CHILDHOOD AND THE EVOLUTION OF THE HUMAN LIFE COURSE

An Introduction

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Childhood has been the focus of research and debate among anthropologists, developmental psychologists, demographers, economists, and other social scientists for fifty years (Konner 1991; Panter-Brick 1998). As a result, there are diverse research traditions and trajectories that have arisen with varying levels of intercommunication. Recent theoretical developments in human evolutionary ecology have shifted away from description of the normative characteristics of childhood across societies towards exploration of the evolutionary history of primate ontogeny and the fitness consequences of a life history that has childhood as a component (Blurton Jones 1993; Blurton Jones et al. 1989, 1997, 1999; Bogin and Smith 1996; Charnov 1993; Charnov and Berrigan 1993; Hawkes et al. 1997, 1998; Janson and van Schaik 1993; Kaplan et al. 2000).

Leigh (2001) has identified four models based in life history theory that have recently been used to explain the slow growth and extended juvenility of primates in general and humans in particular. The brain growth model asserts that slow growth is a consequence of the amount of learning-based knowledge necessarily acquired by adulthood. Essentially, slow growth provides the time needed to fully program the brain with the information needed for adult competence (Bogin 1999). The pleiotropic model developed by Charnov and colleagues (Charnov and Berrigan 1993) argues that among primates the benefits of continued growth to the

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production of offspring outweigh the costs of delaying reproduction when adult mortality is low. In this case, natural selection is not directly acting to extend juvenility, but rather the juvenile period is an artifact of slow growth. Janson and van Schaik (1993) have proposed an ecological risk aversion model, which assumes that in primates the trade-off between foraging efficiency and predation risk selects for low growth rates. The intragroup competitive costs to younger individuals of reduced rates of energy acquisition are outweighed by the reduction of predation risk from being surrounded by more experienced and older individuals who provide increased predator detection and avoidance. The last model identified by Leigh is the embodied capital model of Kaplan and colleagues (Kaplan 1996; Kaplan and Bock 2001; Kaplan et al. 1995, 2000). In this model, large body size and the acquisition of skills and knowledge attainable through slow growth accrue greater net benefits in the form of high levels of production during the adult period. According to Leigh, these models produce the following predictions: the brain growth model predicts rapid growth early in ontogeny but is not consistent with rapid periods of growth after the brain has ceased growing; the adult mortality model accurately predicts extension of all ontogenetic periods but does not explain variation in growth rates; the ecological risk aversion model is consistent with variation in growth rates during ontogeny but may not pertain to humans, which show extensive female provisioning of offspring; and the embodied capital model is consistent with both the prolongation of early ontogenetic phases as well as variation in later growth rates.

Given this current state of theoretical development, today's researchers need to conduct careful analyses of children's growth, learning, resource consumption and production, and development using data collected with explicit attention to socioecological conditions in order to begin to discriminate among these models. The five papers in this collection, originally presented at the 1999 Annual Meeting of the Human Behavior and Evolution Society, examine some of the theoretical models specified above using four sets of data collected in very different ecological contexts. The importance of these papers lies both in their theoretical contributions and in the data specifically collected to examine life history models.

Bock introduces the punctuated development model of the relationship between growth and learning and tests a set of hypotheses derived from this model using time allocation, anthropometric, and experimental task performance data from a multiethnic community of forager/agropastoralists in the Okavango Delta of Botswana. He explores the formation of adult competency in relation to the socioecological context, including subsistence ecology and family composition, of individual children. Bock finds that the development of adult competency in specific tasks entails a step-like relationship between growth and learning in the ontogeny of

ability acquisition, supporting the punctuated development model and contrary to the expectations of other theoretical perspectives, including the brain growth, adult mortality, and embodied capital models. An additional finding is a trade-off between the acquisition of skills and knowledge and immediate productivity among children. Time allocation to these alternatives is primarily determined by the short- and long-term costs and benefits to parents. Lastly, the availability of laborers and the overall labor requirements of the household are major determinants of investment in alternate forms of embodied capital and resulting variation in children's time allocation. The value of children's labor to their parents is dependent on the opportunity costs of engaging in other activities not only for the child in question but for potential substitute laborers as well.

Blurton Jones and Marlowe use experimental data collected among Hadza people to examine the practice model (a correlate of the brain growth model above) in relation to the adult mortality and embodied capital models. Blurton Jones and Marlowe compared males and females in digging tubers. They found that while males and females differ greatly in the time spent practicing digging, they show no difference in efficiency. Their second experiment compared children who had attended boarding school with those who had not, assuming that those who had attended school for some years lost essential practice opportunity to improve tuber digging and archery skills. They found no significant differences in measures of tuber digging or archery proficiency between school attendees and those who had spent their entire lives in the bush. Lastly, Blurton Jones and Marlowe experimentally assessed baobab tree climbing ability. Among those who attempted this dangerous and important skill, they found no effect of age and no effects of practice time. Blurton Jones and Marlowe state that their findings show no support for the practice theory, though they explore ways in which the practice theory can be defended. Moreover, they argue against equating increases in skill with ability gained through learning and practice, cautioning that increases in body size and strength may explain age-dependent differences in task performance.

The two papers by Bliege Bird and Bird examine predictions generated by the brain growth and adult mortality models using children's foraging data collected on the island of Mer in the Torres Straits. In the first paper, Bliege Bird and Bird examine the hypothesis that the difference between human and nonhuman primate life history patterns may be due to a reliance on complex foraging strategies requiring extensive learning, and the resulting prediction that children should reach adult levels of efficiency faster when foraging is cognitively simple. In the cognitively demanding tasks of fishing and spearfishing they find no significant differences in return rates based on experiential factors related to age. In the cognitively simple task of shellfishing, however, they find substantial age-dependent

differences in foraging efficiency. Although these findings do not support the brain growth model, they do support the adult mortality model, since variation in age-dependent foraging in this ecological context is not due to the effects of learning but rather to the effects of size and strength. Meriam children are foraging at a level proportionate to their body size, indicating that learning is not constraining resource acquisition to the extent that slow body growth is. In the second paper, Bird and Bliege Bird examine the conventional wisdom in anthropology that children in foraging societies are entirely dependent on others and unable to provision themselves to any meaningful degree. Using data on children and adult foraging among the Meriam, Bird and Bliege Bird compare the foraging behavior of children and adults in both reef flat collecting and rocky shore harvesting. They quantify age-dependent variation in prey selectivity through the development of a mathematical model. Results suggest that the age-dependent variation in foraging efficiency among the Meriam is largely due to the slow walking speed of children, which reduces their encounter rate with the highest-ranked resources and increases the likelihood of their exploiting smaller prey. Based on these data, Bird and Bliege Bird highlight two implications for our understanding of the evolution of human life histories: that children face different trade-offs than adults, and that after age 5 or 6, children are less likely to be constrained by their intellect than by their size.

Kramer notes that the length of children's dependence on parents varies widely across societies, and that variation in this timing impacts parents in two ways: when older children are able to support themselves, parents have additional resources to utilize in the care of younger children and the production surplus of older children can be used to subsidize dependents, allowing parents to raise more children than would otherwise be possible. She examines these issues using time allocation and demographic data collected in a Mayan community of subsistence agriculturalists. Kramer estimates age-specific production and consumption for all individuals in her sample and then uses the age at positive net production as a proxy for the end of juvenile economic dependence. She finds that while children in this community become net producers by their mid-teens, they subsequently remain in their natal households for several years. While the Maya age at positive net production is lower than has been found in other populations, both among foraging and farming peoples, parents cannot provision their younger children without assistance from other individuals. Kramer argues that parents use surplus production by older Mayan children to finance the cost of large families and subsidize continued parental reproduction. These data are a valuable contribution to a small but growing body of literature focused on measuring the economic costs and benefits of children through direct observation.

Taken together, these five papers show the value of continued efforts to

generate, distinguish, and test alternate models of the salience of childhood in the evolution of the human life course. The varied socioecological contexts—foraging, fishing, agropastoralism, subsistence agriculture, and market incorporation—make these data especially valuable as a comparative data set. The differences between these contexts may be critical in efforts to discriminate among the alternative models. The results and conclusions lend varied support to the various life history models outlined above. Kramer finds no support for the brain growth or adult mortality models but does find support for the embodied capital model. Given the difficulties in assessing the ecological risk model in humans (Leigh 2001) it is not surprising that this model was not examined in depth in any of these papers. Bock develops a new model that builds on both the adult mortality and embodied capital models, while finding support for the embodied capital model in other respects. Blurton Jones and Marlowe and Bliege Bird and Bird find no support for the brain growth model but do find support for the adult mortality model. Further studies such as these have the potential to refine and reformulate models based on the complexities and richness of people's lives and experiences.

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