

The Evolution of Flexible Parenting

LESLEY NEWSON AND PETER J. RICHERSON

Introduction

Women in contemporary Western societies perceive that they have a choice about when they should produce offspring, how many they should have, or if they should have any offspring at all. No innate drive or “maternal instinct” forces them to behave in ways that maximize their reproductive success. It is not just modern birth control technology or abortion that provides them with this choice. Historical and anthropological studies show that women never produced children in an uncontrolled way. Many used breastfeeding to space their pregnancies. As long as their previous child continued to suckle frequently, their risk of getting pregnant again was lower. Abstinence from sexual intercourse was common—or at least sexual intercourse that involved semen being placed in the vagina (e.g., Coale & Watkins, 1986; Low, 2000; McLaren, 1990).

There is also wide variation in how women bring up their children once they are born (e.g., Hrdy, 1999; Whiting & Whiting, 1975). The flexibility of our parenting behavior presents a challenge for scholars who attempt to explain human behavior from an evolutionary perspective. A human child must be cared for and socialized for many years if it is to develop into a successful adult and our ancestors obviously succeeded in raising offspring. But despite this, evolution does not seem to have equipped humans with a specific set of parenting behaviors. Women possess the standard mammalian equipment for gestating, delivering, and feeding offspring but they don’t exhibit one “species typical” mode of parenting. The age women become mothers, how we care for our children, and how we fit them into our other relationships varies from culture to culture, from time to time, and from family to family.

This chapter will present an argument for why human parenting behavior is so diverse. We know that in spite of the flexibility, all contemporary human mothers have one characteristic in common. They receive help raising their young. Even

the “single parents” in modern societies depend on others. For example, others gather food and place it in convenient supermarkets; others manufacture parenting tools, such as high chairs and slings; and institutions have been set up to help parents care for and educate their children. This is not just a modern phenomenon. For a substantial portion of human evolutionary history, those mothers who left surviving offspring received a considerable amount of help feeding and caring for their children (Hrdy, 1999). If this cooperative style of parenting evolved some time ago, if humans are “cooperative breeders,” then flexible parenting and a number of other human characteristics make sense. But if those who study human behavior from an evolutionary perspective accept that humans evolved as cooperative breeders, then many of the evolutionary explanations that psychologists have offered to explain human reproductive behavior need to be reexamined.

An Environment Favoring Flexibility

The findings of paleoclimatologists during the last two decades (e.g., Ditlevsen, Ditlevsen, & Andersen, 2002; Greenland Ice Core Project, 1993; Lehman, 1993) suggest an explanation for natural selection's favoring of behavioral flexibility in humans. For much of the last two and a half million years, during the Pleistocene epoch, the Earth's climate has been highly unstable with extreme temperature fluctuations during recurring ice ages. The number of abrupt climate change events during glacial periods seems to have been increasing over the last 4–8 major glacial cycles (Loulergue et al., 2008; Martrat et al., 2007), roughly paralleling human brain size increases and other features associated with the modernization of humans, such as increasingly sophisticated stone tools (Richerson & Boyd, in press). Animals that could adapt rapidly to changing conditions or to disperse to new habitats had an advantage over animals that were well adapted to exploit a narrow range of habitats. For long-lived creatures such as hominids, adapting to such rapid environmental changes would have required that they change dramatically in just a few generations. Genetic adaptations could not have evolved quickly enough to keep pace with such a rapid rate of change (Richerson & Boyd, 2001). The individuals who succeeded in raising offspring were not simply those whose genes provided them with innate responses to the environmental stimuli experienced by their ancestors. Successful individuals were those whose genes also provided them with the ability to make appropriate responses to environmental stimuli that their ancestors may *never* have encountered.

The oldest fossils of hominids assigned to our own “*Homo*” genus are of individuals who lived in Africa between 2 and 2.3 million years ago (Klein, 2009). The appearance of our genus coincides with a period when moist woodland and rainforest habitats were retreating and being replaced with areas of dry, heterogeneous, and unstable climate (Bobe & Leakey, 2009; Kingdon, 2007; Trauth, Maslin, Deino, & Strecker, 2005). Fossil evidence suggests that *Homo* was the

only hominid who exploited these expanding habitats (Potts, 1998a; Reed, 1997). Fossils of the now extinct *Australopithecus* genus, believed to be precursors of *Homo*, have been found among fossil flora and fauna associated with moister, more wooded habitats. It is therefore likely that they occupied habitats similar to those in which some groups of chimpanzees have been observed to range (McGrew, Baldwin, & Tutin, 1988).

What was special about members of the *Homo* genus that allowed them to exploit this expanding habitat when their more ape-like relatives stayed in the shrinking wooded habitats? One plausible suggestion is that *Homo* had adaptations that allowed them to be flexible and mobile enough to survive in habitats where food and water resources were sparsely distributed and variable (Potts, 1998b). The *Homo erectus* fossils found in Asia dating back over 1.8 million years show that early *Homo* was able to survive a long migration and provides further evidence of their flexibility and mobility (Foley, 1987; Wells & Stock, 2007).

Speculation about the adaptations that would have provided this flexibility and mobility has tended to concentrate on adaptations likely to have improved the survival of hominids trying to exploit drier and more variable habitats. But survival is irrelevant to fitness unless the individuals who survive are also able to produce offspring that survive, mature, and have offspring themselves. Less consideration has been given to determining how hominids successfully raised offspring in drier more variable habitats (O'Connell, Hawkes, & Blurton Jones, 1999). How are they likely to be different from the earlier hominids that exploited moister and more stable habitats? Fossils can only hint at the parenting behavior of long-extinct hominids. But we do know about the parenting behavior of extant apes and of contemporary humans.

Ape Life History and Parenting

In many ways the growth, development, and reproductive biology of contemporary humans is similar to that of great apes. The fossil evidence suggests that *Australopithecus* and early *Homo* were even more ape-like (Smith & Tompkins, 1995). By comparing life history variables and encephalization (brain mass in relation to body mass) in a range of primates, Barrickman and colleagues (2008) showed greater encephalization to be associated with a longer, slower life history. The speed of growth of infants is limited by the speed at which it can be provided with nourishment, and brain tissue has especially high nutritional demands (Aiello & Wheeler, 1995; Kramer & Ellison, 2010). Therefore the larger its brain, the longer it takes for each offspring to be supplied with nutrition sufficient for the brain to reach adult size. This also affects total lifespan because for the investment in brain size to be evolutionarily stable, mothers need to live long enough to raise an average of two children who go on to produce offspring themselves.

Consistent with this, large-brained apes grow very slowly, need a great deal of care for several years at the beginning of life, and have a relatively long lifespan (Charnov & Berrigan, 1993). Humans, of course have an even larger brain, longer period of dependency, and longer lifespan than our ape relatives. Another difference is the style of parenting. Compared to contemporary humans, the parenting of extant great apes is very inflexible. In the more social apes, chimpanzees, bonobos, and gorillas, membership in a group affords mothers and infants some protection but when it comes to care of infants, mother apes literally do all the heavy lifting. Primates produce milk at a slow rate compared to other mammals of a similar size, and primate milk is dilute and low in nutrients so infants have to stay near to their mother all the time and suckle frequently (Hinde & Milligan, 2011). As infants get older they begin to forage beside their mothers but continue to suckle. The ovulation of the mother is suppressed by a hormonal mechanism induced by the physical action of the infant sucking on the nipple (Freeman, Kanyicska, Lerant, & Nagy, 2000; Konner & Worthman, 1980). As the infant's own foraging becomes more competent it suckles less, the ovulatory inhibition ends and the mother becomes fertile again. If her infant dies, a female usually experiences estrus within a month or two. Chimpanzees are weaned at around the age 4.5 years. In gorillas ~~it is a little longer and orangutans even older~~ (Sellen, 2007).

Female great apes spend virtually all their adult lives pregnant, caring for an infant, or both. The effort involved in parenting reduces the degree to which female chimps can be flexible and mobile compared to males. For example, in chimpanzee groups that regularly hunt colobus monkeys, females rarely participate in hunts (Mitani & Watts, 1999). Young infants need to be carried and even when they have developed enough to move independently they still require constant protection and help. The burdens of motherhood prevent females from moving around the canopy fast enough to hunt successfully (Mitani, personal communication). In at least some chimpanzee groups, therefore, the diet of females is different from that of males. It includes less meat and more insects (McGrew et al., 1979; McGrew, 1992). It is reasonable to conclude, therefore, that for an ape with an ape-like parenting style, females and their infants would have found it far more difficult than males to survive in drier more variable habitats where food was more widely spaced.

Apes are also limited in the extent to which they can match their rate of reproduction to changes in the abundance of resources. The slow growth and development of their babies severely limits their fecundity. In groups of chimpanzees observed in the wild, interbirth intervals tend to be in excess of 5 years (Wallis, 1997). Since the reproductive life of female chimpanzees is less than 30 years, even the most successful female is unlikely to produce more than five surviving offspring throughout her life. The interbirth interval of other great apes is similar to that of chimpanzees, or even longer (Furuichi et al., 1998; Robbins et al., 2004; Wich et al., 2004). If times are good and resources are abundant, apes cannot

respond by producing offspring faster. And if times are hard, a mother may not be able to find enough nourishment to make the milk necessary to keep her infant alive. This is not such a problem in stable homogeneous habitats but it might make raising young impossible in harsher environments.

The Evolution of Human Parenting

We know that at some point in human evolutionary history, hominids abandoned the mother-only parenting style of apes and adopted a cooperative breeding style of raising their young. In all contemporary human cultures, mothers receive considerable amounts of help raising their children, and males contribute a substantial amount of parenting effort (Gurven & Hill, 2009; Hill & Hurtado, 2009; Hrdy, 1999, 2009; Mace & Sear, 2005). As a result, the rate of human reproduction is far more flexible than that of apes. Even though we have larger brains than apes and our children grow more slowly, human females have shorter interbirth intervals. The maximum recorded fertility sustained by a human population is that of Protestant group called Hutterites, which settled as farmers in the Western Canada and the United States. Their birth records reveal the population had a total fertility rate of 12.8 from 1921 to 1930. This means that the “average” Hutterite woman gave birth to over 12 children during her lifetime, but many had even greater fecundity (Coale & Treadway, 1986). It would probably be physiologically possible for a chimpanzee female to produce over 12 offspring during her lifetime, but her infants would have to be taken away before they were weaned and raised for her.

The age human mothers wean their children varies from culture to culture, but it is common for children to begin to receive other foods to supplement breast-milk by about six months of age, food that has been foraged and processed by their mother and her helpers (Sellen, 2006). Human infants may need this extra food to support the rapid growth of their brain. As her baby starts to get less of its nourishment from her milk, a fit and well-nourished human mother will become fertile again even though she is still breastfeeding and this means she will give birth to her next child long before her previous one can forage for itself (Valeggia & Ellison, 2001). On the other hand, if resources are very scarce, a woman can delay producing her own children and help to raise her siblings or their children instead (Hill & Hurtado, 2009).

The cooperative breeding of contemporary humans relies strongly on complex culture and the psychological mechanisms that allow human groups to maintain and adjust social norms. All human populations have cultural institutions such as marriage during which a couple publicly acknowledges a sexual relationship and the female’s children are acknowledged to also belong to her husband and his family (Brown, 1991). This serves to formalize an arrangement designed to ensure that the woman will receive help caring for her children. Who provides the

help and what kinds of help they provide varies between cultures and families, but all cultures have strong norms about shared responsibility for the welfare of children. Mothers also rely on culturally transmitted information about things like safe weaning foods and the tools that make childcare easier, such as slings, blankets, and cradles (Hrdy, 1999; Whiting & Whiting, 1975).

Cultural institutions and technology facilitate cooperative breeding in *contemporary* human populations, but does this imply that cooperative breeding is a relatively recent adaptation that only arose after our ancestors had acquired complex culture? Three lines of argument suggest that members of the hominid line began to breed cooperatively more than two million years ago, during a time when the culture of hominid groups was unlikely to have been much more complex than that which has been observed in chimpanzee groups (Whiten et al., 1999).

The first argument that raising young cooperatively has a long history in the hominid line is based on the unique life history of contemporary humans, which limits reproduction to the middle part of our lives. Humans have an extended juvenile stage. Our children grow relatively  until they approach puberty and they then experience a growth spurt. During this childhood stage we are mature enough to help our parents and care for younger children but not yet sexually mature (Bogin, 2006; Kramer, 2005). One explanation for the evolution of this extended childhood is that our ancestors were able to enhance their inclusive fitness more by helping family members raise their young than by raising their own offspring without help. It appears that when a population is well nourished females begin to reach puberty earlier (Gluckman & Hanson, 2006; R. Walker et al., 2006); perhaps this is another mechanism by which females match their reproductive rate to resource availability. At the latter end of life many women, including women in hunter-gatherer societies, remain healthy and vigorous until their late sixties and seventies. They are therefore able to help their children and grandchildren long after they ~~are no longer~~  able to reproduce themselves (Hawkes, O'Connell, Blurton Jones, Alvarez, & Charnov, 1998; Kaplan & Robson, 2002). Again such a long nonreproductive period is unlikely to have been favored by natural selection if women had not been contributing to their fitness by helping their relatives during this period.

The second argument for the antiquity of cooperative breeding in the hominin line is based on the fossil evidence showing brain size beginning to increase with the appearance of *Homo erectus* about 1.8 million years ago. It was at this point that the encephalization of hominins increased beyond that of chimpanzees. It is unlikely that this increase would have been possible without an adaptation that increased the efficiency of parenting because the foraging of the mother alone could not have obtained sufficient resources to support the brain-growth of offspring with a brain larger than that of a chimpanzee. (Barrickman, Bastian, Isler, & Van Schaik, 2008). It is probable, therefore, that females of the genus *Homo* had begun to receive help provisioning their young earlier than 1.8 million years ago.

The third argument is based on the observation that developing complex culture requires prosocial motivations and skills and not just the more Machiavellian social skills observed in chimpanzees (Chapais, 2008). Hrdy (2009) argues that natural selection is more likely to favor these characteristics in the social environment of a group that is raising its young cooperatively. She points out that behaviors such as shared attention and teaching are more commonly observed in cooperatively breeding species than in apes. The evolution of complex culture is unlikely to occur if youngsters are raised only by their mothers (Henrich, 2010). In cooperatively breeding groups, the young can observe a number of more experienced individuals who use slightly different foraging techniques and have different competencies. In such conditions, individuals able to judge the best model to imitate will be the most successful, and their judgments will drive adaptive change in the culture of the group. It seems plausible, therefore, that the cooperation seen in modern humans and our capacity for complex culture evolved together. Once hominin groups began to share more and more information, they could begin to culturally evolve ways to make their cooperative care of young more effective.

It also seems unlikely that hominids could have begun to exploit the dry unstable African habitats if mothers did not receive help with caring for and provisioning their infants. In providing milk to their infants, lactating females give up water from their bodies (Bentley, 1998; Hinde & Milligan, 2011; James et al., 1995; Stumbo, Booth, Eichenberger, & Dusdieker, 1985). And because primate milk is dilute, a female ape with an unweaned child may lose a substantial amount of water each time her child feeds. The need to stay near a source of water would have constrained the foraging activities of lactating females particularly during dry seasons. Other primates who live in dry environments, such as baboons, deal with this by timing their births so that greatest lactational stress occurs during the wet season (Dunbar, Hannah-Stewart, & Dunbar, 2002) or by limiting the amount of milk produced and slowing down the growth of the infant (Altmann & Alberts, 2003). Neither of these options were likely solutions for hominids, whose infants needed to be fed all year round for at least 3 years and were already very slow growing.

If mothers needed to be near a source of water while suckling their infants and this prevented them from being mobile enough to gain sufficient food, mothers would not have been able to raise young in these habitats unless they received help. But who would have provided the help and what kind of help might a mother have received? One source of help might have been her infant's father. While the mother and infant stayed near water, the father could have foraged further away and brought back food for the mother, which she could share with her infant once it was old enough to eat solid food. Another source of help would have been other adult females. They could have taken turns babysitting each other's children with some staying near water caring for and protecting the young ones while the others foraged.

Lovejoy (2009) has suggested that *Ardipithecus ramidus*, which he argues is ancestral to *Homo*, were monogamous biparental carers. If he is correct, then paternal care was established in the hominid line long before the move to drier more variable habitats. It is unlikely to be that simple, however. In pair-bonded primate species, such as gibbons and titi monkeys, the pairs stay close together (Chivers, 1977; Mendoza & Mason, 1986). This increases paternity certainty by allowing the male to prevent other males mating with the female, and once the infant is born, the male is there to protect the mother and infant. Also, in these species, the paternal care does not extend to provisioning mothers and offspring. Male titi monkeys take on the energetic cost of carrying the infant, allowing the mother to forage more efficiently. But they give the infant to the mother to suckle. A mating system that involves a pair-bonded couple separating while the male forages in a habitat where food is sparsely distributed carries severe risks. The female and infant would be dependent on the successful foraging of a single male for the years that it takes for the offspring to become able to survive on its own. And a male off foraging would be unable to protect his mate and offspring. Biparental care which involves males provisioning females and their offspring has not been observed in other mammal species (Clutton-Brock, 1991).

By contrast, communal care of young by females has been observed in mammals as taxonomically diverse as lemurs (Eberle & Kappeler, 2006), sperm whales (Whitehead, 2003), and house mice (Konig, 1993), with females protecting each other's offspring and allowing them to suckle.

During times of water scarcity, hominin mothers would have had to congregate near remaining sources of water. They would have been safer if they formed groups that perhaps also included weaned but not yet mature offspring. Being able to leave her infant with this group while she foraged would have allowed a mother to forage more efficiently and search for food further away from the water source. Having some time to forage unencumbered by their infants might have allowed cooperating females to gain sufficient nutrition to survive and feed their young during dry periods and allow further exploitation of the expanding dry habitats. They may have further enhanced the cooperation by bringing food back from foraging trips to share with the baby sitters and older infants. Bringing back foraged food could have led to an increase in flexibility in the rate of offspring production. During times of relative abundance in the new highly variable habitat more food could be brought back, allowing infants to be weaned earlier and their mothers to become fertile sooner.

Cooperation between mothers may have been sufficient to allow hominids to raise young in habitats where an infant could not be raised by a mother on her own. But much larger gains in reproductive efficiency can be achieved if males also contribute to the provisioning of offspring. Pair-bonding and biparental care would have been highly risky in dry unstable habitats, but the risks would have been less for groups of cooperating males provisioning groups of cooperating females. In a number of social primates species females mate with several

males and dominant males have been observed to acquiesce to subordinates matings with females (Henzi, Clarke, van Schaik, Pradhan, & Barrett, 2010). Mating with several males obscures the paternity of the offspring, and confusion over its paternity can increase the chances of an infant surviving and thus the fitness of its parents (Hrdy, 1979, 1999). If there is a possibility that a male might be the father of an infant, it is less likely to harm the infant and more likely to protect it from other males. An infant whose mother has mated with a number of males therefore has a number of male protectors. In a species in which fathers and possible fathers help to feed infants as well as protect them, the benefits of confused paternity are even greater.

A dry and variable habitat would present many opportunities for cooperation between groups of cooperative males and groups of cooperative females. Males would be attracted to water and to potentially fertile females. If the males contributed to the provisioning of the females and their offspring, infants could be weaned sooner and their mothers become fertile sooner. The more males provisioned, the more frequently females would be fertile. Thus, groups that cooperated and foraged more effectively would produce offspring more rapidly. These groups would, in fact, be reproductive units. Groups that maintained a culture of cooperation would out-compete those whose members were less cooperative. Thus through cultural evolution and gene-culture coevolution, hominin groups could evolve more complex cultures that allowed them to exploit the chaotic Pleistocene habitats more flexibly and more efficiently (Richerson & Boyd, 2005).

Having more than one male as the possible father of her children may have been helpful for part of human evolutionary history and some contemporary cultures still practice polyandry (Smith, 1998) or partible paternity (Beckerman & Valentine, 2002). However, in most contemporary cultures a child is recognized as having a single father who acknowledges that he and his family have an obligation to the child (Brown, 1991). Genetically evolved mechanisms that encourage bonding and empathy undoubtedly play a role in supporting the sexual fidelity and altruism that encourages the investment of a child's paternal kin. This support network is not, however, maintained by these mechanisms alone; culturally evolved institutions, norms, and values that a population shares also play an essential role. The wide variability in human sexual and reproductive behavior does not support the belief that humans have genes that drive them to form pair bonds with mates of the opposite sex and deliver biparental care.

Chapais (2008) and Henrich et al. (2012) argue that groups gain advantages from developing mechanisms to establish paternity of offspring and ensure that most men have wives. Members of such groups will be able to develop larger kinship networks to call on for help, and groups in which most men have access to a woman are more peaceful. It may be, therefore, that the more successful human groups were those that culturally evolved the best systems for encouraging and maintaining bonds that ensured that a child had the support of both its maternal and paternal kin. This does not always mean that support comes from the father

himself. For example, the degree to which fathers provide food or direct care for their offspring varies substantially across habitats and cultural groups (Gurven & Hill, 2009; Hill & Hurtado, 2009), and studies of a number of horticultural and hunter-gatherer subsistence populations have found the death or absence of a father to have no effect on child survival or success (Sear & Mace, 2008; Winking, Gurven, & Kaplan, 2011).

Perhaps the most successful institutions for ensuring children get the support they need are those that help to arrange and maintain stable marriages in which multiple generations of the children's kin provide them with lifelong support. Marriage has become severely weakened as institution in contemporary Western cultures (Cherlin, 2004), and these cultures are unusual in the extent to which young adults are left on their own to find and choose the person with whom they will have children (Apostolou, 2007, 2010). Smaller scale societies afforded much less opportunity for observing and choosing a potential spouse, and networks of family and friends helped to match up young adults. On the basis of phylogenetic analyses using data from contemporary hunter-gatherers, R. S. Walker, Hill, Flinn, and Ellsworth (2011) determined that the arranging of marriages in human populations began before anatomically modern humans left Africa more than 50,000 years ago.

Cooperative Breeding and the Evolution of Human Behavior

The argument we have presented here includes a great deal of speculation about what might have gone on in the past. Our purpose in presenting it is not to persuade readers of the details of this particular account. The currently available evidence only provides an outline of what might be the course of human evolution. Our purpose is to review a growing body of evidence that demands we consider new accounts of human evolution and question assumptions that have underpinned much of the research in evolutionary psychology for the last two decades.

Evolutionary psychologists have argued that psychological mechanisms that enabled our ancestors to survive and reproduce as foragers during the Pleistocene continue to influence the behavior of humans living today (e.g., Barkow, Cosmides, & Tooby, 1992). They argue that we are descended from males and females who monitored their environment and scrutinized potential mates in order to make fitness-maximizing reproductive decisions. However, most of the hypotheses developed to explain human mating are based on the assumption that these Pleistocene men and women formed pair bonds and their offspring received biparental care. For example, according to Gangestad and Simpson (2000, p. 586):

Given the demands of biparental care during evolutionary history, both men and women were selected to use long-term mating tactics and invest in offspring. However, they were also selected to use ecologically

contingent, conditional mating strategies, dedicating some effort to short term and extra-pair mating under specific conditions. Women may have evolved to trade off evidence of a man's genetic fitness for evidence of his ability and willingness to invest in offspring.

On the strength of such assumptions, investigations have been carried out on many undergraduates in Western universities in the hope of gaining an understanding of the evolved psychological mechanisms that are likely to have influenced the choosing of mates with whom to pair-bond or with whom to have extra-pair copulations.

However, if conditions during the Pleistocene obliged human females to raise their children as part of cooperatively breeding groups, their choices would have been constrained and rewarded very differently than if they raised their young independently or with the help of only a mate. For cooperative breeders, willing helpers in the social group are an essential resource that must be available if they are to achieve reproductive success. Individuals must therefore be sensitive to social cues when deciding whether it is a good time to mate. When developing hypotheses to explain these decisions we should consider the behavior of other cooperatively breeding mammals such as callitrichid monkeys, mongooses, and wolves. It has been demonstrated in some of these species that females receive information during social interactions that causes them to help raise the children of other females rather than give birth to children themselves (French, 1997).

Contemporary humans are undoubtedly also sensitive to social cues when making reproductive decisions. Many of these come in the form of cultural norms and values, but humans are constantly exchanging information about the sexual behavior and parenting behavior of other members of their social group (Dunbar, 1996). Although reproductive norms vary between cultures, it has been shown in a number of cultures that, by adhering to the norms of their culture, individuals tend to make reproductive decisions consistent with maximizing fitness (Borgerhoff-Mulder, 1988; e.g., Chagnon, 1988; Cronk, 1989; and reviews by Cronk, 1991; Hill & Hurtado, 1996; Irons, 1979; Low, 1993, 1999, 2000; Wang, Lee, & Campbell, 1995). Even cultural norms that cause her to delay becoming pregnant, such as a rule that a woman should not have sex until her child is weaned, can increase fitness by allowing her to have a greater lifetime fertility or to raise healthier children who go on to give her many grandchildren.

Reproductive norms are not a set of inflexible rules. They prescribe how individuals should respond to their own changing circumstances. Productive norms have been shown to regulate the fertility of a population in response to resource availability. For example, in late medieval and early modern northern Europe, men were not "eligible bachelors" (i.e., considered as potential husbands) until they had economic means to set up an independent household (Hajnal, 1982; Watkins, 1989), and many men remained unmarried and childless. The strict enforcement of monogamy meant that men with a high income could only

have legitimate offspring with one woman, and so many women also remained unmarried and childless. A study of birth and marriage rates in early modern England shows that the fertility of the population rose and fell with the price of grain (i.e., the availability of food) and that lower birthrates during the lean times were not due to married women having fewer children, but by women marrying late or remaining unmarried (Wrigley, 1978; Wrigley & Schofield, 1981; Coale, 1986).

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It is interesting that when a population begins to undergo economic development the beliefs and values of its members begin to change in characteristic ways (Inglehart & Welzel, 2005; Inkeles & Smith, 1974; Newson & Richerson, 2009). For example, before economic development people tend to share certain “traditional values” such as a belief that women and men should do different work, that elders should be respected, and that families should have as many children as they can afford to raise. With economic development these begin to be replaced. One of the earliest and easiest to detect changes is the adoption of the belief that it is prudent to limit family size. For evolutionary theorists this change is ~~a~~ puzzling because people begin to produce fewer children at a time when they are becoming more prosperous. They cease to behave as if they are competing for reproductive success.

Recognizing the cooperative nature of human reproduction suggests a reason why this change occurs—the social cues change. Economic development causes a dramatic change in the structure of social groups as people pursue new opportunities to work and gain education (Newson, Postmes, Lea, & Webley, 2005; Newson et al., 2007). People's social networks widen so that a far higher proportion of the social interaction they experience is with non-kin. As a population undergoes economic development its members increasingly identify with social groups other than their families and are influenced mostly by people who have no interest in their reproductive success. Within families, the importance of marriage and motherhood may still be discussed. But at work, in school, in the streets of towns, and in the media, other options get talked about. For example, women may learn about the benefits of getting a job and earning money to buy fashionable clothes rather than helping at home or earning money to help their family. Reproductive norms do not change immediately but they gradually diverge from that which encourages reproductive success.

With the human population now over seven billion and continuing to rise rapidly, it is good to know that our reproduction is flexible. Our genes do not compel us to compete for mates and reproductive success and have as many children as we can afford. It is also a relief that human populations are capable of culturally evolving solutions to problems our species has never faced before. Not only can we produce new technology, we are capable of changing our values, beliefs, and goals. An evolutionary approach to understanding human behavior and the way we cooperate as well as compete has a great deal to offer. We also have a great deal more to learn about human evolution.

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