BOOKS: ANTHROPOLOGY

Origins of Trade-offs in Maternal Care

A. Magdalena Hurtado

In countries as culturally divergent as India and the United States, some women kill their infants, while others give up their lives for their children. Between these extremes, diverse childcare strategies mark the reproductive trajectories of women, who respond to their social and physical environments and to their infants' behaviors and strengths. Through an absolutely fascinating array of scientific, ethnographic, and historical summaries and anecdotes, anthropologist Sarah Blaffer Hrdy invokes evolutionary principles to explain the behavior, endocrinology, and psychology associated with these trajectories. Just as for other phenotypes (such as well-timed ovulation), maternal decisions about when and how much to invest in children must be accounted for in terms of natural selection—"Mother Nature" without morals or values. All who have an interest in the biological influences on female behaviors or in human evolutionary ecology, the field that can make sense of variation in these behaviors, will find *Mother Nature* to be an important contribution.

Mother Nature
A History of Mothers, Infants, and Natural Selection
by Sarah Blaffer Hrdy
Pantheon, New York, 1999. 745 pp. $35, C$49.95. ISBN 0-679-44265-0.

The book is divided into three parts. In "Look to the Animals," Hrdy traces the intellectual history that, since Darwin, has placed reproductive strategies at the forefront of evolutionary theory. The combination of this theory with detailed behavioral field data on many species provides the rich background that allows Hrdy to delve into the ancestral biology of human mothers and infants. She isolates five legacies common to all human populations in spite of the diversity of environments in which they are found: the complex physiology that guides female reproductive decisions, social conflict and cooperation, maternal inability to raise offspring without assistance, lactation, and long periods of juvenile dependence on mothers.

In Part Two, "Mothers and Allomothers," Hrdy elaborates on these legacies. The most important among them is lactation, a form of investment in offspring that only mothers can provide. Lactation introduced a link between care and only one sex, and it prolonged intimacy between mothers and infants—particularly in primates, who breastfeed for longer periods than other mammals of similar size. Because only female mammals lactate, the immunological and dietary payoffs of this expensive effort favor a high maternal-to-paternal investment ratio. Thus, the rate of increase in mortality of young mammals as a function of increasing fertility is higher among females than males. This difference in rates helps explain why the optimal number of offspring is expected to be higher for males than for females when lactation is the primary form of parental investment. The disparities in the trade-offs that men and women face decrease, however, in places where paternal investment (such as food provisioning) has a significant impact on offspring survivorship. Therefore, Hrdy concludes that lactation, not sex per se, is the main determinant of sex differences in parental care in humans.

Another important trait, found in humans and some other animals, is maternal dependence on male partners and alloparents (caretakers other than the parents) to help raise multiple young. In all societies, a woman's ability to elicit the necessary help from other adults is key to her reproductive success. Hrdy proposes that this dependence is responsible for the high levels of maternal infanticide in humans compared with other primates. Her review of cross-species and historical data on infanticide is outstanding. In humans the probability that a mother will kill her infants greatly increases when the father abandons them or dies; substitutions for paternal economic help are hard to come by. To avoid these situations, women have evolved creative ways to elicit assistance from others, including godparents and multiple fathers. Groups like the Canela, Mundurucu, Mehinaku, Bari, and Ache of lowland South America believe that fetuses are composite products of several men. Thus, children can have more than one father, and those who do often enjoy a survival advantage.

Hrdy completes her presentation of past selection pressures that shape our present biology by focusing the last part of the book on infants. In "An Infant's-Eye View," she describes the complex interplay of conflicts of interest between offspring and mothers: how large to grow in the womb, the timing of birth, when to stop breastfeeding, and how much investment to give to rival siblings. Here, as elsewhere throughout *Mother Nature*, Hrdy provides excellent references for readers interested in developing a deeper understanding of conflicts among close kin.

My primary criticism of Hrdy is her strong support of a currently fashionable female-centered version of hominid evolution. In this view, fathers are much less reliable allocaretakers than grandmothers, and an assumed ancestral consistency of grandmaternal food sharing and childcare helps explain the increased survival of lineages that ultimately extended the human

Maternal effects. Reminding viewers that the womb is like a plant that may wither, the text of this 19th-century Japanese print reflects the belief that a woman's conduct during pregnancy affects the embryo.

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The author is in the Department of Anthropology, 240 Anthropology Building, University of New Mexico, Albuquerque, NM 87131, USA. E-mail: amhurtado@unm.edu

life-span. This scenario, however, is not supported by data on hunter-gatherers nor by much of the evidence presented in Hrdy's book. If the grandmothers-as-main-helpers view were correct, societies in which grandmothers reside with their daughters should have the lowest rates of maternal infanticide. Yet no observations suggest that matrilocality has this effect. Instead, in foraging societies like the Hiwi of Venezuela, women kill their infants at a high rate even though they live in close proximity to their mothers. Paternal absence is the strongest predictor of infanticide. Moreover, the effects of paternal food acquisition and childcare on a woman's fitness are likely to be much greater than the effects of her mother's work. Among Ache, Hiwi, and Hadza foragers, the average food acquisition of grandmothers is less than one-half the average for men of reproductive age. Recent analyses of time-activity data from the Hiwi show that adolescents and fathers give more care to infants than do grandmothers. And data on Ache foragers of Paraguay show that grandmothers have a positive effect on their sons'—but not their daughters'—fitness. In addition, having a father alive decreases child mortality sixfold compared with having grandmothers alive. Thus available evidence suggests that fathers, not grandmothers, are critical in the evolution of female life-history traits. This is not belittling to women. It simply means that human life history reflects coevolution in response to constraints operating on both sexes.

Knowing the effects of different allocaretakers on relative fitness has important implications for policy. As Hrdy points out, in evolutionarily novel environments it is difficult for women to hold jobs because the tasks "occur in separate domains from child rearing." In addition to this spatial separation, I would add that women lose the scheduling flexibility they had as hunter-gatherers. Among foragers, women quit work earlier when nursing and then work longer hours as their children get older. Today, trade-offs for mothers are particularly cruel: working outside the home and caring for children full-time are both fitness-enhancing activities, but inflexible work hours and commuting make them mutually exclusive. Our modern work structure forces mothers to rely more than ever on allocaretakers, but it is unclear whether societies' interventions should be aimed at increasing grandmaternal assistance, paternal help, or the quality of accessible non-kin help. In the meantime, as Hrdy states, the behaviors of women who opt only for careers will be selected against. Natural selection will instead favor the behaviors of women who reproduce regardless of the unpleasantness of the trade-offs they face. And the legacy of maternal ambivalence towards work will be passed on along with such behaviors. Whether these phenotypes bring joy, satisfaction, anger, depression, or homicidal tendencies is of no concern to Mother Nature.

BOOKS: METEOROLOGY

Spiraling Storm Systems

Charles J. Neumann

Hurricanes rival major earthquakes as the worst of natural disasters in terms of loss of life and property damage. Thus they are of considerable interest to many scientists and decision-makers, especially those involved in urban planning, disaster relief, and insurance. James Elsner and A. Birol Kara have written an account for such readers that emphasizes physical models to explain the relation of hurricane activity to meteorological and oceanographic events. As the book's subtitle indicates, the authors devote considerable attention to links between hurricanes and climate and to social and economic vulnerability to such storms.

Hurricanes of the North Atlantic Climate and Society
by James B. Elsner and A. Birol Kara
Oxford University Press, New York, 1999. 504 pp. $49.95. ISBN 0-19-512508-8.

Hurricanes of the North Atlantic is longer and more technical than previous books on tropical cyclones. Surprisingly, the authors do not discuss tropical storms (winds of 18 to 33 m/s). Because almost all hurricanes begin as tropical storms, it might have been appropriate to devote at least part of a chapter to these systems. It should also be noted that the authors limit their discussion of motion and intensity prediction models to one table and a short paragraph.

These omissions aside, Elsner and Kara offer the most complete account and discussion of Atlantic hurricanes that I have encountered. Using newly researched pre-1900 data, they extend many of their analyses back to the year 1851. They have prepared a large number of original tables and figures to illustrate their points; nearly every page includes at least one figure or table. To ground their subsequent discussions, the authors go into considerable detail about—and devote entire chapters to—purely tropical (warm-core), baroclinically initiated (initially cold-core), and baroclinically enhanced (by strong temperature and moisture contrasts) hurricanes.

A chapter on hurricane cycles and trends discusses the observed effects of *El* Niño–Southern Oscillation (semi-regular shifts between warm and cold phases in the equatorial Pacific Ocean), quasi-biennial oscillation (shifts in tropical stratospheric winds between east and west phases), sea surface temperatures, and solar activity on past and present hurricane activity. In considering the potential effects of these factors and global warming on future hurricane activity, the authors, commendably, do not make scientifically unwarranted speculations. Several chapters cover other timely topics such as hurricane return periods, seasonal forecasting (including history), the relatively new field of sub-basin forecasting, and how this approach relates to the insurance industry and society.

Given the length of the book, the presence of several minor faults is understandable. The section on general hurricane climatology could have been improved. For example, a single chart showing hurricane days (for various classes of storms) would have been easier to understand, more meaningful, and less "noisy" than the separate charts that show beginning and ending dates. Elsewhere, the authors' use of observed coastal county hurricane return periods along the U.S. Atlantic and Gulf coasts can suggest spurious discontinuities in what is actually a smooth gradient of coastal hurricane frequency. Although the authors note the effect of county size on their statistics, a chart showing the unbiased coastal strike expectancies would have been helpful.

The authors discuss the usefulness of the Poisson distribution to estimate rare hurricane events. Earlier in the book, however, many of their tables that use relative frequencies to illustrate extremely rare events (such as three or four landfalls during a single month) are labeled "probabilities" or "observed probabilities." A more appropriate term might have been "empirical probabilities" (as used by the authors in later tables).

Hurricanes of the North Atlantic is a suitable reference in applied climate science. I would certainly recommend it to those looking for up-to-date insight into the nature of Atlantic hurricane activity. It is, however, too detailed and specialized for those seeking a broad overview of Atlantic tropical cyclones.

The author is at 6855 Southwest 104th Street, Miami, FL 33156, USA. E-mail: cbneum@aol.com