive effort.

Early Stress and Age at First Reproduction

Fourteen of the 136 women (10.3%) participating in the study had been pregnant (14.6% of the 96 women who had had sexual intercourse). Twelve of these pregnancies ended in elective abortion, one in stillbirth, and one resulted in a healthy child who is living with its mother). Notwithstanding its small size and the absence of information about contraceptive practice for the sample as a whole, this subsample provided a unique opportunity to explore directly the correlates of one of the most critical life history variables, age at first reproduction. To this end I used a series of *t*-tests to compare subjects who had been pregnant with those who were sexually active but had never been pregnant (see Table 5).

Perhaps not surprisingly, the women who had been pregnant experienced menarche earlier than those who had not. Those who had been pregnant also experienced first intercourse much earlier than those who had not. With both earlier menarche and earlier sexual activity the women who actually fell pregnant were clearly at greater risk for early pregnancy than the other women. It is unlikely that this accounts for the entire difference between the groups, however, for those who had been pregnant (relative to those who had not): (1) used significantly more negative adjectives to describe their fathers (but not their mothers and not their parents' relationship); (2) had relatively poorly educated parents; (3) expected much

Table 5. Early Stress and Age at First Reproduction: Women Who Had Ever Been Pregnant Compared with Those Who Were Sexually Active but Never Pregnant

Measure	*Pregnant (n = 14)*	*Sexually active but never pregnant (n = 82)*
Age at menarche	12.00	12.71*
Age at first intercourse	14.92	17.34***
Sex partners/year since first intercourse	.74	.91
Relationship with father	–.07	2.90††
Relationship with mother	4.21	3.43
Parents' relationship	.29	.49
Parents' education	15.85	21.22†
Expected lifespan	73.85	82.44††
Grade point average	2.71	3.00†

*$p \leq .05$, 1-tailed *t*-test
***$p \leq .001$, 1-tailed *t*-test
†$p \leq .05$, 2-tailed *t*-test
††$p \leq .01$, 2-tailed *t*-test

shorter lifespans; and (4) had significantly lower GPAs. Thus, while it is scarcely a test of my particular life history version of the Belsky et al. model, this small subsample of women who were actually on their way to reproduction serves at least to illustrate some of the life history model's major predictions—namely, the connections between early stress, early menarche, early sex, and early reproduction, on one hand, and short time preference (i.e., expected lifespan), on the other.

Multivariate Analyses

Although they construe it differently, both life history theory and the attachment theory model predict that early environmental risk and uncertainty will affect the development of alternative reproductive strategies. Life history theory, however, makes no prediction about the role of adult attachment in this developmental process—nor does the Belsky et al. model make any predictions about time preference. To explore the relationships between my primary dependent variables and the various sets of antecedent variables specified by life history theory and the attachment theory model, I conducted two series of multiple regression analyses—one for age at first sexual intercourse and the other for number of sex partners per year of sexual activity. My measures of early stress were subjects' relations with her mother and father, and between her parents, her SES while young, her parents' education, and the number of separate stressors she experienced while growing up. Time preference variables were her ZTPI future and present-hedonistic and present-fatalistic scores, and expected lifespan. Adult attachment variables were the degree to which each subject identified with the three adult attachment types.

Age at first sex. Because age at menarche was correlated with age at first sex, I forced age at menarche into the regression equation first. (None of my early stress variables were correlated with age at menarche.[4]) I then entered all the adult attachment variables as a block, followed by all the time preference variables as a block. By itself, age at menarche had an R^2 of .07 (df = 1; p = .01). With the adult attachment variables in the equation the R^2 rose only to .09 (df = 4; p = .10). When the time preference variables were added, however, the total R^2 rose to .17 (df = 8; p = .04). Of all the time preference variables, only expected lifespan made a significant independent contribution (β = .31, t = 2.81, p = .006).

This suggests that despite the correlation between measures of adult attachment and time preference, the effects of early stress on age at first sex are mediated rather more through the psychology of time preference (especially expected lifespan) than adult attachment—at least as measured by the CRQ. This interpretation was reinforced when I examined the effects of individual early stressors. To do this I entered all the early stress variables as a block after the time preference variables (and age at menarche). By themselves, the time preference variables accounted for 15% of the variance in age at first sex (df = 5; p = .02). With the early stress variables entered, however, the R^2 rose to .23 (df = 11; p = .03)—but none of the measures of relations with or between parents made a contribution to the overall equation. Of all the early stress variables, only years of parents' education made a significant independent contribution (β = .29, t = 2.36, p = .02) (however, SES while growing up came close: β = –.22, t = –1.90, p = .06).

New sex partners per year. The results were less clear for new sex partners per year. I began by entering the time preference variables into the equation first. As a block they accounted for only 8% of the variance (df = 4; p = .13), with none making a significant independent contribution. When I reversed the order of entry, entering the adult attachment variables as a block first, they too accounted for only 8% of the total variance, but did so significantly (df = 3; p = .05). Only strength of identification with the avoidant style of adult attachment made a significant independent contribution (β = .27, t = 2.39, p = .02). When the time preference variables were entered next, as a block, the R^2 rose from .08 to .14 but did not reach significance (df = 7, p = .07). In this final equation, only avoidant attachment made a significant independent contribution (β = .27, t = 2.21, p = .03). The ZTPI future time perspective, however, came close (β = –.21, t = –.1.93, p = .06).

This suggests that the effect of early stress on number of sex partners per year was mediated somewhat more through adult attachment than time preference. As a test of this idea I entered all the early stress variables as a block after the adult attachment variables. With only the adult attachment variables in the equation, $R^2 = .09$ (df = 3; $p = .05$). With the early stress variables entered, however, the R^2 doubled, to .20 (df = 9; $p = .03$). But in the final equation, none of the adult attachment variables made a significant independent contribution, nor did any of the early stress variables—*except* relationship with mother and father as measured on the Hazan and Shaver (1987) adjective checklist (relations with mother: $\beta = -.24$, $t = -2.04$, $p = .05$; relations with father: $\beta = -.35$, $t = -2.52$, $p = .01$). Assuming that current images of early relationships with parents are tapping some dimension of attachment history, these results are consistent with the interpretation that early stress affects number of sex partners per year through the attachment process. But if this is so, these results also suggest that current (adult) images of early attachment relationships may be a better way to explore the effect of adult attachment styles on sexual behavior than the CRQ.

CONCLUSION: INTERNAL WORKING MODELS AS ALGORITHMS FOR ALLOCATING REPRODUCTIVE EFFORT

The evidence suggests, then, that even in this generally well-off, well-educated and low-stress sample (1) current recollections of early stress are related to adult time preference and some measures of adult attachment and sexual behavior, and (2) individual differences in time preference are related to adult sexual behavior—particularly age at first sexual intercourse. These findings are broadly consistent with a life history theory interpretation of the Belsky, Steinberg, and Draper model of the development of reproductive strategies. Because of the problems inherent in retrospective self-report research, however, these findings must be considered tentative. My conclusion, therefore, is that while we must continue to question *whether* attachment history, time preference, and reproduction go together, there are now empirical evidence as well as powerful theoretical models to justify more probing questions about *how* and *why* they go together.

If the tradeoff between current and future reproduction is an important determinant of organisms' optimal reproductive strategy, as current theory and evidence suggest, then we might expect selection to have favored phenotypic mechanisms for accomplishing this goal. Because mere survival by itself does not produce descendants, and because juveniles, by definition, cannot allocate reproductive effort, their only remaining avenue to reproductive success is through development. Their optimal *developmental* strategy (i.e., incipient reproductive strategy), therefore, is to maximize *future* reproductive returns by optimizing the current tradeoffs between survival, on one hand, and growth, development, learning, and all other preparations for reproduction, on the other (Chisholm 1996). Everything else being equal, when environmental risk and uncertainty are high, survival into the future (in order to reproduce) is problematical, and the optimal reproductive strategy may often be to reach the future quickly (i.e., mature early in order to reproduce early) and/or to seize any opportunity for reproduction that may arise (i.e., reproduce often). To the extent that (1) individual differences in time preference and the allocation of reproductive effort may both be entrained by the attachment process, and (2) individual differences in time preference are related to the allocation of reproductive effort (both of which my results suggest may be possible), then time preference may be viewed as a component or function of Bowlby's internal working model. On this view, internal working models of attachment might constitute part of an evolved algorithm for the contingent development of a person's local optimal reproductive strategy.

What we need now are prospective studies that combine more and better measures of

1. early environmental risk and uncertainty
2. individual differences in children's perceptions of this risk and uncertainty (including, but certainly not limited to, their attachment histories)
3. children's time preference
4. children's cognitive, affective, neuroendocrine, and physical growth and development
5. adult sexual/romantic and parenting behavior

We also need cross-cultural and historical research, both etic (outsider's categories) and emic (insider's categories) (Harris 1994), to describe cultural constructions of development and the nature of the person (thereby perhaps to determine whether they include anything like the concept of time preference used here).

Finally, we also need to continue exploring the implications for policy that follow from the mounting theoretical and empirical evidence that early risk and uncertainty can have a major impact on later sexual, parenting, and related reproductive behaviors. Geronimus (1987, 1994, 1996), for example, argues that early childbearing is often a rational (even if unconscious) response to the high mortality rates and "pervasive health uncertainties" associated with persistent poverty and inequality. It follows then that "focusing on teen pregnancy prevention as the *solution* to persistent poverty may be the modern-day equivalent to suggesting that those without bread can eat cake" (1996:346; emphasis added). Hill and her colleagues draw the same conclusion from their own life history analysis of the determinants of early reproduction: "Public policy-makers who attempt to change teenage childbearing patterns or youthful violence should keep life course patterns in mind. Modifying only the current costs (disadvantages) without changing the array of future choices may have little effect when the discount rate is very high" (1997:316). And Vila is getting at the same thing when he argues (in a slightly different context) that "Keeping adequate resources flowing toward child development programs is *a social investment strategy that pays compound interest*" (1997:18; original emphasis).

Perhaps the biggest lesson from life history theory, however, is that people, like other organisms, are not evolved to maximize health, wealth, vigor, happiness, or lifespan. They are evolved to have descendants. Consequently, when people lack the political and economic (i.e., social and material) resources required to hold risk and uncertainty at bay they may be predisposed to develop in ways that maximize short-term reproduction in the face of their risky and uncertain futures—even at the cost of their own decreased health, wealth, vigor, happiness, and shorter lives. A public health policy informed by life history theory and the tradeoff between current and future reproduction would therefore work to improve health and longevity by reducing risk and uncertainty. Since a major source of risk and uncertainty is inequality, at least in industrial societies, one of the best ways to improve health and longevity is therefore to reduce inequality (Marris 1991; Nussbaum 1995; Sen 1992, 1993; Wilkinson 1996). In affirming the central role of equality in the well-being of all people, life history theory provides an adaptationist foundation for public health and social policy.

The research for this study was supported in part by the Agricultural Experiment Station, University of California, Davis. The preparation of this paper was supported by the Departments of Anthropology and Anatomy and Human Biology at the University of Western Australia, and a grant from the Australian Research Council. I thank Jay Belsky, Barry Bogin, Andrea Wiley, Victoria K. Burbank, Eric Charnov, Len Freedman, Rick Grosberg, Linc Schmitt, Emily Rousham, Sally Stanley, Neil Pelkey, Keith Barton, Martin Daly, Bryan Vila and the anonymous reviewers for their help in developing the ideas presented here. An early version of this paper was presented at the annual meeting of the Human Behavior and Evolution Society, Northwestern University, June 26, 1996.

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NOTES

1. An algorithm "is a certain sort of formal process that can be counted on—logically—to yield a certain sort of result whenever it is 'run' or instantiated" (Dennett 1995:50).

2. Stress is defined here loosely as anything that engenders the stress response.

3. While the African-American women in Burton's (1990) sample were older than the women in this sample, they were also poor, relatively uneducated, and under chronic stress. In this context it is instructive to note that 91% of the women in her sample did not expect to live to their sixtieth birthday. This, Burton notes, is considerably lower than the actual life expectancy for African-American women in the United States as a whole.

4. The relationship between early stress and age at menarche is complicated. On one hand, there are three kinds of evidence that early stress in the form of malnutrition and/or disease acts to *delay* menarche. First, the secular decrease in age at menarche seen across developed nations over time is usually attributed to improved living standards and nutrition (Tanner 1962). Second, comparisons of age at menarche within countries show that it generally occurs later in rural than urban populations and later in lower than higher income groups (Eveleth and Tanner 1990). Third, prospective studies show that young girls who suffer malnutrition and/or high disease loads reach menarche later than well-nourished, healthy controls (e.g., Khan et al. 1996). On the other hand, there is also evidence that at least some kinds of early psychosocial stress act to *accelerate* menarche (e.g., Graber et al. 1995; Kim et al. 1997; Moffitt et al. 1992; Proos et al. 1991; Surbey 1990; but see also Campbell and Udry 1995). All things considered, it may be adaptive to delay reproduction until health and nutrition improve and to accelerate menarche when mortality rates rise with age, but to understand fully the relationship between early stress and age at menarche we need to study the interacting effects of health, nutrition, and mortality rates, and more, on age at menarche.

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