

THE EVOLUTIONARY ECOLOGY OF ATTACHMENT ORGANIZATION

James S. Chisholm
University of Western Australia

Life history theory's principle of allocation suggests that because immature organisms cannot expend reproductive effort, the major trade-off facing juveniles will be the one between survival, on one hand, and growth and development, on the other. As a consequence, infants and children might be expected to possess psychobiological mechanisms for optimizing this trade-off. The main argument of this paper is that the attachment process serves this function and that individual differences in attachment organization (secure, insecure, and possibly others) may represent facultative adaptations to conditions of risk and uncertainty that were probably recurrent in the environment of human evolutionary adaptedness.

KEY WORDS: Life history theory; Attachment theory; Individual differences; Reproductive strategies; Environment of evolutionary adaptedness.

The time is ripe for a synthesis of life history theory and attachment theory. Each is concerned with the development of emotional and/or sexual "bonding" and parenting over the lifespan, but in critically complementary ways. Life history theory, the most dynamic of all evolutionary perspectives on human behavior, is concerned primarily with ultimate explanations—the adaptive functions of entire life cycles—but it is inadequate for studying the mechanisms of gene \times environment

Received February 10, 1995; accepted April 27, 1995.

Address all correspondence to James S. Chisholm, Department of Anatomy and Human Biology, University of Western Australia, Nedlands, WA 6907, Australia. E-mail: jchisholm@anhb.uwa.edu.au

Copyright © 1996 by Walter de Gruyter, Inc., New York
Human Nature, Vol. 7, No. 1, pp. 1—38.

1045-6767/96/\$1.00 + .10

interaction that actually produce alternative life cycles. On the other hand, attachment theory, the dominant theory of human social-emotional development, is primarily concerned with proximate and ontogenetic explanations—the origin of individual differences in myriad aspects of affect, cognition, growth, maturation, and behavior that are related to attachment history. Attachment theory, however, having strayed from its early “safe haven” in evolutionary theory, is currently inadequate for understanding the function of individual differences in attachment, in either infancy or adulthood, or the relationships between attachment, sexuality, and parenting. The goal of this paper is to illustrate how a synthesis of life history theory and attachment theory enhances each and can improve our understanding of the evolution and development of attachment across the lifespan.

This article is divided into three parts. First comes an overview of attachment theory and a sketch of the attachment process and the nature and determinants of individual differences in attachment. Second, I outline life history theory, focusing on (1) the “general life history problem” (Schaffer 1983; Stearns 1992) of the optimal allocation of resources to survival, growth, and reproduction across the lifespan; (2) the reasons why a capacity for the contingent, facultative development of so-called secure and insecure attachment (and possibly other types) may be (or once was) biologically adaptive; and (3) why life history research is increasingly directed at uncovering the psychobiological mechanisms capable of producing the optimal allocation of resources across the lifespan. The central thesis of this paper is that under the conditions of environmental risk and uncertainty that were probably recurrent in the environment of human evolutionary adaptedness (EEA) the major individual differences in attachment that we observe today functioned to optimize the trade-off between infant survival, on one hand, and growth and development, on the other. This thesis is further developed in the third section of the paper, where I examine sources of environmental risk and uncertainty for infants and juveniles in the EEA and recent data on the relationship between attachment history and adult reproductive behavior. In the concluding section I briefly discuss implications of this life history model of attachment for attachment theory and for society.

ATTACHMENT THEORY

Origins

Attachment theory (Bowlby 1969, 1973, 1980) is a theory of the origin and nature of love. It has roots in psychoanalytic theory, ethology, control systems theory, and World War II. Trained in psychoanalytic child

psychiatry, John Bowlby believed that early experience, especially with one's mother,¹ had a powerful effect on adult personality and behavior. Freud himself, after all, had written that the infant-mother relationship was "unique, without parallel, established unalterably for a whole lifetime as the first and strongest love-object and as the prototype of all later love-relations—for both sexes" (1940:45; quoted in Lamb et al. 1985:8). This belief was reinforced repeatedly by Bowlby's personal experience—but not for the reasons Freud might have predicted. Commissioned by the World Health Organization to study the emotional development of children orphaned during World War II, Bowlby observed that even when these children had been well nourished as infants, they were still more likely to be depressed and to develop other emotional or behavioral problems than children who had not experienced maternal deprivation. Freudian theory held that the origin of the infant's love for its mother—and thus the basis for normal personality development—was in the reduction of the infant's primary drive of hunger. The pleasure of taking in food, in Freud's view, came to be experienced by the infant as love for the person providing the food. Because his observations did not square with Freud's drive-reduction theory of infant love, Bowlby began searching for an alternative model that could accommodate his growing conviction that infants were born with a primary, autonomous drive to be close to—to be attached to—their mothers.

He found it in the emerging field of ethology—particularly research by Robert Hinde (1961) and Konrad Lorenz (1935) on imprinting in birds and by Harry Harlow (1958) on "motherless monkeys"—and in control systems theory. Because human infants were helpless for so many months after birth, Bowlby reasoned, their chances for avoiding predators in the "environment of evolutionary adaptedness" (1969:50) would have been enhanced by a strong motivation to remain close to their mothers—in much the way that the survival of goslings appeared to be enhanced through their powerful motivation to follow their mothers. With Harlow's demonstration that normal social-emotional development in rhesus monkeys depended on "contact comfort" (physical contact with mother; i.e., being close to her) and not just on feeding, the secondary drive interpretation of the infant-mother relationship was effectively demolished. Combining ethology and control systems theory (e.g., Miller, Galanter and Pribram 1960), Bowlby proposed that through natural selection infants were endowed with the "set-goal" of proximity to mother that functioned to increase infant survival by keeping infants close to their primary source of safety.

The Process of Attachment

From such beginnings in the 1950s—and aided in particular by the contributions of Mary Ainsworth and her colleagues (e.g., Ainsworth

1969, 1979a, 1979b; Ainsworth et al. 1978)—attachment theory today is the predominant theory of infant social-emotional development. It is now generally accepted that the process of attachment begins in earnest in the second half of the first year when infants normally first show anxiety at being separated from their mothers. Whereas infants separated from their mothers (e.g., by adoption) prior to seven or eight months of age generally establish new attachment relations easily, those separated from their mothers after this age are more likely to react strongly and take longer to establish new attachments (Yarrow 1967). Although there is little support today for the view that attachment formation is a critical period phenomenon, there is a consensus that the older a child is before starting to form attachments, the more difficult it will be (e.g., Sroufe 1988). What is clear is that attachment is a *process*, not a static bond; it is an ongoing, dynamic interaction between infant and mother in which they cycle in and out of each other's company or attention repeatedly, many times a day, potentially for many years. These cycles of mother-infant interaction are worth closer examination because, as I will argue in more detail later, this cyclical process is at the interface of attachment theory and life history theory.

The attachment cycle (Bretherton and Ainsworth 1974; Sroufe and Waters 1977; see also Brazelton et al. 1974) is conceived as beginning with a child (say, a one-year-old) at Bowlby's "set-goal" of being close to his mother. The experience of being physically close to mother is thought to engender what Sroufe and Waters (1977) term "felt security," i.e., feelings of safety and protection. These feelings of security, in turn, lead to the second phase of the cycle. They engender or "release" the child's motivation to play or explore, to venture away from mother (psychologically, if not physically), to use her as a "secure base" from which to engage the world of objects and people. This leads to the third phase, that of separation anxiety. Although there are wide individual differences in separation anxiety, all children eventually show signs of insecurity or fear when they are separated from their mothers, either because they went too far from mother, for too long, or because they encountered something fear-provoking. Too much novelty by itself can also be a potent source of anxiety. Having inhibited the child's inclination to play or explore, his rising anxiety then "releases" his motivation to approach his mother, which initiates the fourth phase of the cycle. This approach may be a literal, physical approach, or it may be a symbolic approach. A symbolic approach may be only a quick glance at mother, by which the child reassures himself that she is still there, or it may be an active vocalization or display in an attempt to elicit some overt response from her. The last phase of the cycle is the reunion between mother and child—the way she responds to her child's literal or symbolic approach. Theoretically—and by some methods, empirically (e.g., Ainsworth et al. 1978)—this fifth phase is the

nexus of the entire attachment phenomenon. Put simply, the critical issue is whether the mother's response renews her child's sense of "felt security." If it does not (and this depends in part on the child's state and temperament as well as, for example, other demands on the mother), he may retain for some time the sense of anxiety or fear that led him to seek reunion with his mother in the first place. Or, if she receives him roughly, rebuffs him, has been inconsistent in her responses, or has been intrusive and interfered with his attempts to separate and explore (perhaps out of her own fear), he may become even more afraid and uncertain. He may then be psychologically inclined to defend himself against his feelings of fear and uncertainty. However, if her response is sensitive and accepting, with sufficient consistency, and his sense of security is renewed, he may soon be motivated again to play and explore, thereby learning more about his world—and simultaneously initiating another turn in the cycle of attachment. Foreshadowing arguments about the links between attachment theory and life history theory that I will develop more fully later, it is important to emphasize (following Bretherton 1985) that the attachment cycle outlined above is continuously active, with the child oscillating between the pull of the *environment*—when mother is seen as a "secure base" from which to explore—and the pull of *mother*—when she is seen as a "safe haven" for reducing arousal when the child is frightened or tired from exploring. Figure 1 is a schematic representation of the cycle of attachment.

It is through the child's experience of many revolutions of this attachment cycle, day in and day out, for months or years, that he comes to have an attachment "bond" to his mother. Bowlby proposes that on the basis of their attachment experiences children construct "internal working models" of, first, themselves and their primary attachment figure and, later, of their social relations in general. Although the form that these models take is unknown (Main 1991), they are thought of metaphorically as generalized expectations about "self-with-others," or trust in the physical and emotional availability of others to oneself, and in oneself as deserving or worthy of what one expects from others. These models or schemas are simultaneously affective as well as cognitive and perceptual, so that representations of past events and perceived alternative courses of action have emotional or motivational dimensions that affect perception, cognition, and choices about action in the future. Once organized, internal working models of attachment tend to operate outside consciousness and partly for that reason are resistant, but not closed, to change, especially if one's experience also changes (Belsky and Cassidy 1994; Bretherton 1985; Main 1991; Main et al. 1985; Sroufe 1988).

Although Bowlby-Ainsworth attachment theory holds that the psychobiological capacity for attachment is universal and innate, attachment

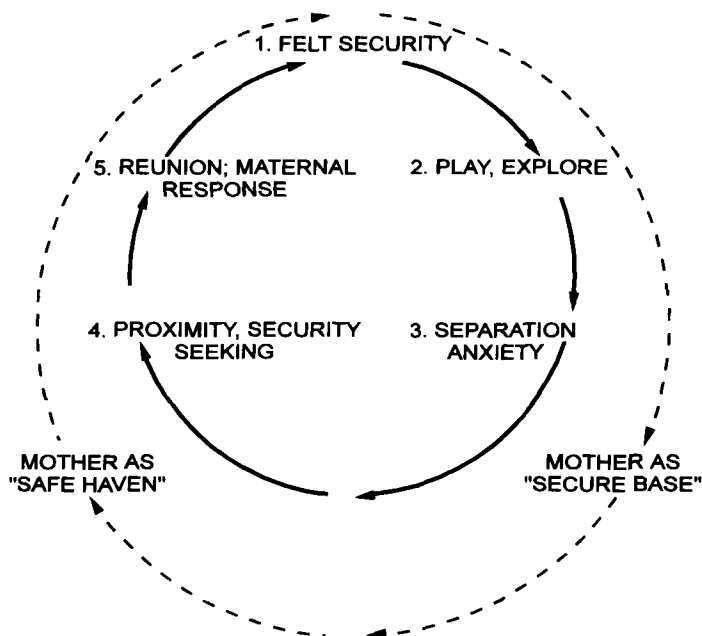


Figure 1. The attachment cycle.

itself is something that only emerges from cycles of infant-mother (organism \times environment) interaction during ontogeny. Because infants, mothers, and the environments in which they interact are highly variable, there is a considerable range of individual differences in the patterns of attachment that are generated by these cycles of interaction. Based on his observations of this range, Bowlby was convinced that sensitive and responsive mothering is critical for the development of what he believed was "normal," secure attachment and subsequent "normal" social-emotional development.

Individual Differences in Attachment

A quarter-century of research on individual differences in infant-mother attachment has largely sustained Bowlby's early clinical judgment. Notwithstanding the effects of child temperament and other factors on patterns of attachment (e.g., Bates et al. 1985; Crockenberg 1981; Goldsmith and Harmon 1994; Gunnar et al. 1989; Kagan 1982; Wachs and Desai 1993), there is a consensus that children whose mothers have been generally available, responsive, and accepting are more likely to use their mothers as both a secure base from which to explore and play and as a safe haven, for comfort and reassurance, when they

become upset. Such children are said to be securely attached. On the other hand, children whose mothers have been less available and responsive, or more intrusive or rejecting, often show an inability or unwillingness to play and explore, or to be comforted by their mother when they do become upset. Such children are said to be insecurely attached. As they grow older they are more likely to become anxious, aggressive, or depressed, or to develop difficulties in close interpersonal relations. Available longitudinal evidence indicates that these patterns are normally stable over at least the first decade in stable families, but they can change, in expectable ways, when the family environment changes (Belsky and Cassidy 1994; Sroufe 1988). In low-risk samples 60–70% of children are typically classified as secure and 30–40% are classified as insecure; even higher insecurity rates (60% or more) are reported in some cross-cultural studies and in high-risk samples (Belsky and Cassidy 1994; Campos et al. 1983; Lamb et al. 1985). Most of this research has been based on Ainsworth's (Ainsworth et al. 1978) Strange Situation paradigm, or, more recently, Waters and Deane's (1985) Q-sort method. Both techniques, however, yield dimensions of secure vs. insecure attachment and tend to identify the same children as secure and insecure (Vaughn and Waters 1990).

In addition to this secure-insecure dimension of individual differences in attachment, research using Ainsworth's Strange Situation paradigm also consistently identifies two kinds of insecure attachment.² The first is the *avoidant* pattern, in which children show little overt distress at separation from mother and do not seek reunion with her but instead focus their attention on toys and other apparent diversions from mother. In home observations, mothers of children that are later classified as avoidant are more likely to rebuff or reject their child's bids for attention, especially for physical contact, and/or to intrude insensitively on their child's ongoing activities. The second pattern of insecure attachment is the *anxious/ambivalent* pattern.³ Anxious/ambivalent children tend to be distressed prior to separation, difficult to reassure, and seem so preoccupied with their mothers' moods or availability that they are disinclined to play or explore. In home observations, mothers of children that are later classified as anxious/ambivalent are not overtly rejecting but are most likely to be underinvolved with their children, or slow or inconsistent in responding (Cassidy and Berlin 1994; Isabella and Belsky 1991). However, while Strange Situation research consistently identifies these two types of insecure attachment, and there is some evidence that they have different developmental consequences (e.g., Cassidy and Berlin 1994; Main 1990; Shaver and Hazan 1994), their status remains unclear, for neither is predicted by attachment theory (Lamb et al. 1985), and neither is identified by Waters and Deane's (1985) Q-sort methodology.

Bowlby himself, along with many other attachment theorists, believed

that sensitive, responsive mothers and their securely attached infants are nature's prototype, and that insecure attachment is, to some extent, abnormal and maladaptive. Ainsworth, for example, argues that "one major aspect of the environment of evolutionary adaptedness for infant attachment behavior is not merely a mother figure but one who is sensitively responsive to infant behavioral cues" (1979b:5). Indeed, Ainsworth developed the neutral A-B-C nomenclature (for avoidant, secure, and anxious/ambivalent attachment, respectively) because she hoped thereby to avoid stigmatizing A and C children or their parents as somehow deviant (Ainsworth et al. 1978). And Sroufe, who argues that the A and C patterns of attachment are specific adaptations to particular environments, also says that "in an important sense they are *maladaptations*" (1988:25; original emphasis). Moreover, there is evidence from many sources that the insecure attachments—avoidant and anxious/ambivalent—are indeed associated with later cognitive, perceptual, and/or social-emotional difficulties (for reviews see Belsky and Cassidy 1994; Bretherton and Waters 1985; Lamb et al. 1985; Sroufe 1988; Wolkind and Rutter 1985) and even physical growth difficulties (Drotar 1991; Monckberg 1992; Valenzuela 1990). Prospective laboratory studies of attachment behavior in bonnet macaques also show that environmental stresses experienced by mothers have important consequences for the development of their young, including long-term effects on noradrenergic and serotonergic functions that mediate the experience of fear and anxiety. The attachment process is implicated as the specific mechanism of these effects because the stressed mothers differ from controls in being more anxious and less consistently responsive to their young (Andrews and Rosenblum 1991; Rosenblum and Andrews 1994; Rosenblum et al. 1994; see also Suomi 1991).

Despite the apparent justification, however, evolutionary-minded skeptics have long resisted the implication that so-called insecure attachment is a disorder. Instead, they argue, hominid infancy wasn't always as ideal as Bowlby imagined, and such a consistent pattern of individual differences in attachment, with such a high incidence of so-called insecure attachment, might well indicate potentially adaptive alternative developmental strategies rather than pathology (e.g., Blurton Jones 1993; Dunn 1976; Freedman and Gorman 1993; Hinde 1982, 1983; Lamb et al. 1985; Main 1981, 1990;⁴ Tronick et al. 1987; Wiley and Carlin 1994). The most complete articulation of this position to date has been by Lamb and his colleagues, who argue that

in light of current theory in evolutionary biology, it is not easy to designate certain behavioral patterns as adaptive or maladaptive. Although not all behavioral patterns are equally adaptive, of course, it is clear that there is no single, species-appropriate pattern or template of behavior against

which all other patterns can be evaluated. More plausibly, persons are equipped with a flexible repertoire, the selection from which depends on the specific environment in which he or she lives, the behavior of others, and the person's inherent characteristics. . . . Viewed from this perspective, it therefore becomes important to specify *how* these alternative patterns may be adaptive under *what* caregiving circumstances (Lamb et al. 1985:57; original emphasis).

What is needed, in other words, is an evolutionary ecology of attachment organization: we need to understand the "caregiving circumstances" in which the capacity for the contingent development of so-called secure and insecure attachment (and possibly avoidant and anxious/ambivalent as well) would have been evolutionarily adaptive. Life history theory is an obvious place to turn, for its subject matter is how the life cycles of all organisms are shaped by local instantiations of the universal circumstance of having to survive, grow and develop, and reproduce with limited resources.

LIFE HISTORY THEORY

The Components of Fitness

Life history theory is the evolutionary study of life cycles and life history traits, including size at birth, age at first reproduction, reproductive rate, and length of life. It is one of the most dynamic areas of all evolutionary biology; even Stephen Stearns, perhaps its leading practitioner, noted in 1992 that he could no longer keep pace with the "explosion" of life history research in evolutionary ecology, zoology, demography, and quantitative genetics, where the theory originated thirty years ago (e.g., Bonner 1965; Williams 1957, 1966). The impetus for life history theory's dramatic growth has been its crucial insight that life cycles in themselves constitute evolved reproductive strategies. To nonbiologists this may seem a curious narrowing of reference, but it makes sense to evolutionists because of life history theory's principle of allocation (Levins 1968), which holds that organisms have finite resources of energy, nutrients, safety, information, and time to be allocated among the often conflicting demands of the components of fitness. These include, at a minimum, survival, growth and development, and reproduction, which itself consists of mating (the production of offspring, which increases their quantity) and parenting (the rearing of offspring, which increases their quality) (e.g., Alexander and Borgia 1979; Hirschfield and Tinkle 1975; Low 1978). Because of the inevitable gap between means and ends,⁵ the fundamental assumption of life his-

tory theory is that natural selection will tend to favor mechanisms that achieve the optimal allocation of limited resources among survival, growth and development, and reproduction. This necessarily entails trade-offs between the components of fitness; resources allocated to survival, for example, cannot also be allocated to growth. However, because evolution is ultimately driven by differential reproduction—not differential survival or growth and development—the life cycles thus created may be conceived of as reproductive strategies. Reproductive strategies, in turn, may be thought of as suites of functionally integrated anatomical, physiological, psychological, and developmental mechanisms for optimizing the trade-offs among the components of fitness throughout the life cycle (Charnov 1993; Hill 1993; Roff 1992; Stearns 1992).⁶

It is important to emphasize here that life history theory's assumption of optimality does not imply any a priori, noncontingent definition of an optimal life cycle or reproductive strategy, for what is optimal in one environment is likely to be suboptimal in another. Indeed, "optimal" means "best available given existing constraints"—not "best imaginable." Moreover, while evolutionary biology's assumption of optimality is immensely useful for generating new hypotheses, it is itself only a working hypothesis (Emlen 1985; Orzack and Sober 1994; Parker and Maynard Smith 1990). For me, however, the optimality assumption's most conspicuous virtue is that it compels us always to go beyond what is "normal," in the sense of merely common or statistically average, and to contemplate instead the adaptive significance of the *full range* of variability in a trait. In other words, the assumption of optimality demands an analytical focus on the potential adaptive function of individual differences in their local socioecological and political-economic contexts (e.g., Caro and Bateson 1986; Nesse and Williams 1995; Tauber 1994; Wiley 1992). It is no longer possible to assume that "species typical" implies normality or indicates the "target" of selection.

The General Life History Problem

Life history research has examined a number of trade-offs (e.g., survival vs. growth, survival vs. reproduction, growth vs. reproduction, quantity vs. quality of offspring), but there is a growing consensus that the most important or pervasive trade-off is the one between current and future reproduction. The "general life history problem," as it is known (Schaffer 1983), is a model that predicts the optimal allocation of resources to reproduction at a given age based on the assumption that there is a trade-off between current and future reproduction (Stearns 1992). Put simply, this means that beyond some point, increased reproduction in the short term (current reproduction) is expected to decrease number of descendants in the long term (future reproduction)—either

through the current consumption of resources that would have had greater fitness returns in the future, or by reducing parents' probability of survival into the future. Evolutionary theory thus does not expect selection always to favor traits that simply maximize number of offspring in each generation. Instead, under certain conditions (e.g., low environmental risk and uncertainty; see below) selection is expected to favor traits that minimize between-generation variance in number of offspring. This is because, over a period of generations, consistently having a small number of high-quality offspring who survive to reproduce ultimately results in more descendants than would having a larger number of low-quality offspring whose chances of survival are low or unpredictable (Gillespie 1977; Kaplan 1994; Rogers 1990; Rubenstein 1982; Seger and Brockmann 1987; Stearns 1992).

Viewing life cycles as reproductive strategies shaped by trade-offs between the components of fitness prompted the search for the socio-ecological factors that, by determining the optimal trade-off, should (by the assumption of optimality) influence what selection will favor. Evidence is accumulating that extrinsic mortality rates are among the most important determinants of the optimal trade-off between current and future reproduction, both within and between species (Charnov 1993; Charnov and Berrigan 1993; Gadgil and Bossert 1970; Harpending et al. 1990; Promislow and Harvey 1990, 1991; Roff 1992; Seger and Brockmann 1987; Stearns 1992). To paraphrase Stearns, the key problem in life history theory is not that of understanding how habitats affect life histories, but how habitats affect *mortality regimes*—and then how mortality regimes affect life histories (1992:208). Extrinsic mortality refers to death from predation, disease, accidents, homicide, and other environmental hazards that are not affected by changes in the allocation of reproductive effort. Intrinsic mortality, on the other hand, refers to death from the costs or trade-offs of reproductive effort. For example, physiological costs (trade-offs) of early menarche in women (which facilitates current reproduction) may include increased risk later in life for unhealthy weight gain (Wellens et al. 1992) or breast cancer (Apter et al. 1989). In risky or uncertain environments, where extrinsic mortality rates are high or unpredictable, the short-term reproductive strategy of maximizing number of offspring in the current generation may be the optimal strategy, because by maximizing the probability of having at least *some* offspring who manage to survive and reproduce it thereby minimizes the probability of lineage extinction—that is, of having one's own genes vanish from the gene pool. In environments that are safe and predictable, on the other hand, the long-term strategy of consistently producing fewer offspring over many generations may be optimal because, as mentioned, through time a "less is more" reproductive strategy can result in more descendants. Or as Kaplan put it, "it may be necessary to

measure fitness in terms of third-generation (or longer) effects. Models including these effects are likely to predict lower optimum rates of fertility than the one-generation model that maximizes number of surviving offspring" (1994:770–771).

Because evolution is ultimately more concerned with reproduction than survival, however, the capacity of parents to affect their children's reproductive value is expected to influence the optimal trade-off between parents' current and future reproduction independently of extrinsic mortality rates. Thus, from the perspective of life history theory (and contrary to a great deal of "common sense"), when resources are limited it is *not* necessarily adaptive or rational to have fewer offspring so as to be able to invest more in each one (Chisholm 1995b). In other words, even when mortality rates are not high (everything else being equal), the optimal strategy of parents who lack the material or social resources (e.g., power, prestige) to make a difference in their children's reproductive value (e.g., health, education, employment, marriage prospects, competence as parents—i.e., children's capacity to produce grandchildren with good reproductive value) may be to increase fertility (which increases current reproduction) while reducing investment per child (which tends to decrease future reproduction). The "nonintuitive message" here (as Borgerhoff Mulder [1992:350] described this apparent paradox) is that when the flow of resources is chronically low or unpredictable—which is when we might otherwise expect parental investment to be *most* critical for offspring reproductive value—it may in fact be (or have been) biologically (i.e., evolutionarily) adaptive to *reduce* parental investment, to allocate resources not to parenting (or even, beyond some threshold, to the parents' own health or longevity), but to *offspring production* instead (Borgerhoff Mulder 1992; Harpending et al. 1990; Kaplan 1994; Pennington and Harpending 1988).

Attachment as an Allocation Mechanism

If natural selection has favored mechanisms that tend to achieve the optimal allocation of limited resources among survival, growth and development, and reproduction across the lifespan, as the optimality assumption holds, what are these mechanisms? Do they exist? This is one of the most important questions in life history theory, for without some understanding of these mechanisms we cannot adequately test life history models nor fully understand the process of adaptation. Possibly to rationalize their relative inattention to the processes that actually generate adaptations, some evolutionary biologists have made use of the "phenotypic gambit," which is the simplifying assumption that the relationship between genotype and phenotype is not especially important for understanding adaptation (e.g., Grafen 1984; Smith and Winterhalder 1992). But for some purposes it *is* important, for without an under-

standing of how phenotypes emerge developmentally from gene \times environment interaction we can have no clear picture of the trait that is supposed be the adaptation (e.g., Barkow et al. 1992; Bateson 1976, 1982; DeRousseau 1990; Gottlieb 1991; Gould 1991; Gould and Lewontin 1979; Hall 1992; Hinde 1987; Oyama 1985, 1994; Stamps 1991; Stearns 1982; Worthman 1994). To understand what selection *should* favor it is necessary to test our optimality models against the qualities of real organisms (the phenotypic gambit); to understand what selection *can* favor we must understand how these organisms work—which means understanding the developmental and historical processes whereby genes and environments construct the phenotypic mechanisms that actually produce adaptations. Bernardo describes 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 optimization 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 (Bernardo 1993:172).

For both practical and theoretical reasons it is crucial to understand the physiological and psychological mechanisms whereby humans allocate reproductive effort across the lifespan. On the practical or public health side, knowledge of these mechanisms would be invaluable for attempts to control population growth rates and the myriad other problems associated with the too-early or too-extensive allocation of mating effort (e.g., Chisholm 1995b; Fox 1989; Kaplan 1994; Liesen 1995; Tauber 1994; Smuts 1992, 1995; Wiley 1992). On the theoretical side, knowledge of these mechanisms would be invaluable for attempts to resolve the pernicious nature-nurture dichotomy. This is because reproduction is what drives evolution and connects us with all of nature. In a slowly developing, long-lived, and culturally rich species like ourselves, therefore, it is in the realm of our reproductive behavior that we can expect selection to have been particularly assiduous.⁷ Because the cost of failure to learn or learning gone wrong is so great in the realm of mating and parenting, it is here that we would most expect to find “learning biases” or “predispositions to learn” (e.g., Boyd and Richerson 1985; Harpending et al. 1990; Johnston 1982; Kaplan 1994). As Harpending et al. put it,

We do not believe for a moment that natural selection operating on genetic material directly could have led in our species to any [hypothetical optimal outcome]. But it is certainly plausible that humans are engineered to sense the state of the environment and to favor (read “learn more easily”) certain behaviors over others depending on their perception of the environment (1990:255).

But what is the nature of this engineering? How do young humans "sense" the state of their environment? The main argument of this paper is that this "sensing" is fundamentally emotional. In this view the process of infant-mother attachment (the "growth of love," in Bowlby's [1965] terms) is an evolved developmental system (Oyama 1985) whereby children are biologically predisposed to monitor the most adaptively significant features of their environments as the basis for allocating resources contingently to optimize the critical trade-off between current and future reproduction. Because juveniles, by definition, cannot reproduce, the most immediate threats to their fitness are not to their reproduction *per se*, but to the other primary—and ontogenetically prior—components of fitness, their survival and growth and development. Because the possibility for juveniles of any future reproduction at all is always absolutely contingent on current survival and growth, selection on hominid juveniles may be expected to have favored psychobiological mechanisms for gauging environmental threats to, and opportunities for, their survival and growth and for allocating their resources accordingly. For example, in highly risky and uncertain environments—when such threats are severe and imminent—the optimal strategy may be to allocate resources to immediate survival, which might actually halt growth, as in "hospitalism" (Spitz 1945) or nonorganic failure to thrive (Drotar 1991; Monckberg 1992). However, infants and juveniles cannot endlessly maximize present survival at the expense of inadequate growth, development, and learning—i.e., preparations for reproduction (Bateson 1994; Janson and van Schaik 1993; Rubenstein 1993). The attachment cycle may thus be viewed as a psychobiological mechanism for optimizing the trade-off between survival (i.e., security; mother as "safe haven"), on one hand, and growth and development and learning (i.e., play and exploration; mother as "secure base"), on the other.

THE FUNCTIONS OF ATTACHMENT IN THE EEA

Risk, Uncertainty, and Attachment

While it is increasingly appreciated that the EEA was neither as uniform nor as benign as Bowlby seems to have imagined (e.g., Edgerton 1992; Foley 1992), it is perhaps not sufficiently appreciated that as each of our ancestors entered the EEA—i.e., as infants—a major component or vector of their environmental risk and uncertainty was their parents (or their parents' suitors or new mates). Viewed from the perspective of those entering it, in fact, the EEA probably held certain risks that were

recurrent and quite predictable—but whose *timing* was uncertain. Under such conditions selection is expected to favor patterns of development that are sufficiently plastic so that the *nature* (i.e., structure, function) of adaptive alternative phenotypes (facultative adaptations) is reliably contingent on, or appropriate to, the predictable risk itself. But because it is the timing of these recurrent, predictable risks that is unknown, the actual *appearance* (i.e., instantiation, development, production) of locally appropriate phenotypes is expected to be contingent on any cue that reliably indicates that one of these risks is actually impending (Fagen 1982, 1993; Johnston 1982; Stearns 1982). For example, in both cats (Bateson et al. 1990) and rats (Smith 1991) lactating mothers on restricted diets wean their offspring earlier than those on normal diets. Somewhat counterintuitively, however, this research has found that the offspring of food-restricted mothers engage in *more* play than the offspring of normally fed mothers. These findings are interpreted as evidence for a mechanism in offspring whereby, on the basis of cues from mother, they are “switched” onto an evolved alternative developmental pathway that tended to be adaptive under presumably recurrent conditions of limited food. Bateson and colleagues suggest that because the developmental consequences (future payoff) of play are so important, selection has favored a mechanism that serves to increase the amount of play when a cue from mother indicates impending food shortages that would result in early weaning, hence early foraging for self—which shortens the phase of the life cycle when play occurs. In effect, this hypothetical mechanism “squeezes” play into the time available before the immediate demands of survival outweigh the marginal future benefits of continued play. Citing Lott’s (1991) recent review, Bateson notes that analogous alternative strategies “occur more frequently in mammals than had been realized” (1994:402).

What were the predictable risks faced by our developing ancestors? Following arguments by Bateson (1994), Belsky et al. (1991), Blurton Jones (1993), Draper and Harpending (1982), Hinde (1982), Lamb et al. (1985), and Main (1990), among others (including, of course, Trivers 1974), it is likely that the most adaptively significant feature of children’s environments has always been their parents’ reproductive strategies—or more precisely, the quantity and quality of the parental investment they receive. Viewed from the life history perspective sketched above, then, the common individual differences in attachment that we observe today can be interpreted as facultative adaptations to parental behaviors that in the EEA were reliable indicators of what were probably two of the more recurrent (and not mutually exclusive) threats to juvenile survival and growth: parents’ *inability* to invest in offspring, and parents’ *unwillingness* (not necessarily conscious) to invest.⁸ From time to time

throughout human evolution there were undoubtedly some parents who were *unable* to protect or provide for offspring simply because they lacked resources. Without doubt, from time to time there were also some parents who were *unwilling* (not necessarily consciously) to invest because (for reasons given earlier, in the section on "The General Life History Problem") their optimal reproductive strategy was to reduce or terminate parental investment, allocating their resources instead to other offspring with higher reproductive value, or to the production of additional offspring, thereby maximizing current reproduction.

In the life history model of attachment presented here there is, consequently, no *a priori*, noncontingent, "normal" pattern of attachment; so-called secure and insecure attachment are both normal. In this view secure attachment develops today as a facultative adaptation to consistently sensitive, responsive, and accepting parenting because in the EEA this style of parental behavior was reliable evidence that parents possessed both the resources and the motivation to invest in offspring for an extended period. Under the conditions of low environmental risk and uncertainty that would tend to support or enable such parental behavior, life history theory predicts that (*ceteris paribus*) the optimal reproductive strategy will be the high-parenting effort strategy of maximizing future reproduction by investing heavily in relatively few high-quality offspring. On the other hand, according to this view, insecure attachment (both kinds, if there are two) develops today as a facultative adaptation to what we call insensitive, intrusive, unresponsive, or rejecting parenting because in the EEA this style of parental behavior was reliable evidence that parents were unable and/or unwilling to invest in offspring. Under the conditions of high environmental risk and uncertainty that would tend to make such parental behavior more likely, life history theory predicts that (*ceteris paribus*) the optimal reproductive strategy will be the high-mating effort strategy of maximizing current reproduction by investing relatively little in many low-quality offspring.

Although we cannot rule out the possibility that the avoidant (A) and anxious/ambivalent (C) attachment styles are merely artifacts of the Strange Situation test (e.g., Lamb et al. 1985), they are, as mentioned, widely reported and seem to have different developmental consequences. It also seems important to distinguish between parents' ability and willingness to invest, because these are among the most fundamental determinants of parental investment. The ability and willingness to invest in offspring are neither dichotomous nor mutually exclusive variables, however, and parents may be both unable and unwilling to invest. Nonetheless, not only are even young infants manifestly good observers of their parents' mood and apparent motivation (e.g., Cohn and Tronick 1983), it might be useful for infants to distinguish between

motive and opportunity, so to speak, because the optimal infant response to “able-but-unwilling” parents would seem necessarily to be somewhat different from the optimal response to “unable-but-willing” parents. Finally, while attachment theory offers no a priori rationale for the existence of avoidant and anxious/ambivalent attachment types, life history theory may. Therefore, in the interest of fostering common ground between life history theory and attachment theory (but at the risk of explaining something that doesn’t exist!), I offer the hypothesis that avoidant attachment represents a facultative adaptation to parental *unwillingness* (not necessarily conscious) to invest and that anxious/ambivalent attachment represents a facultative adaptation to parental *inability* to invest.

In this model avoidant and anxious/ambivalent patterns of attachment have distinct ultimate, as well as proximate, causes. In terms of proximate causation, avoidant children avoid their mothers because their mothers rebuff or reject them. In terms of ultimate causation, however, such rejection may have been a reliable indicator of a mother’s relative unwillingness to invest because her optimal reproductive strategy was to allocate resources to already existing children with greater reproductive value, or to the production of additional offspring. The hallmarks of avoidant attachment—low expression of affect and literal avoidance of mother—might represent a facultative adaptation to caregivers who, regardless of ability, were unwilling to invest.⁹ And just as human and nonhuman parents today intermittently reject, neglect, abandon, and kill their children, so too, certainly, did our hominid ancestors (e.g., Boswell 1988; Freedman and Gorman 1993; Gomendio 1991; Hausfater and Hrdy 1984; Hrdy 1977, 1979, 1992; Levine 1987; Scheper-Hughes 1992; Smuts 1992; van Schaik and Dunbar 1990). Likewise, in terms of proximate causation anxious/ambivalent children are wary of, and preoccupied with, their mothers’ moods and intentions because their mothers are underinvolved or inconsistent. In terms of ultimate causation, however, in the EEA such inconsistency may have been a reliable indicator of a mother’s relative inability to invest because of her own inadequate or unpredictable resources. In this view, anxious, wary preoccupation with mother represents a facultative adaptation for extracting resources (i.e., felt security) from a mother who is irritable and preoccupied herself—with fear, hunger, or exhaustion.

Table 1 is a schematic representation of the life history model of attachment outlined above. To develop this model more fully, I turn now to examples of the threats and opportunities that parental investment strategies pose to offspring, and how individual differences in attachment might constitute adaptive responses to common individual differences in parents’ ability or willingness to invest. Taking the life history view of

Table 1. A Model Depicting How the Three Main Patterns of Attachment Organization Might Result from the Interaction between Parents' Reproductive Strategies and Children's Developmental (i.e., incipient reproductive) Strategies

Attachment Classification	Parental Reproductive Strategy	Child's Developmental (i.e., Incipient Reproductive) Strategy
A. Insecure Avoidant	<ul style="list-style-type: none"> • Short-term • Unwilling to invest • High mating effort • Dismissing, rejecting of child 	<ul style="list-style-type: none"> • Maximize short-term survival • Avoid rejecting, potentially infanticidal parent
B. Secure	<ul style="list-style-type: none"> • Long-term • Able and willing to invest • High parenting effort • Unconditionally accepting, sensitive, responsive to child 	<ul style="list-style-type: none"> • Maximize long-term learning, quality of development • Maintain investment from "rich" parent
C. Insecure Anxious, Ambivalent	<ul style="list-style-type: none"> • Short-term • Unable to invest • Parenting effort with inadequate resources • Inconsistent, preoccupied but not rejecting of child 	<ul style="list-style-type: none"> • Maximize short-term maturation, "quantity" of development • Maintain investment from "poor" parent

life cycles as reproductive strategies, I refer also to some of the accumulating evidence that attachment history is related to adult sexuality or romantic love styles.

Individual Differences in Attachment as Incipient Reproductive Strategies

Under conditions of low environmental risk and uncertainty, as just mentioned, life history theory predicts that, *ceteris paribus*, the optimal reproductive strategy will be the high-parenting effort strategy of maximizing future reproduction by investing heavily in relatively few high-quality offspring. Under conditions of high environmental risk and uncertainty, on the other hand, life history theory predicts that the optimal reproductive strategy will be the high-mating effort strategy of maximizing current reproduction and investing relatively little in many low-quality offspring. Consistent with these predictions, there is abundant evidence that when parents today perceive that the environment in which they rear children is one of low risk and uncertainty—i.e., that they and their children will have an adequate flow of material and non-material (social-emotional resources, including safety and time, and reasonable prospects that things will continue as they are)—they find it

easier (or "natural") to be sensitive, responsive, and available to their children; there is also abundant evidence that when parents perceive that they and their children will not have an adequate flow of material or nonmaterial resources they find it less easy to be consistently sensitive, responsive, and available to their children (e.g., Brenner 1973; Conger et al. 1984; Crockenberg 1981; Duncan et al. 1994; Egeland et al. 1987; Erickson et al. 1985; Lempers et al. 1989; McLoyd 1990; Radke-Yarrow 1991; Sampson and Laub 1994).¹⁰

According to the model advanced here, the reason that consistently sensitive and responsive parenting is associated with secure attachment today is that when infants in the EEA experienced consistently sensitive parenting (through their repeated experience of "felt security" in innumerable revolutions of the attachment cycle) they also "sensed" that their environments were low in risk and uncertainty. The optimal reproductive strategy in such environments is the high-parenting effort strategy, but because infants and juveniles cannot expend reproductive effort, their best avenue to reproduction is through development. The optimal *developmental* strategy (i.e., incipient reproductive strategy) for secure infants would thus be to maximize future—*reproductive*—returns on their current growth and development. This may be the ultimate explanation (*sensu* Tinbergen 1963) of why securely attached children often seem to do better than insecurely attached children in the realms of physical growth (e.g., Valenzuela 1990) as well as cognitive-perceptual and social-emotional development (e.g., reviews by Belsky and Casidy 1994; Bretherton and Waters 1985; Lamb et al. 1985; Sroufe 1988; Wolkind and Rutter 1985). When parents are both able and willing to invest, neither survival nor growth and development are threatened, and all resources can be allocated to maximizing the "quality" of development, i.e., future returns on growth, learning, play, and exploration. Future returns from present learning or play may accrue via increased behavioral flexibility (Fagen 1982, 1993; Johnston 1982). Future returns from present growth may accrue via accelerated maturation, for when young mammals encounter conditions that are favorable for growth it will generally be adaptive for them to reproduce early. This is because when populations are expanding—as they tend to when resource availability favors growth—individuals who reproduce early have greater long-term fitness because their offspring are born earlier and thus start reproducing earlier themselves (e.g., Cole 1954). This may provide an ultimate explanation for why improved health and nutrition almost always lead to earlier menarche (e.g., Eveleth and Tanner 1990).

On the other hand, according to the model being advanced, the reason that inconsistent, insensitive, and unresponsive parenting is associated with insecure attachment is that when infants in the EEA experienced inconsistent, insensitive parenting (through their failure to

experience "felt security" in sufficiently many revolutions of the attachment cycle) they also "sensed" that their environments were high in risk and uncertainty. Everything else being equal, the optimal reproductive strategy in such conditions is to maximize current reproduction—but again, because immature organisms cannot expend reproductive effort, the best avenue to reproduction is through development. The optimal *developmental* strategy (i.e., incipient reproductive strategy) for insecure children would thus seem to be to maximize future—*reproductive*—returns on their current patterns of growth and development. When parents are unable and/or unwilling to invest, then either survival or growth and development, or both, are at risk, and we would expect resources to be allocated *intraindividually* to optimize the trade-off between survival and growth and development that maximized returns on reproductive effort to be expended later.

Which alternative pattern of growth and development offered the best returns on reproductive effort expended in the future would seem to depend on which of the remaining two major components of fitness were threatened most, survival or growth and development, and on the nature of the specific threats to each. For example, when survival is under immediate threat, as mentioned above, the optimal strategy may be simply to halt growth and development in the hope that conditions improve. Under other conditions of threat to survival or growth, however, the optimal strategy may sometimes be to grow or mature *rapidly*—to minimize *total time* spent in a vulnerable stage of development—or *slowly*—to minimize risk *per unit time* in a vulnerable stage (Janson and van Schaik 1993; see also Bogin 1994, 1995; Rubenstein 1993). For example, Ellison (1990), Peacock (1990, 1991), Worthman (1993), and Vitzthum (1994), among others, have each argued that human females rely on information from the environment concerning threats to their health or growth as a basis for adjusting the amount (or timing) of resources allocated to future reproduction. In general, adult reproductive capacity seems to be delayed or scaled back following episodes of malnutrition, disease, or metabolic imbalance during development. Ellison (1990) hypothesizes that this "feed forward" developmental process might come about through the evolution of a mechanism for monitoring rates of growth and development. Because rates of growth and development are highly sensitive to nutritional and infectious perturbations, he argues, the rates themselves might have evolved to function as part of a "bioassay," on the basis of which conditions for future reproduction might be (unconsciously) predicted. The same underlying "feed forward" mechanism that accelerates menarche under good conditions may be operating here—in the other direction—to delay menarche under poor conditions.

By analogy with Ellison's "bioassay," and building on the Belsky et al.

(1991) attachment theory model of the effects of early psychosocial stress on adult mating and parenting behavior, I have suggested (Chisholm 1993) that the cognitive-emotional consequences of early stress (e.g., insecure internal working models) might have evolved to function as a "socioassay" by which future social relations might be predicted (probably not consciously). Although the psychobiological mechanisms involved are unclear, this may provide an ultimate explanation for why various kinds of emotional stress during development seem associated with *earlier* age at menarche or first sexual intercourse (Graber et al. 1995; Herman-Giddens et al. 1988; Hill et al. 1994; Jones et al. 1972; Moffitt et al. 1992; Surbey 1990; Trickett and Putnam 1993; Wyatt 1990). This is because when young mammals encounter conditions that are not favorable for survival—i.e., the conditions of environmental risk and uncertainty indexed by emotional stress during development—it will generally be adaptive for them to reproduce early (see the section on "The General Life History Problem").

These "socioassays" may also be part of the ultimate explanation for why (at least in the United States) adults with secure attachment histories differ in some aspects of sexual behavior and romantic love styles from adults with insecure attachment histories. Hazan and Shaver (1987; Shaver and Hazan 1994), for example, found that both men and women who were judged to have had histories of secure attachment described their love relationships in terms of trust, closeness, and a relative absence of jealousy and fear of intimacy. Men and women with insecure histories, on the other hand, were more likely to use terms suggestive of fear of intimacy, emotional peaks and valleys, jealousy, obsession, and "extreme sexual attraction" (Hazan and Shaver 1987:515). Of particular relevance to the view that individual differences in attachment represent incipient reproductive strategies (Belsky et al. 1991; Chisholm 1993, 1995a) is Hazan and Shaver's additional finding that (controlling for age) the love relationships of secure adults lasted, on average, ten years, while those of insecure adults lasted only five or six years. Similar findings have been reported by Hill et al. (1994), who found that insecure adults were less likely than secure adults *ever* to have been in a love relationship—but if they had ever married or cohabited, they did so at a *younger* age, and after a *shorter* courtship. Although there are few reports of gender differences in the antecedents of adult attachment, Hill and her colleagues also found that attachment history affected men's and women's love relationships differently: Secure men had *longer* love relationships than insecure men whereas secure women entered love relationships when they were *older* and after a *longer* courtship than did insecure women. Because the constraints on male and female reproduction are different (Trivers 1972), this pattern of sex differences is consistent with the model presented here that individual differences in

attachment have significance for later reproductive behavior. Finally, in addition to these indications that secure attachment may be associated with relatively reduced or delayed mating effort in adulthood, there is also evidence that secure adults tend to be more sensitive and responsive to their children than adults with insecure attachment histories (e.g., Main 1991; Ricks 1985). Given the trade-off between mating effort (offspring quantity) and parenting effort (offspring quality) predicted by life history theory, this is perhaps not surprising.

CONCLUSION

The life history model of attachment presented here supports an adaptationist view of the major individual differences in attachment by specifying why there should be no *a priori*, noncontingent, "normal" style of attachment. It suggests, rather, that the attachment process functions as an evolved mechanism for "switching" developmental trajectories closer to a child's local optimal path. It suggests further that the developmental basis for the difference between secure and insecure attachment might be part of a psychobiological mechanism for allocating resources contingently to optimize the trade-off between current and future reproduction. More speculatively, it also suggests that the developmental basis for the difference between avoidant and anxious/ambivalent attachment might be part of a psychobiological mechanism for allocating resources contingently to optimize the trade-off between survival and growth.

Viewing the attachment process as a mechanism for entraining potentially adaptive variation in life history traits has implications for public health and social policy as well as attachment theory. Without an understanding of the attachment process and how it generated individual differences that were potentially adaptive in the environments that gave rise to them in the first place (at least in the EEA), it would be easier to continue with the old assumption that it was *secure* attachment that was the adaptation, rather than the *process* of attachment, which gives rise naturally to insecure as well as secure attachment. In recognizing that insecure attachment is (or once was) a normal, potentially adaptive response to environmental risk and uncertainty we learn something important about human nature—namely, that if we want to reduce the distressing personal and social problems that are too often the consequence (and cause) of insecure attachment, we will have to reduce environmental risk and uncertainty. The lesson from life history theory is that people, like all organisms, are not evolved to maximize health, vigor, happiness, or lifespan, but ultimately, having descendants. Consequently, life history theory predicts that children faced with unaccept-

able levels of risk and uncertainty will quite naturally grow and develop in ways that maximize current reproduction in the face of such risk and uncertainty—even at the cost of decreased well-being and shortened lives. Insecure attachment, in other words, is fully expected to have some maladaptive consequences, in both children and adults—but it probably did in the EEA as well—for if the model presented here is not far off, it is the first stage in the development of a short-term, “fail-safe” reproductive strategy. As such, on the basis of life history theory’s principle of allocation, we expect trade-offs in the form of reduced survival or health. Combining life history theory and attachment theory has implications for social and health policy because it helps us understand why, when this happens to enough children, for long enough, “insecurity becomes embedded and acquires a cultural history” (Marris 1991:87). To redress such embedded insecurity we need enduring policies aimed at fostering long-term “felt security.” Vila calls such policies “nurturant strategies” (see also Ruddick 1989), which is apt because from the perspective of conjoined life history and attachment theory advanced here, the essence of nurturing seems to be the reduction of risk and uncertainty.

An early version of this paper was presented in the symposium “Childhood in Life-history Perspective: Developing Views” organized by Gilda Morelli and Paula Ivey for the Annual Meeting of the Society for Cross-Cultural Research in Santa Fe, New Mexico, February 16–20, 1994. My thanks to Jay Belsky, Victoria K. Burbank, Paula Ivey, Robin Smith Jacobvitz, Jane Lancaster, Michael Lamb, Gilda Morelli, Ross Thompson, Noel Wescombe, and two anonymous reviewers for their help in developing the ideas expressed here.

James S. Chisholm recently joined the Department of Anatomy and Human Biology at the University of Western Australia. Previously he taught in the Department of Anthropology at the University of New Mexico and in the Division of Human Development at the University of California, Davis. He is a biosocial anthropologist whose research interests lie in the fields of human behavioral biology, evolutionary ecology, and life history theory, where he focuses on infant social-emotional development and the development of reproductive strategies in adolescence and young adulthood. In addition to numerous articles he is the author of *Navajo Infancy: An Ethological Study of Child Development* (Aldine de Gruyter, 1983).

NOTES

1. Throughout I tend to use “mother” instead of “father,” “parent,” or “care-giver” for reasons of style and because women seem always to have been primarily responsible for the care of infants and small children. This does not mean that any particular woman, or group of women, should feel obligated to do so. Nor is

there any evidence that the sex of the person caring for a child matters to the child, or to his capacity for secure attachment. Throughout I use masculine pronouns to refer to children for reasons of style and the arbitrary reason that I am male.

2. A third type of insecure attachment ("insecure-disorganized") has been proposed but has yet to be well-studied or validated in nonclinical samples. It seems, moreover, to characterize only a small number of children (Belsky and Cassidy 1994).

3. Anxious/ambivalent attachment is also known as *resistant* attachment. Jay Belsky (College of Health and Human Development, Pennsylvania State University, personal communication 1995) notes that "resistant" is more descriptive of such children's observable behavior, whereas "anxious, ambivalent" is more evocative of such children's presumed internal working models of attachment.

4. Despite her recognition of alternative or "conditional" attachment strategies, in referring to insecure attachment as a "secondary" strategy, Main (1990) may be clinging to the view that because secure attachment is "primary" it must also be "normal."

5. Means (resources) are always limited. Not only are the energy and nutrients available to individuals almost always limited, safety, information, and time are always limited. Safety and information are always limited because no environments are absolutely without risk and uncertainty. Time is always limited, in two ways: in the sense that (1) there are always occasions when it is impossible to do two things at the same time, and (2) all organisms have a maximum life potential—a limited time to live. Ends, on the other hand, are always *unlimited*, in the sense that evolution is driven not by leaving descendants, but by leaving *more* descendants than others. Fitness, in other words, is always relative.

6. Some of an organism's traits are functionally integrated, in the sense that they work together to carry out some metabolic, physiological, developmental, or behavioral process which is or was favored by selection. Such traits are integrated in a network of adaptive causation; they cause something to happen that may be adaptive. Other traits have no function and do not cause anything adaptive to happen. Instead, they are merely correlated with each other or with other integrated traits (e.g., Stamps 1991; Stearns 1992). The distinction is not always easy to make in practice.

7. For example, Stephen Jay Gould—who is occasionally misrepresented as an anti-adaptationist—has argued that the assumption of optimality is most useful for analyzing "explicitly biological traits shared with other related species lacking our cultural richness—e.g., . . . behaviors of sexual and parent-child bonding" (1991:60).

8. Parental investment may be direct or indirect (e.g., Kleiman and Malcolm 1981). In the former, parental care is received *directly* by the young (e.g., feeding, carrying, grooming). In the latter, it is received only *indirectly* or circuitously, often *in the absence* of the parent (e.g., resource accrual, group defense). For Kaplan (1994) this distinction is the one between *care of* and *investment in* offspring, which helps to illustrate how pervasive the trade-off between current and future reproduction may be: *care of* offspring tends to maximize their current fitness (i.e., it fosters survival and growth and development right now, in the present), whereas *investment in* offspring tends to maximize their fitness at some time removed (i.e., their potential for health, growth, or reproduction in the future). Because I am concerned in this paper with how our infant and juvenile ancestors perceived parental investment (i.e., their "felt security"), I am more concerned with direct forms of parental care.

9. Levine (1987), for example, recounts the story of a Nepalese woman in an area where there had traditionally been a strong preference for sons. The woman gave birth to two sons, of whom both survived, and seven daughters, of whom only three survived. Her last child was a girl, and the woman was so enraged at having another daughter she initially refused to feed it. Other relatives prevailed, however, and she ultimately gave in. Even so,

The mother's bitterness again surfaced in a refusal to interact with the child or even name her. Instead she has called her daughter a succession of abusive terms, one of which was "Ready To Die." Yet the girl has not died and remains a healthy, if very quiet child (1987:292).

10. Poverty, of course, does not automatically entail high environmental risk and uncertainty, nor does wealth necessarily entail low environmental risk and uncertainty. While wealth and privilege are clearly buffers against many kinds of risk and uncertainty, they are not panaceas against all kinds. Moreover, what matters in theory are *perceptions* of risk and uncertainty. Although we expect there to be a reasonably good fit between objective and subjective assessments of environmental risk and uncertainty, there is evidence that, whether one is rich or poor at the moment, subjective assessments of risk and uncertainty depend in part on one's past experience of risk and uncertainty (e.g., Gardner 1993; Lawrence 1991; Maital and Maital 1977; O'Rand and Ellis 1974; see also Rogers 1994). There is also evidence that perceptions of risk and uncertainty in close emotional relationships depend in part on risk and uncertainty in one's attachment history (e.g., Main 1991). Perceptions of risk and uncertainty are thus likely to be affected not only by objective measures of current environmental risk and uncertainty, but also by personal, subjective experience—and the meanings and values (cultural constructions) that are attached to such experiences by others who share them (see also Marris 1991).

REFERENCES

- Ainsworth, M.
 1969 *Infancy in Uganda: Infant Care and the Growth of Love*. Baltimore: Johns Hopkins University Press.
 1979a Infant-Mother Attachment. *American Psychologist* 34:932–937.
 1979b Attachment as Related to Mother-Infant Interaction. In *Advances in the Study of Behavior*, Vol. 9, J. Rosenblatt, R. Hinde, C. Beer, and M. Busnel, eds. Pp. 1–51. New York: Academic Press.
- Ainsworth, M., S. Bell, and D. Stayton
 1971 Individual Differences in Strange Situation Behavior of One-year-olds. In *The Origins of Human Social Relations*, H. Schaffer, ed. Pp. 17–57. London: Academic.
- Ainsworth, M., M. Blehar, E. Waters, and S. Wall
 1978 *Patterns of Attachment*. Hillsdale, New Jersey: Lawrence Erlbaum.
- Alexander, R., and G. Borgia
 1979 On the Origin and Basis of the Male-Female Phenomenon. In *Sexual Selection and Reproductive Competition in Insects*, M. Blum and N. Blum, eds. Pp. 413–440. New York: Academic Press.

Andrews, M., and L. Rosenblum

1991 Attachment in Monkey Infants Raised in Variable- and Low-Demand Environments. *Child Development* 62:686–693.

Apter, D., M. Reinilla, and R. Vihko

1989 Some Endocrine Characteristics of Early Menarche, a Risk Factor for Breast Cancer, Are Preserved into Adulthood. *Journal of Clinical Endocrinology and Metabolism* 57:82–86.

Barkow, J., L. Cosmides, and J. Tooby, eds.

1992 *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*. New York: Oxford University Press.

Bates, J., C. Maslin, and K. Frankel

1985 Attachment Security, Mother-Child Interaction, and Temperament as Predictors of Behavior-Problem Ratings at Three Years of Age. In *Growing Points in Attachment Theory and Research*, I. Bretherton and E. Waters, eds. Monographs of the Society for Research in Child Development (Serial No. 309), 50(1–2):167–193.

Bateson, P.

1976 Rules and Reciprocity in Behavioral Development. In *Growing Points in Ethology*, P. Bateson and R. Hinde, eds. Pp. 401–421. Cambridge: Cambridge University Press.

1982 Behavioural Development and Evolutionary Processes. In *Current Problems in Sociobiology*, King's College Sociobiology Study Group, eds. Pp. 133–151. Cambridge: Cambridge University Press.

1994 The Dynamics of Parent-Offspring Conflict in Mammals. *Trends in Ecology and Evolution* 9(10):399–403.

Bateson, P., M. Mendl, and J. Feaver

1990 Play in the Domestic Cat Is Enhanced by Rationing of the Mother during Lactation. *Animal Behaviour* 40:514–525.

Belsky, J., and J. Cassidy

1994 Attachment: Theory and Evidence. In *Development through Life: A Handbook for Clinicians*, M. Rutter and D. Hay, eds. Pp. 373–402. Oxford: Blackwell.

Belsky, J., L. Steinberg, and P. Draper

1991 Childhood Experience, Interpersonal Development, and Reproductive Strategy: An Evolutionary Theory of Socialization. *Child Development* 62:647–670.

Bernardo, J.

1993 Determinants of Maturation in Animals. *Trends in Ecology and Evolution* 8(5):166–173.

Blurton Jones, N.

1993 The Lives of Hunter-gatherer Children: Effects of Parental Behavior and Parental Reproductive Strategy. In *Juvenile Primates: Life History, Development and Behavior*, M. Pereira and L. Fairbanks, eds. Pp. 309–326. New York: Oxford University Press.

Bogin, B.

1994 Adolescence in Evolutionary Perspective. *Acta Paediatrica*, Supplement 406:29–35.

1995 Growth and Development: Recent Evolutionary and Biocultural Re-

- search. In *Biological Anthropology: The State of the Science*, N. Boaz and L. Wolfe, eds. Pp. 49–70. New York: Wiley-Liss.
- Bonner, J.
 - 1965 *Size and Cycle*. Princeton: Princeton University Press.
- Borgerhoff Mulder, M.
 - 1992 Reproductive Decisions. In *Evolutionary Ecology and Human Behavior*, E. Smith and B. Winterhalder, eds. Pp. 339–374. New York: Aldine de Gruyter.
- Boswell, J.
 - 1988 *The Kindness of Strangers: The Abandonment of Children in Western Europe from Late Antiquity to the Renaissance*. New York: Pantheon.
- Bowlby, J.
 - 1965 *Child Care and the Growth of Love*. Harmondsworth: Penguin Books.
 - 1969 *Attachment*. Attachment and Loss, Vol. 1. New York: Basic Books. (second edition published in 1982)
 - 1973 *Separation: Anxiety and Anger*. Attachment and Loss, Vol. 2. New York: Basic Books.
 - 1980 *Loss: Sadness and Depression*. Attachment and Loss, Vol. 3. New York: Basic Books.
- Boyd, R., and P. Richerson
 - 1985 *Culture and the Evolutionary Process*. Chicago: University of Chicago Press.
- Brazelton, T., B. Kozlowski, and M. Main
 - 1974 The Origins of Reciprocity: The Early Mother-Infant Interaction. In *The Effect of the Infant on Its Caregiver*, M. Lewis and L. Rosenblum, eds. Pp. 49–76. New York: Wiley.
- Brenner, M.
 - 1973 *Mental Illness and the Economy*. Cambridge, Massachusetts: Harvard University Press.
- Bretherton, I.
 - 1985 Attachment Theory: Retrospect and Prospect. In *Growing Points in Attachment Theory and Research*, I. Bretherton and E. Waters, eds. Monographs of the Society for Research in Child Development (Serial No. 309), 50(1–2):3–35.
- Bretherton, I., and M. Ainsworth
 - 1974 Responses of One-year-olds to a Stranger in a Strange Situation. In *The Origins of Fear*, M. Lewis and L. Rosenblum, eds. Pp. 131–164. New York: Wiley.
- Bretherton, I., and E. Waters, eds.
 - 1985 *Growing Points in Attachment Theory and Research*. Monographs of the Society for Research in Child Development (Serial No. 309), 50(1–2).
- Campos, J., K. Barrett, M. Lamb, H. Goldsmith, and C. Stenberg
 - 1983 Socioemotional Development. In *Infancy and Developmental Psychology*, M. Haith and J. Campos, eds. Handbook of Child Psychology, Vol. 2, fourth ed. Pp. 783–915. New York: Wiley.
- Caro, T., and P. Bateson
 - 1986 Organization and Ontogeny of Alternative Tactics. *Animal Behaviour* 4:1482–1499.

Cassidy, J., and J. Berlin

1994 The Insecure-Ambivalent Pattern of Attachment: Theory and Research. *Child Development* 65:971-991.

Charnov, E.

1993 *Life History Invariants*. Oxford: Oxford University Press.

Charnov, E., and D. Berrigan

1993 Why Do Female Primates Have Such Long Lifespans and So Few Babies? or Life in the Slow Lane. *Evolutionary Anthropology* 2:191-194.

Chisholm, J.

1993 Death, Hope, and Sex: Life History Theory and the Development of Reproductive Strategies. *Current Anthropology* 34(1):1-24.

1995a Love's Contingencies: The Developmental Socioecology of Romantic Passion. In *Romantic Passion: A Universal Experience*, W. Jankowiak, ed. New York: Columbia University Press.

1995b Life History Theory and Life Style Choice: Implications for Darwinian Medicine. *Perspectives in Human Biology* 1:19-28.

Cohn, J., and E. Tronick

1983 Three-month-old Infants' Reactions to Simulated Depression. *Child Development* 54:185-193.

Cole, L.

1954 The Population Consequences of Life History Phenomena. *Quarterly Review of Biology* 29:103-137.

Conger, R., J. McCarty, R. Yang, et al.

1984 Perception of Child, Child-rearing Values, and Emotional Distress as Mediating Links between Environmental Stressors and Observed Maternal Behavior. *Child Development* 54:2234-2247.

Crockenberg, S.

1981 Infant Irritability, Mother Responsiveness, and Social Support Influences on the Security of Infant-Mother Attachment. *Child Development* 52:857-869.

DeRousseau, C.

1990 Life-history Thinking in Perspective. In *Primate Life History and Evolution*, C. DeRousseau, ed. Pp. 1-13. New York: Wiley-Liss.

Draper, P., and H. Harpending

1982 Father Absence and Reproductive Strategy: An Evolutionary Perspective. *Journal of Anthropological Research* 38:255-273.

Drotar, D.

1991 The Family Context of Nonorganic Failure to Thrive. *American Journal of Orthopsychiatry* 61:23-34.

Duncan, G., J. Brooks-Gunn, and P. Klebanov

1994 Economic Deprivation and Early Childhood Development. *Child Development* 65:296-318.

Dunn, J.

1976 How Far Do Early Differences in Mother-Child Relations Affect Later Development? In *Growing Points in Ethology*, P. Bateson and R. Hinde, eds. Pp. 481-496. Cambridge: Cambridge University Press.

Edgerton, R.

1992 *Sick Societies: Challenging the Myth of Primitive Harmony*. New York: Free Press.

Egeland, D., D. Jacobvitz, and K. Papatola

1987 Intergenerational Continuity of Abuse. In *Child Abuse and Neglect: Biosocial Dimensions*, R. Gelles and J. Lancaster, eds. Pp. 255–276. New York: Aldine de Gruyter.

Ellison, P.

1990 Human Ovarian Function and Reproductive Ecology: New Hypotheses. *American Anthropologist* 92:933–952.

Emlen, S.

1985 Evolutionary Ecology and the Optimality Assumption. In *The Latest on the Best: Essays on Evolution and Optimality*, J. Dupré, ed. Pp. 163–177. Cambridge, Massachusetts: MIT Press.

Erickson, M., L. Sroufe, and B. Egeland

1985 The Relationship between Quality of Attachment and Behavior Problems in Preschool in a High-Risk Sample. In *Growing Points of Attachment Theory and Research*, I. Bretherton and E. Waters, eds. Monographs of the Society for Research in Child Development (Serial No. 309), 50(1–2):147–166.

Eveleth, P., and J. Tanner

1990 *Worldwide Variation in Human Growth*, second ed. Cambridge: Cambridge University Press.

Fagen, R.

1982 Evolutionary Issues in the Development of Behavioral Flexibility. In *Ontogeny*, P. Bateson and P. Klopfer, eds. *Perspectives in Ethology*, Vol. 5. Pp. 365–383. New York: Plenum.

1993 Primate Juveniles and Primate Play. In *Juvenile Primates: Life History, Development and Behavior*, M. Pereira and L. Fairbanks, eds. Pp. 182–196. New York: Oxford University Press.

Foley, R.

1992 Evolutionary Ecology of Fossil Hominids. In *Evolutionary Ecology and Human Behavior*, E. Smith and B. Winterhalder, eds. Pp. 131–164. New York: Aldine de Gruyter.

Fox, R.

1989 *The Search for Society: Quest for a Biosocial Science and Morality*. New Brunswick, New Jersey: Rutgers University Press.

Freedman, D., and J. Gorman

1993 Attachment and the Transmission of Culture: An Evolutionary Perspective. *Journal of Social and Evolutionary Systems* 16(3):297–329.

Freud, S.

1940 *An Outline of Psychoanalysis*. New York: Norton.

Gadgil, M., and W. Bossert

1970 Life History Consequences of Natural Selection. *American Naturalist* 104:1–24.

Gardner, W.

1993 A Life-Span Rational-Choice Theory of Risk-taking. In *Adolescent Risk-*

- Taking*, N. Bell and R. Bell, eds. Pp. 66–83. Newbury Park, California: Sage Publications.
- Gillespie, J.
1977 Natural Selection for Variances in Offspring Numbers: A New Evolutionary Principle. *American Naturalist* 111:1010–1014.
- Gomendio, M.
1991 Parent-Offspring Conflict and Maternal Investment in Rhesus Macaques. *Animal Behavior* 42:993–1005.
- Goldsmith, H., and C. Harman
1994 Temperament and Attachment: Individuals and Relationships. *Current Directions in Psychological Science* 3:53–57.
- Gottlieb, G.
1991 Experiential Canalization of Behavioral Development: Theory. *Developmental Psychology* 27:4–13.
- Gould, S. J.
1991 Exaptation: A Crucial Tool for an Evolutionary Psychology. *Journal of Social Issues* 47(3):43–65.
- Gould, S. J., and R. Lewontin
1979 The Spandrels of San Marcos and the Panglossian Paradigm: A Critique of the Adaptationist Program. *Proceedings of the Royal Society of London B*, 205:581–598.
- Graber, J., J. Brooks-Gunn, and M. Warren
1995 The Antecedents of Menarcheal Age: Heredity, Family Environment, and Stressful Life Events. *Child Development* 66:346–359.
- Grafen, A.
1984 Natural Selection, Kin Selection, and Group Selection. In *Behavioural Ecology: An Evolutionary Approach*, second ed., J. Krebs and N. Davies, eds. Pp. 62–84. Sunderland, Massachusetts: Sinauer Associates.
- Gunnar, M., S. Mangelsdorf, M. Larson, and L. Hertzgaard
1989 Attachment, Temperament, and Adrenocortical Activity in Infancy: A Study of Neuroendocrine Regulation. *Developmental Psychology* 25:355–363.
- Hall, B.
1992 *Evolutionary Developmental Biology*. New York: Chapman and Hall.
- Harlow, H.
1958 The Nature of Love. *American Psychologist* 13:673–685.
- Harpending, H., P. Draper, and R. Pennington
1990 Culture, Evolution, Parental Care, and Mortality. In *Disease in Populations in Transition*, A. Swedland and G. Armelagos, eds. Pp. 251–265. South Hadley, Massachusetts: Bergin and Garvey.
- Hausfater, G., and S. Hrdy, eds.
1984 *Infanticide: Comparative and Evolutionary Perspectives*. New York: Aldine de Gruyter.
- Hazan, C., and P. Shaver
1987 Romantic Love Conceptualized as an Attachment Process. *Journal of Personality and Social Psychology* 52:511–524.

- Herman-Giddens, M., A. Sandler, and N. Friedman
1988 Sexual Precocity in Girls: An Association with Sexual Abuse? *American Journal of Diseases of Children* 142:431–433.
- Hill, E., J. Young, and J. Nord
1994 Childhood Adversity, Attachment Security, and Adult Relationships: A Preliminary Study. *Ethology and Sociobiology* 15:323–338.
- Hill, K.
1993 Life History Theory and Evolutionary Anthropology. *Evolutionary Anthropology* 2(3):78–88.
- Hinde, R.
1961 The Establishment of the Parent-Offspring Relation in Birds, with Some Mammalian Analogies. In *Current Problems in Animal Behaviour*, W. H. Thorpe and O. L. Zangwill, eds. Pp. 175–193. London: Cambridge University Press.
1982 Attachment: Some Conceptual and Biological Issues. In *The Place of Attachment in Human Behavior*, C. Parkes and J. Stevenson-Hinde, eds. Pp. 60–76. New York: Basic Books.
1983 Ethology and Child Development. In *Infancy and Developmental Psychology*, M. Haith and J. Campos, eds. Pp. 27–94. Handbook of Child Psychology, Vol. II, P. Mussen, series ed. New York: Wiley.
1987 *Individuals, Relationships, and Culture: Links between Ethology and the Social Sciences*. Cambridge: Cambridge University Press.
- Hirschfield, M., and D. Tinkle
1975 Natural Selection and the Evolution of Reproductive Effort. *Proceedings of the National Academy of Science* 72:2227–2231.
- Hrdy, S.
1977 Infanticide as a Primate Reproductive Strategy. *American Scientist* 65:40–49.
1979 Infanticide among Animals: A Review, Classification, and Examination of the Implications for the Reproductive Strategies of Females. *Ethology and Sociobiology* 1:13–40.
1992 Fitness Tradeoffs in the History and Evolution of Delegated Mothering with Special References to Wet-nursing, Abandonment and Infanticide. *Ethology and Sociobiology* 13:409–442.
- Isabella, R., and J. Belsky
1991 Interactional Synchrony and the Origins of Infant-Mother Attachment: A Replication Study. *Child Development* 62:373–384.
- Janson, J., and C. van Schaik
1993 Ecological Risk Aversion in Juvenile Primates: Slow and Steady Wins the Race. In *Juvenile Primates: Life History, Development and Behavior*, M. Pereira and L. Fairbanks, eds. Pp. 57–74. New York: Oxford University Press.
- Johnston, T.
1982 Selective Costs and Benefits in the Evolution of Learning. In *Advances in the Study of Behavior*, Vol. 12, J. Rosenblatt, R. Hinde, C. Beer, and M.-C. Busnel, eds. Pp. 65–106. New York: Academic Press.

- Jones, B., J. Leeton, I. McLeod, and C. Wood
 1972 Factors Influencing the Age of Menarche in a Lower Socio-economic Group in Melbourne. *Medical Journal of Australia* 21:533-535.
- Kagan, J.
 1982 *Psychological Research on the Human Infant: An Evaluative Summary*. New York: W. T. Grant Foundation.
- Kaplan, H.
 1994 Evolutionary and Wealth Flows Theories of Fertility: Empirical Test and New Models. *Population and Development Review* 20(4):753-791.
- Kleiman, D., and J. Malcolm
 1981 The Evolution of Male Parental Investment in Mammals. In *Parental Care in Mammals*, D. Gubernick and P. Klopfer, eds. Pp. 347-387. New York: Plenum.
- Lamb, M., R. Thompson, W. Gardner, and E. Charnov
 1985 *Infant-Mother Attachment: The Origins and Developmental Significance of Individual Differences in Strange Situation Behavior*. Hillsdale, New Jersey: Lawrence Erlbaum.
- Lawrence, E.
 1991 Poverty and the Rate of Time Preference: Evidence from Panel Data. *Journal of Political Economy* 99:54-77.
- Lempers, J., D. Clark-Lempers, and R. Simons
 1989 Economic Hardship, Parenting, and Distress in Adolescence. *Child Development* 60:25-49.
- Levine, N.
 1987 Differential Child Care in Three Tibetan Communities: Beyond Son Preference. *Population and Development Review* 13(2):281-304.
- Levins, R.
 1968 *Evolution in Changing Environments*. Princeton: Princeton University Press.
- Liesen, L.
 1995 Feminism and the Politics of Reproductive Strategies. *Politics and the Life Sciences* 14(2):145-162.
- Lorenz, K.
 1935 Der Kumpan in der Umwelt des Vogels [Companionship in Bird Life]. *Journal of Ornithology* 83:137-213. (English translation in C. H. Schiller, ed., *Instinctive Behavior*. New York: International Universities Press, 1957).
- Lott, D.
 1991 *Intraspecific Variation in the Social Systems of Wild Vertebrates*. Cambridge: Cambridge University Press.
- Low, B.
 1978 Environmental Uncertainty and the Parental Strategies of Marsupials and Placentals. *American Naturalist* 112:197-213.
- Main, M.
 1981 Avoidance in the Service of Attachment: A Working Paper. In *Behavioral Development: The Bielefeld Interdisciplinary Project*, K. Immelmann, G. Barlow, L. Petrinoich, and M. Main, eds. Pp. 651-693. New York: Cambridge University Press.

- 1990 Cross-cultural Studies of Attachment Organization: Recent Studies, Changing Methodologies, and the Concept of Conditional Strategies. *Human Development* 33:48–61.
 - 1991 Metacognitive Knowledge, Metacognitive Monitoring, and Singular (coherent) vs. Multiple (incoherent) Models of Attachment. In *Attachment across the Life Cycle*, C. Parkes, J. Stevenson-Hinde, and P. Marris, eds. Pp. 127–159. New York: Tavistock/Routledge.
- Main, M., N. Kaplan, and J. Cassidy
- 1985 Security in Infancy, Childhood, and Adulthood: A Move to the Level of Representation. In *Growing Points in Attachment Theory and Research*, I. Bretherton and E. Waters, eds. Monographs of the Society for Research in Child Development (Serial No. 309), 50(1–2):66–104.
- Maital, S., and S. Maital
- 1977 Time Preference, Delay of Gratification and the Intergenerational Transmission of Economic Instability: A Behavioral Theory of Income Distribution. In *Essays in Labor Market Analysis*, O. Ashenfelter and W. Oates, eds. Pp. 179–199. New York: John Wiley and Sons.
- Marris, P.
- 1991 The Social Construction of Uncertainty. In *Attachment across the Life Cycle*, C. Parkes, J. Stevenson-Hinde, and P. Marris, eds. Pp. 77–90. London: Routledge.
- McLoyd, V.
- 1990 The Declining Fortunes of Black Children: Psychological Distress, Parenting, and Socioemotional Development in the Context of Economic Hardship. *Child Development* 61:311–346.
- Miller, G., E. Galanter, and K. Pribram
- 1960 *Plans and the Structure of Behavior*. New York: Holt, Rinehart and Winston.
- Moffitt, T., A. Caspi, and J. Belsky
- 1992 Childhood Experience and the Onset of Menarche: A Test of a Sociobiological Experience. *Child Development* 63:47–58.
- Monckberg, F.
- 1992 Nutrition, Emotional Factors, and Growth. In *Human Growth: Basic and Clinical Aspects*, M. Hernandez and J. Argente, eds. Pp. 117–131. New York: Elsevier.
- Nesse, R., and G. Williams
- 1995 *Why We Get Sick: The New Science of Darwinian Medicine*. New York: Times Books/Random House.
- O’Rand, A., and R. Ellis
- 1974 Social Class and Social Time Preference. *Social Forces* 53:53–62.
- Orzack, S., and E. Sober
- 1994 Optimality Models and the Test of Adaptationism. *American Naturalist* 143:361–380.
- Oyama, S.
- 1985 *The Ontogeny of Information*. Cambridge: Cambridge University Press.
 - 1994 Rethinking Development. In *Psychological Anthropology*, P. Bock, ed. Pp. 185–196. Westport, Connecticut: Praeger.

Parker, G., and J. Maynard Smith

1990 Optimality Theory in Evolutionary Biology. *Nature* 348:27–33.

Peacock, N.

1990 Comparative and Cross-cultural Approaches to the Study of Human Reproductive Failure. In *Primate Life History and Evolution*, C. DeRousseau, ed. Pp. 195–220. New York: Wiley-Liss.

1991 An Evolutionary Perspective on the Patterning of Maternal Investment in Pregnancy. *Human Nature* 2(4):351–385.

Pennington, R., and H. Harpending

1988 Fitness and Fertility among the Kalahari !Kung. *American Journal of Physical Anthropology* 7:303–319.

Promislow, D., and P. Harvey

1990 Living Fast and Dying Young: A Comparative Analysis of Life-history Variation in Mammals. *Journal of the Zoological Society of London* 220:417–437.

1991 Mortality Rates and the Evolution of Mammal Life Histories. *Acta Oecologica* 12:94–101.

Radke-Yarrow, M.

1991 Attachment Patterns in Children of Depressed Mothers. In *Attachment across the Lifespan*, C. Parkes, J. Stevenson-Hinde, and P. Marris, eds. Pp. 115–126. New York: Tavistock/Routledge.

Ricks, M.

1985 The Social Transmission of Parental Behavior: Attachment across Generations. In *Growing Points in Attachment Theory and Research*, I. Bretherton and E. Waters, eds. Monographs of the Society for Research in Child Development (Serial No. 309), 50(1–2):211–227.

Roff, D.

1992 *The Evolution of Life Histories: Theory and Analysis*. New York: Chapman and Hall.

Rogers, A.

1990 The Evolutionary Economics of Reproduction. *Ethology and Sociobiology* 11:479–495.

1994 Evolution of Time Preference by Natural Selection. *American Economic Review* 84:460–481.

Rosenblum, L., and M. Andrews

1994 Influences of Environmental Demand on Maternal and Infant Development. *Acta Paediatrica*, Supplement, 397:57–63.

Rosenblum, L., J. Caplan, S. Freedman, T. Bassoff, et al.

1994 Adverse Early Experiences Affect Noradrenergic and Serotonergic Functioning in Adult Primates. *Biological Psychiatry* 35(4):221–227.

Rubenstein, D.

1982 Risk, Uncertainty, and Evolutionary Strategies. In *Current Problems in Sociobiology*, King's College Sociobiology Study Group, eds. Pp. 91–111. Cambridge: Cambridge University Press.

1993 On the Evolution of Juvenile Lifestyles in Mammals. In *Juvenile Primates: Life History, Development and Behavior*, M. Pereira and L. Fairbanks, eds. Pp. 38–56. New York: Oxford University Press.

Ruddick, S.

1989 *Maternal Thinking: Toward a Politics of Peace*. New York: Ballantine Books.

Sampson, R., and J. Laub

1994 Urban Poverty and the Family Context of Delinquency: A New Look at Structure and Process in a Classic Study. *Child Development* 65:523–540.

Schaffer, W.

1983 The Application of Optimal Control Theory to the General Life History Problem. *American Naturalist* 121:418–431.

Scheper-Hughes, N.

1992 *Death without Weeping: The Violence of Everyday Life in Brazil*. Berkeley: University of California Press.

Seger, J., and J. Brockmann

1987 What is Bet-hedging? In *Oxford Survey in Evolutionary Biology*, Vol. 4, P. Harvey and L. Partridge, eds. Pp. 182–211. Oxford: Oxford University Press.

Shaver, P., and C. Hazan

1993 Adult Romantic Attachment. In *Advances in Personal Relationships*, Vol. 4, D. Perlman and W. Jones, eds. Pp. 29–70. Greenwich, CT: JAI Press.

Smith, E.

1991 The Influence of Nutrition and Postpartum Mating on Weaning and Subsequent Play Behaviour of Hooded Rats. *Animal Behaviour* 41:513–524.

Smith, E., and B. Winterhalder

1992 Natural Selection and Decision-making: Some Fundamental Principles. In *Evolutionary Ecology and Human Behavior*, E. Smith and B. Winterhalder, eds. Pp. 25–60. New York: Aldine de Gruyter.

Smuts, B.

1992 Male Aggression against Women: An Evolutionary Perspective. *Human Nature* 3(1):1–44.

1995 The Evolutionary Origins of Patriarchy. *Human Nature* 6(1):1–32.

Spitz, R.

1945 Hospitalism: An Inquiry into the Genesis of Psychiatric Conditions in Early Childhood. *Psychoanalytic Study of the Child* 1:53–74.

Sroufe, L.

1988 The Role of Infant-Caregiver Attachment in Development. In *Clinical Implications of Attachment*, J. Belsky and T. Nezworski, eds. Pp. 18–38. Hillsdale, New Jersey: Lawrence Erlbaum.

Sroufe, L., and E. Waters

1977 Attachment as an Organizational Construct. *Child Development* 48:1184–1199.

Stamps, J.

1991 Why Evolutionary Issues Are Revising Interest in Proximate Behavioral Mechanisms. *American Zoologist* 31:339–348.

Stearns, S.

1982 The Role of Development in the Evolution of Life Histories. In *Evolution and Development*, J. Bonner, ed. Pp. 237–258. Dahlem Konferenzen. New York: Springer-Verlag.

1992 *The Evolution of Life Histories*. New York: Oxford University Press.

Suomi, S.

- 1991 Primate Models of Affective Disorders. In *Neurobiology of Learning, Emotion, and Affect*, J. Madden, ed. Pp. 195–214. New York: Raven Press.

Surbey, M.

- 1990 Family Composition, Stress, and Human Menarche. In *The Socioendocrinology of Primate Reproduction*, F. Bercovich and T. Zeigler, eds. Pp. 11–32. New York: Liss.

Tauber, A.

- 1994 Darwinian Aftershocks: Repercussions in Late Twentieth Century Medicine. *Journal of the Royal Society of Medicine* 87:27–31.

Tinbergen, N.

- 1963 On the Aims and Methods of Ethology. *Zeitschrift für Tierpsychologie* 20:410–433.

Trickett, P., and F. Putnam

- 1993 The Impact of Child Sexual Abuse on Females: Toward a Developmental Psychological Integration. *Psychological Science* 4(2):81–87.

Trivers, R.

- 1972 Parental Investment and Sexual Selection. In *Sexual Selection and the Descent of Man*, B. Campbell, ed. Pp. 136–179. New York: Aldine de Gruyter.
1974 Parent-Offspring Conflict. *American Zoologist* 24:249–264.

Tronick, E., G. Morelli, and S. Winn

- 1987 Multiple Caretaking of Efe (Pygmy) Infants. *American Anthropologist* 89:96–106.

van Schaik, C., and R. Dunbar

- 1990 The Evolution of Monogamy in Large Primates: A New Hypothesis and Some Crucial Tests. *Behaviour* 115:31–62.

Valenzuela, M.

- 1990 Attachment in Chronically Underweight Young Children. *Child Development* 61:1984–1996.

Vaughn, B., and E. Waters

- 1990 Attachment Behavior at Home and in the Laboratory: Q-sort Observations and Strange Situation Classifications of One-year-olds. *Child Development* 61:1965–1973.

Vila, B.

- 1994 A General Paradigm for Understanding Criminal Behavior: Extending Evolutionary Ecological Theory. *Criminology* 32(3):311–359.

Vitzthum, V.

- 1994 Resolution of a Paradox: The Evolution of a Flexibly Responsive Reproductive System. *Human Biology*, in press.

Wachs, T., and S. Desai

- 1993 Parent-report Measures of Toddler Temperament and Attachment: Their Relation to Each Other and to the Social Microenvironment. *Infant Behavior and Development* 16(3):391–396.

Waters, E., and K. Deane

- 1985 Defining and Assessing Individual Differences in Attachment Relationships: Q-methodology and the Organization of Behavior in Infancy and Early Childhood. In *Growing Points in Attachment Theory and Research*,

- I. Bretherton and E. Waters, eds. Monographs of the Society for Research in Child Development (Serial No. 309), 50(1-2):41-65.
- Wellens, R., R. Malina, A. Roche, W. Chumlea, S. Guo, and R. Siervogel
1992 Body Size and Fatness in Young Adults in Relation to Age at Menarche. *American Journal of Human Biology* 4:783-787.
- Wiley, A.
1992 Adaptation and the Biocultural Paradigm in Medical Anthropology: A Critical Review. *Medical Anthropology Quarterly* 6:216-236.
- Wiley, A., and L. Carlin
1994 Biological Bases and Environmental Contingencies: Biocultural Perspectives on Mother-Infant Attachment. Paper presented at the 93rd annual meeting of the American Anthropological Association, December 4, Atlanta.
- Williams, G.
1957 Pleiotropy, Natural Selection, and the Evolution of Senescence. *Evolution* 11:398-411.
1966 *Adaptation and Natural Selection*. Princeton: Princeton University Press.
- Wolkind, S., and M. Rutter
1985 Separation, Loss, and Family Relationships. In *Child and Adolescent Psychiatry: Modern Approaches*, M. Rutter and L. Hersov, eds. Pp. 34-57. Palo Alto: Blackwell Scientific.
- Worthman, C.
1993 The Company They Keep: Sex Differences in Maturational Timing. Paper presented at the session on "Evolution Medicine: New Directions and Perspectives." Annual Meeting of the American Association for the Advancement of Science, February 15, Boston.
1994 Developmental Microniche: A Concept for Modelling Relationships of Biology, Behavior, and Culture in Development. Paper presented at the session on "Human Growth and Development: Modelling Relationships of Biology and Context." Annual meeting of the American Association of Physical Anthropologists, March 31-April 2, Denver.
- Wyatt, G.
1990 Changing Influences on Adolescent Sexuality over the Past Forty Years. In *Adolescence and Puberty*, J. Bancroft and J. Reinisch, eds. Pp. 182-206. Kinsey Institute Series 3. New York: Oxford University Press.
- Yarrow, L.
1967 The Development of Focused Relationships during Infancy. In *Exceptional Infant*, Vol. 1, J. Hellmuth, ed. Pp. 227-242. Seattle: Special Child.