

SOCIAL ROLES, PRESTIGE, AND HEALTH RISK

Social Niche Specialization as a Risk-Buffering Strategy

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Selection pressure from health risk is hypothesized to have shaped adaptations motivating individuals to attempt to become valued by other individuals by generously and recurrently providing beneficial goods and/or services to them because this strategy encouraged beneficiaries to provide costly health care to their benefactors when the latter were sick or injured. Additionally, adaptations are hypothesized to have co-evolved that motivate individuals to attend to and value those who recurrently provide them with important benefits so they are willing in turn to provide costly care when a valued person is disabled or in dire need. Individuals in egalitarian foraging bands can provide a number of valuable benefits, such as defense, diplomacy, food, healing, information, technical skill, or trading savvy. We therefore expect that humans have evolved psychological mechanisms motivating the pursuit and cultivation of a difficult-to-replace social role based on the provisioning of a benefit that confers a fitness advantage on its recipients. We call this phenomenon *social niche specialization*. One such niche that has been well-documented is meat-sharing. Here we present cross-cultural evidence that individuals cultivate two other niches, information and tool production, that serve (among other things) to buffer health risk.

KEY WORDS: **Altruism; Banker's paradox; Cooperation; Costly signaling; Cultural production; Health risk; Information exchange; Prestige; Social roles**

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Man is by nature committed to social existence, and is therefore inevitably involved in the dilemma between serving his own interests and recognizing those of the group to which he belongs. Insofar as this dilemma can be resolved, it is resolved by the fact that man's self-interest can best be served through his commitment to his fellows.

—Goldschmidt 1959:14

A wide array of evidence suggests that the risk of injury and illness was a significant adaptive problem over the course of human evolution (for a review, see Sugiyama 1996; Sugiyama and Chacon 2000) and that the human mind contains a suite of adaptations dedicated to the problems of injury and illness (Bowlby 1969; Fiddick 1999; Fiddick et al. 2000; Marks 1987; Rozin and Fallon 1987; Rozin et al. 1986, 1990; Rutherford et al. 1996). Disabling injury and/or illness is reported in a number of foraging cultures (e.g., Bailey 1991; Baksh and Johnson 1990; Chagnon 1975, 1979, 1997; Gurven et al. 2000; Hagen et al. 2001; Hill and Hurtado 1996; Kaplan et al. 2000; Sugiyama and Chacon 2000; Truswell and Hansen 1976). In a study of the causes, distribution, and duration of injuries and illnesses suffered by Shiwiari hunter-horticulturalists, Sugiyama (in press) found that the fitness benefits derived from protection and aid during health care crises were substantial. The oral tradition, too, bespeaks the hazards of foraging life. Consider, for example, the following passage from a Selknam legend: "They had just begun to climb a steep mountain. North at once sent heavy rain upon them and halfway up the mountain they could climb no higher. The ground became extremely slippery; they were constantly sliding downward. . . . They hurt themselves badly and were too weak to stand on their feet" (Wilbert 1975:53).

Besides the immediate problem of surviving a pathological condition once it occurs, individuals and their dependents also face fitness costs from lowered nutritional intake (Sugiyama and Chacon 2000), particularly of the rich but difficult-to-acquire game that is a key component of the human foraging diet (e.g., Kaplan et al. 2000; Kelly 1995; Sugiyama and Chacon 2000; Tooby and DeVore 1987; Walker et al. 2002). Nutritional decrements are associated with shorter reproductive lifespan, delay of menarche and onset of puberty, fewer offspring, a lower proportion of live births, lower infant survival and body weight, and increased juvenile mortality in a variety of primates (including humans) and other mammals (see, e.g., Allen 1984; Altmann 1991; Buzina et al. 1989; Frisch and McArthur 1974; Green et al. 1986; Hill and Hurtado 1996; Kohrs et al. 1976; Manocha and Long 1977; Prentice et al. 1987; Riley et al. 1993; Schwartz et al. 1988). The dire fitness consequences of disabilities are illustrated in yet another Selknam myth, in which a man falls ill and is unable to hunt. Although it is not customary for

women to travel unaccompanied, the man sends one of his wives on the long journey to her relatives to ask for food. When she gets there she pithily explains her family's predicament: "My husband has been sick now for some time and can't go hunting; all of us are suffering great hunger" (Wilbert 1975:118). These nutritional costs are not necessarily limited to dependents: because pathology-related disability may interfere with foraging for periods longer than those caused by day-to-day variance in foraging luck, it may severely impact nutrition throughout the entire sharing group if provisioning of adults is not practiced (Sugiyama and Chacon 2000). The abundant perils of forager life thus raise the question, What adaptations might have evolved to garner health-care aid in times of disability?

Within human families, offspring are hypothesized to carve out personality niches that are distinct from their siblings' in order to better garner parental investment (e.g., Sulloway 1997). Cross-cultural evidence suggests that this pattern holds for Shuar Native Amazonians of Ecuador as well as people from Western industrialized countries (Roach 2002). Social investment, however, is a recurrent and bottomless need. Because parents tend to die before their offspring, they cannot be counted on indefinitely, and no one or two individuals can be depended on to supply all of one's wants. Furthermore, neolocal, matrilineal, or patrilineal postmarital residence patterns mean that adults often find themselves living away from their natal group members. A solution to this problem is at hand: as individuals move through life, they become affiliated with various groups besides their parents and immediate family—friends, allies, affines, village—all of whom are potential sources of aid. It seems unlikely that natural selection would leave these sources untapped.

Reciprocal altruism is perhaps the best-known example of an evolved aid-garnering strategy. Reciprocal altruism theory posits that traits designed to produce apparently altruistic behavior in their bearers can evolve when there is sufficient probability that compensatory benefits will be returned. Trivers (1971) suggests that the potential benefit from extending aid increases as the need of the recipient increases because expected compensation for providing the aid will be higher. Health risk, however, throws a monkey wrench into this system: as the need of the sick or injured party increases past critical levels, the probability that the disabled person will live to provide compensatory benefits to the altruist diminishes, and with it the potential benefit of extending aid to him or her. The problems do not end there. The ability to recognize and punish cheaters (i.e., exchange partners who do not reciprocate) or exclude them from future exchanges is a necessary feature for the evolution of adaptations arising via the pathway of reciprocal altruism (Axelrod and Hamilton 1981; Trivers 1971; Cosmides and Tooby 1992). Yet disabled individuals lack the

physical formidability necessary to compel past exchange partners to reciprocate, and detection of cheaters at the time of injury is of no value to the injured party if he or she dies and is thereby preempted from excluding cheaters from future exchanges.

Adaptations arising from reciprocal altruism thus appear to be inadequate to cope with the problem of health risk. Individuals who are sensitive to current probable payoffs have incentive to renege on exchange commitments to a disabled exchange partner: there is no profit to be gained by investing in someone who cannot reciprocate now and is unlikely to be able to do so in the future (Tooby and Cosmides 1996). Withholding aid further decreases the likelihood that the injured party will recover, making him or her an even worse investment. Although an individual who refused to recompense his disabled exchange partner might face negative repercussions should the injured party recover (i.e., reprisals, loss of reputation, loss of other exchange partners), what constitutes adequate aid in these circumstances cannot be well specified: an individual could simply proffer nominal aid—sufficient to dampen possible future reprisals but insufficient to sustain the disabled party until he or she recovers.

Thus, social exchange offers at best a partial solution to the health risk problem: it is a practicable strategy when an individual can offer something in return for the requested aid, but not when he is down on his luck and can offer nothing whatsoever. Tooby and Cosmides (1996) have labeled this problem the Banker's Paradox: it is when one is most in need of aid that one has the least collateral and is least likely to be able to repay the aid in the future. The logic of reciprocal exchange dictates that at some point, the probability that the person in need will be able to reciprocate in the future will fall below an acceptable level, and he or she will be abandoned (Sugiyama 1996; Sugiyama and Chacon 2000; Tooby and Cosmides 1996). In a similar fashion, prolonged injury or illness renders an individual incapable of reciprocating at a time when he or she is most in need of investment.

Sugiyama (1996) and Sugiyama and Chacon's (2000) discussion of meat-provisioning elucidates some fundamental problems that health-risk-buffering adaptations must solve. The first facet of this problem is how to motivate potential sources of aid to become reliable sources of aid when one suffers severe physical pathology. One viable solution is to provision recipients consistently. Kaplan and Hill (1985), for example, suggest that good Ache hunters may receive preferential treatment when they are sick or injured because other band members benefit from maintaining access to the meat these hunters provide when they are well. Consistent, generous provisioning of meat serves as an indicator to recipients that, should the hunter become incapacitated, the flow of such benefits will resume if and when he recovers (Gurven et al. 2000; Sugiyama 1996; Sugiyama and Cha-

con 2000). It also circumvents a problem posed by the inherent unpredictability of illness and injury: if a hunter shares meat consistently, he removes the risk that he will become incapacitated at a time when interest in his continued residence in the band has waned (Sugiyama and Chacon 2000).

Game provisioning by the best hunters among Yora forager-horticulturalists is consistent with these predictions (Sugiyama and Chacon 2000), and a formal model expanding on these ideas was supported with data collected among the Ache (Gurven et al. 2000). Gurven and colleagues (2000) argue that the relative proportion of an individual's kill transferred to recipients is a costly signal of the provider's commitment to them. The more costly a signal, the more confidence can be placed in its "honesty" because the very cost of the signal makes it unprofitable to fake (Zahavi and Zahavi 1997). Therefore, the proportion of available resources transferred from a given individual (i) to each other recipient individual or household ($j \dots n$) during times of individual i 's good health is expected to signal the degree to which i is committed to each recipient's welfare: the higher the relative cost of the transfer (in this case, the higher the proportion of the kill transferred), the greater the signaled commitment. Thus, when i is incapacitated and dependent on others for subsistence, each recipient ($j \dots n$) of individual i 's past largesse is expected to provide health-care aid to i as a function of the relative cost of previous food transfers received from i . Total aid to i is the sum of the aid provided from individuals $j \dots n$.

When differences between the hunting returns of the best hunter and other hunters are low, when foraging returns uniformly exceed need by a large margin, or when food storage techniques allow individuals to survive long periods of disability without subsistence aid, then being a more generous and successful hunter might not provide irreplaceable benefits, provide a particularly strong signal of commitment, or yield higher-than-average solicitude (although subsets of the social group may be highly dependent on a given hunter and therefore motivated to aid him). For this and other reasons, an adaptation specifying that each individual attempt to become the best hunter in his or her group will not solve the health risk problem. Interestingly, Gurven et al.'s (2000) "signaling generosity" model accounts for slightly more than half the variance in food transfers to disabled Ache individuals, but it measures only food-for-food exchanges. There are other benefits besides food that may be conferred upon others and for which people may be willing to pay high short-term costs (e.g., health care, protection, provisioning) in order to retain access. These include foraging and technological expertise, political savvy, medical aid, and alliance partnership in warfare (Sugiyama 1996; Sugiyama and Chacon 2000). Benefits that can be provided by one individual but not by others (or less well by others) are expected to be especially valued (Sugiyama

and Chacon 2000; Tooby and Cosmides 1996). *Social niche specialization* (i.e., the cultivation of recognized, useful roles within the social group) is thus one hypothesized outcome of the selection pressure exerted by health risk, yielding interlacing networks of cooperative endeavors encompassing numerous benefit classes (Sugiyama 1996; Sugiyama and Chacon 2000; Tooby and Cosmides 1996).

The cultivation of these benefit niches demands the execution of several cognitive tasks. We thus expect a suite of psychological mechanisms to have evolved, designed to (1) identify the important needs of others (or have reliably developing knowledge of recurrent needs), (2) compare their bearers' ability to provide those needs with the abilities of others, (3) identify the needs that their bearers are most qualified to provide and are not well provided by others, and then (4) cultivate abilities in this area such that they confer needed benefits in a way that (5) generates a reputation for generosity (Gurven et al. 2000; Sugiyama 1996; Sugiyama and Chacon 2000; Tooby and Cosmides 1996). Such a system requires the evolution of complementary adaptations designed to recognize important benefits, identify individuals who consistently and generously provide these benefits at no apparent cost, and motivate behavior that preserves access to these benefits, such as extending aid to individuals who provide uniquely valuable benefits (Tooby and Cosmides 1996).

Further, because the functional payoff of social niche specialization may never be needed, or may be needed only rarely, there exists a degree of uncertainty that a given niche will indeed provide the benefits it is ultimately designed to deliver. For solution, this problem requires a complementary, contingent set of mechanisms: one (activated in the specialist condition) designed to assess an interim system of reliable cues that a given behavioral path is indeed providing uniquely valuable benefits, and another (activated in the beneficiary condition) designed to provide such signals to uniquely valuable individuals. One signal that an individual is generously providing uniquely valuable benefits for which we might find anthropological evidence is the status accorded to the individual who fills it, or the esteem in which he or she is held (Sugiyama and Chacon 2000). We therefore expect to find, even in egalitarian foraging societies, a recurrent pattern across cultures in which (1) the social niches that individuals seek to occupy are those that provide valuable benefits to other individuals; (2) people track variation between individuals in ability to provide valuable benefits; (3) individuals who excel in these niches are held in high esteem; and (4) highly esteemed individuals tend to receive, among other things, more aid during health care crises. Because the set of valuable benefits an individual can provide in egalitarian foraging bands is relatively limited (e.g., defense, diplomacy, food, healing, information, technical skill, trad-

ing savvy; Sugiyama 1996; Sugiyama and Chacon 2000), we expect social roles based on provision of these benefits to recurrently appear across foraging cultures. Tellingly, humans in subsistence-level societies engage in an array of service-oriented behaviors (Brown 1991; Murdock 1945), including healer, spiritual leader, military strategist, political negotiator, economic negotiator, artisan, and storyteller.

In the remainder of this paper, we address two potential areas of specialization: information and tool production. We present cross-cultural evidence that (1) these niches are indeed cultivated; (2) the human mind tracks individual differences in verbal and manufacturing skill, as well as qualitative variation between artifacts; and (3) individuals who excel in these niches are held in high esteem. Societies were identified from cultures coded as foraging societies within the Human Relations Area Files (HRAF). Although the ethnographic examples reviewed here are anecdotal (they were not originally collected to address this issue, which is usually mentioned only in passing, nor do they constitute a stratified random sample), we were struck as we were reading the literature by how explicitly both informants and observers made the connection between social niche specialization and prestige. The weight of our argument here will rest on the details of how this psychology is expressed on the individual level within cultures; for this reason, we think the anecdotal evidence warrants examination and discussion.

ALTERNATIVE THEORETICAL EXPLANATIONS OF SOCIAL NICHE SPECIALIZATION

Social niche specialization encompasses a wide range of behaviors, some traditionally considered to be social roles (e.g., shaman, chief), others crafts (e.g., pottery making, boat building), and others performance or art (e.g., storytelling, song composition/singing, dance). What these behaviors have in common is that they require skills that (1) are not uniformly distributed across the population and (2) can be exploited by the individual who bears them to provide benefits to fellow group members. In this section, we review various hypotheses that might be invoked to account for skill niche specialization and discuss their advantages and limitations.

Inclusive fitness theory posits that adaptations designed to provide fitness benefits to others at a cost to their bearers could evolve when the cost to the "altruist" is less than the benefit to the recipient discounted by the probability that they share genes in common (Hamilton 1964). Among humans, even in populations where group members are closely related, factors such as migration, high mortality rates, abduction of females, and

residence patterns associated with mating would have led to situations in which some individuals lived among people to whom, in comparison to the average degree of relatedness between the other group members, they were more distantly related. Over the course of human evolution this circumstance would have become a recurrent feature of the social world. Thus, kin selection *per se* is unlikely to be the only solution to the health risk problem. As with reciprocal altruism, the benefit to providers of aid to disabled kin must not only be devalued by the degree of relatedness between the two, it must be weighed against potential benefits of alternate kin-investment pathways. Again, the banker's paradox suggests that as the severity of disability increases, an inflection point will be reached at which probable payoffs are higher if investment is diverted to other individuals.

It might be argued that the phenomenon we are describing here can be explained in terms of the principle of comparative advantage. Developed by Ricardo in the early nineteenth century, this principle holds that trade can be mutually beneficial even when one country is more productive than others in every item that is exchanged. Essentially, Ricardo showed that under some conditions, wealth is maximized when each country specializes in producing those goods that yield the highest net returns and trades for all other items regardless of how inexpensively it can produce them compared with other countries. To take the minimal case of two countries and two items of production, if country A can produce both products more efficiently than country B, it still behooves country A to specialize in the product it makes most efficiently, because it can then trade that product for that which it produces less efficiently. This benefit of trade holds even for products that country A could produce more efficiently than country B (i.e., a product for which country A has an absolute advantage), because the benefit of specializing in the most efficiently produced item is greater than the absolute benefit of producing the other item minus the opportunity cost of spending time and energy on the less efficiently produced item instead of trading for it. Conversely, a country that produces all items less efficiently than country A still benefits from trade by specializing in production of the item that, within country A, is more costly to produce than country A's most efficiently produced item: in other words, those items that country A can obtain relatively more efficiently via trade than manufacture. In this way, exchange itself leads to specialization and economic interdependence (Ridley 1996).

One might argue that social niche specialization will arise between individuals in like fashion, even without extrinsic pressures such as risk of long-term disability from illness and injury. Such an argument ignores critical assumptions built into Ricardo's model that do not seem to hold in the kind of small-scale subsistence societies that are our evolutionary heritage. These assumptions include the following: that there are no transport or

transaction costs, that costs of production are constant for the trading parties, that traded goods are identical regardless of the producer, that production can occur anywhere, that there are no trade barriers, and that there is perfect information about where the cheapest goods can be found. Most important for this discussion, Ricardo's law assumes that there is no cost to dependency on specific others for items of trade. Among small-scale societies, however, this does not pertain. Mobility on both the band and individual level is used by foragers both to gain access to resources and to avoid conflict (e.g., Cashdan 1990). Indeed, even though cooperation is an endemic feature of human society, it occurs under specific conditions and involves both coordination and potential opportunity costs (e.g., Alvard and Nolin 2002; Sosis 2000; Sugiyama 1999). Further, transport costs may be high and access to a given product under conditions of specialization may vary through time. Production costs for individuals also vary across the lifespan (e.g., Bleige Bird and Bird 2002; Blurton Jones et al. 1997; Blurton Jones and Marlowe 2002; Kaplan et al. 2000; Walker et al. 2002). Qualitative variance exists between artifacts produced by different individuals (e.g., Gubser 1965; Gusinde 1961 [1937]; Wiessner 1983), and coalitional alliances may function as de facto trade barriers. On the whole then, significant deviations from Ricardo's assumptions exist in foraging societies, which must be overcome by some additional benefit to targeted specialization.

Ethnographically, the kind of full specialization hypothesized by Ricardo's law of comparative advantage does not exist in known foraging societies and appears to arise between individuals with the advent of surplus production associated with intensive agricultural production. Finally, Ricardo's principle is an observation about market economies, which are not representative of the conditions under which the behavior we are describing evolved. As such, Ricardo's model says nothing about selection pressures leading to specialist psychology or why social niche specialization often involves no direct reciprocity. Trade involves reciprocity in which terms are quantitatively specified. Social niche specialization, in contrast, is quantitatively unspecified and latent.

Miller's (1997, 1998, 2000) application of costly signaling theory to art behavior raises the question of what role sexual selection may have played in the emergence of social niche specialization, some of which falls under the rubric of art behavior (e.g., storytelling, song composition, oratory, handicraft production). Combining costly signaling theory with indicator theory and runaway sexual selection, Miller argues that art behaviors emerged as courtship displays used chiefly by males to attract females. A work of art or an act of performance is an indicator of skill, which in turn is an indicator of various fitness attributes (2000:281–282). One such attribute is protean intelligence: once humans had acquired theory of mind (i.e., the ability to intuit and thus "predict" the beliefs and intentions of

others), Miller argues, selection favored the emergence of strategies designed to foil this capacity. One of the most effective ways to outwit one's conspecifics is to behave in an unpredictable or *protean* manner. Human creative behaviors function to advertise this capacity for behavioral unpredictability by "strip[ping] proteanism down to its bare essentials: the innovative, unpredictable recombination of recognisable perceptual, conceptual, or performative elements" (Miller 1997:332). Thus, oratory, storytelling, and poetry recitation serve as "*cognition indicators*, which reveal mental capacities for perception, attention, memory, planning, and creativity" (Miller 1998:115).

The logic of the handicap principle may be applied to other human behaviors. For example, it might be argued that shamanism advertises an individual's knowledge of plants with curative properties and his/her skill at diagnosis and healing, and that this behavior is thus a reliable indicator of such fitness attributes as memory, intelligence, and compassion. Similarly, trade and diplomacy can be seen as indicators of important social skills such as communication, negotiation, manipulation, and deception. Are the increased mating opportunities presumably afforded by such advertising sufficient to account for the cultivation of social niches? Perhaps. But costly signaling does not necessarily engender the good will of signal recipients, and thus does not solve the problem of health risk. Costly signaling may garner an individual more mates, but it is not likely to garner him/her health-care aid in times of need: as noted above, when an individual is sick or injured he/she is manifestly unfit (albeit perhaps only temporarily), and thus not a good investment. This point is illustrated by comparing alternative explanations of conspicuous gift-giving (e.g., potlatch, philanthropy). Zahavi and Zahavi argue that such behavior advertises an individual's fitness by demonstrating his or her proficiency at extracting resources from the environment (1997:225). Plausible, but equally plausible is the Eskimo proverb that "with whips you make dogs, with gifts you make slaves"—that is, lavish gift giving makes debtors of recipients.

On this view, what is striking about many of the behaviors encompassed by social niche specialization is that they are utilitarian in nature. While they may indeed advertise certain fitness attributes of the specialist, these behaviors also offer potential benefits to others: storytellers inform and educate (Scalise Sugiyama 2001), chiefs maintain group coherence, shamans heal. And some social roles do not appear to advertise fitness attributes at all. Some people are valued not for any particular skill but, rather, because they are recognized as being particularly likely to aid their fellows during communal work parties, to share what game they have, or to support their fellows in conflicts (Sugiyama 1996). Hart and Pilling (1979) tell of a Tiwi craftsman who exemplifies this behavior. Tu'untalumi was in the habit of

giving away graveposts in excess of his ritual obligations, and “it was acts of this sort that made the old man so well liked and admired” (1979:47) rather than his skill as a craftsman. His crony Timalarua, in contrast, was admired not for his generosity but for his skill:

When one of his [Timalarua’s] posts appeared at a funeral, people would point it out admiringly saying, “Timalarua made that one” and the speaker would trace the lines and designs on it with his finger, using much the same gestures as an art critic in a modern gallery. When a post by Tu’untalumi was identified and admired, however, the admiration was for Tu’untalumi the generous person rather than Tu’untalumi the artist. One was a wonderful craftsman, the other was a wonderful man (1979:48).

The role cultivated by Tu’untalumi is somewhat akin to that of the loyal deputy: a person not particularly skilled or productive, but eminently helpful and dependable—what Gurven and colleagues (2000) call an individual who signals that he/she “means well.” Unlike costly signaling of one’s own fitness, the cultivation of a useful social niche, with its conferral of benefits to others, signals degree of generosity and commitment, benefits that recipients should attempt to retain access to—even if it entails relatively costly long-term aid during periodic crises (Gurven et al. 2000; Sugiyama and Chacon 2000; Tooby and Cosmides 1996).

SOCIAL NICHE SPECIALIZATION AND PRESTIGE

... a smarter animal living in a group enjoys a double advantage: the benefit of the knowledge and the benefit of whatever it can get in trade for the knowledge.

—Pinker (1997:192)

There is abundant anecdotal evidence that the cultivation of useful social niches is associated with prestige. For example, evidence from a wide array of non-Western cultures indicates that persons with access to useful, specialized knowledge are held in high esteem. Among the Yamana, for example, a “person who commands superior knowledge attracts those around him, influences them, and is highly regarded far and wide” (Gusinde 1961 [1937]:211). Information related to subsistence is particularly sought and valued. Among the Yuman tribes, for example, there were few men who knew how to track deer, and consequently, a “man who knew how to hunt them was looked up to” (Spier 1933:69). Similarly, Eskimo hunters “are traditionally concerned with knowing as much as possible, and individuals are given special respect and prestige if they are

especially knowledgeable" (Nelson 1969:374). Turnbull reports that "One other consideration determines the extent of influence of a [Mbuti] man or woman in economic matters, and that is their knowledge of the territory. Thus, no matter how deserving of respect as hunters, a visiting Mbuti family who do not know the territory well will have little to say regardless of their kinship, age or other considerations" (1965:179). And among the Shiwiari, Sugiyama's informants state that men with the knowledge and ability to make superior products are highly valued not only because they can do so, but because they are sources of information and advice for others. Once they have established a reputation for manufacturing excellence, they need not necessarily concentrate on practicing their skills to be valued: they are appreciated for the knowledge they can provide.

Interestingly, access to useful information appears cross-culturally as a criterion for leadership: chiefs are expected to be knowledgeable. Among the Bororo of Brazil, for example, "the chief of a village is always the most knowledgeable man" and "the true influential leaders and authorities are the men who excel in knowledge; i.e., they know the myths and songs and their meanings" (Levak 1934:4). Indeed, in several cultures, it is part of a leader's duty to inform the people. For example, the reputation of Toba leaders "was based on the utilization of knowledge and power for the good of the group" (Miller 1980:15). And among the Owens Valley Shoshone:

Many larger villages . . . had a single headman. His title means 'talker'. His task was principally to keep informed about the ripening of plant foods in the different localities, to impart this information to the villagers and, if all the families traveled to the same pine nut area, to manage the trip and help arrange where each was to harvest (Steward 1938:247).

Similarly, an Apache leader "generally gets on a hill or a high place and gives advice to the people. He does this every day or sometimes just once in two or three days if there is nothing much to report" (Opler 1941:469, quoting an informant). One of the Maricopa and Halchidhoma words for chief, *gwin ai vic* (meaning "one who tells things"), implies a similar obligation (Hodge 1959). The link between leadership and information acquisition/dissemination further suggests that specialized information peddling is a pathway to prestige.

One of the most prominent forms of information peddling is storytelling. Scalise Sugiyama (1996, 2001) argues that narrative functions as a virtual reality, enabling individuals to acquire adaptively useful information about the social and physical environment without undertaking the costs and risks of first-hand experience. Tellingly, storytelling ability appears to be highly esteemed cross-culturally. Among the Apache, for example, "The expert raconteur is highly regarded" (Opler 1941:437). And

although "there are no professional storytellers among the Epulu net hunters, there are individuals who have a greater mastery of the art than others. They seem to hold an important position in the community, especially in relation to the activities of the *molimo* society. The storyteller and the clown seem to occupy a privileged position and to have a definite role to play in the men's society" (Turnbull 1965).

Information transmission among our foraging ancestors would have been an oral (or possibly pictorial; Mithen 1990) affair. Effective speaking technique would have been integral to this task. We would thus expect oratorical skill to confer prestige in preliterate societies, and this appears to be the case. For example, one of Opler's Apache informants claims that "The leader has to be a good man, a *good talker*" (1941:469; italics ours). Goodwin echoes this observation, noting that among the Apache, "ability to make speeches . . . was a sign of leadership and prestige" (1942:166). Spier writes that "Three of the six [Havasupai] chiefs are recognized as the best speech makers in the tribe" (1928:327), and orators are included in Spier's list of socially prominent positions among the Yumans (1933:155). Toba chiefs are noted for, among other things, their eloquence (Karsten 1923:15), as are Western Apache subchiefs (Goodwin 1942:164). The link between information dissemination, eloquence, and prestige is evinced in Ray's observation that a kind of nobility exists among the Lillooet Indians "in which membership is acquired through wealth, *wisdom, oratory, and liberality*. Men constituting this group are called 'chiefs'" (1939:27, italics ours).

Like access to useful information, expert tool manufacture is also widely associated with high esteem. Among the Warao, for example, "great prestige is enjoyed by master craftsmen of the group, such as expert basket makers, hammock makers, [and] canoe makers" (Wilbert and Layrisse 1980:8). According to Wilbert, expert Warao "boat builders enjoy great prestige in the tribe" (1972:74). Indeed, the "prestige accruing to a master craftsman and owner of a seagoing five-piece canoe is incomparably higher than for anything else he may do in his entire life" (Wilbert 1976:331). Gusinde tells of a Selknam man named Kokpomec, who "was also a *kexaalcen*, knowing well how to make all kinds of tools and weapons. All his experiments were successful. Thus he invented a host of new things and instructed the people in their use. . . . He always worked for the very best result. The other people were aware of Kokpomec's superiority, and treasured him for it" (in Wilbert 1975:85). Among the Yamana, "people who work skillfully and produce good things are appreciated far and wide" (Gusinde 1961 [1937]:211). According to Despard, for example, "The dextrous spear, paddle, and canoe-maker, is held in honour, and called *yersh-man-oa*, or handyman" (quoted in Gusinde 1961 [1937]:211). Indeed, "one who is able to achieve a faultless one [canoe] is universally

highly esteemed" (Gusinde 1961 [1937]:109) and "Those few men who are able to make a perfectly shaped large harpoon point are universally praised" (Gusinde 1961 [1937]:168).

Gubser's study of the Nunamiut describes a clear-cut link between prestige, usefulness, and receipt of aid in time of need:

One's prestige is a function of how one performs the role expected of him. If he does moderately well, his prestige is on the plus side and he is thought of as a nice person. If he performs his tasks particularly well, is generous and outgoing, his prestige increases; he strengthens the ties with the members of his own family and others consider him to be a very fine person. If he rebels from his role, is lazy and refuses to do what he really should, his prestige declines. His family may say nothing but he knows how they feel; he may sense that other people are talking behind his back. Whenever someone refuses to do him a favor or responds slowly and grudgingly to a request, he knows why. It is a painful retribution. A person not only avoids great pain by performing his role well but also experiences the pleasure of knowing that people are talking favorably about him, behind his back as well as to his face. When he asks a favor or is in need, people are more responsive (1965:106).

For this reason, "Many people strive to build up a reserve of . . . public prestige that may be extremely valuable in times of political crisis or personal need" (Gubser 1965:123).

Freuchen's account of the disabled Eskimo boy, Tatterat, makes the link between social niche specialization, esteem, and health-care aid (i.e., provisioning) more explicit:

Before he [Tatterat] came to live with us at the trading station, his devoted mother pushed him around on a small sled, and he talked to people and got their news. Even the most inconspicuous event he could turn into a news item of considerable interest. Everywhere he came, people flocked around his little sled to hear the latest; his art and finesse in holding their attention and amusing them were incomparable. He was a veritable living newspaper, and his store of tales and gossip seemed inexhaustible. People gave him bits of food and clothing because he entertained them so well, and it is no doubt on account of this artistic talent that he survived at all (1961:202).

Conversely, the outcome of a Shiwiar political meeting observed by Sugiyama indicates that lack of utility results in loss of prestige and aid. Shamans who expended their effort healing and performing shamanistic attacks on behalf of people outside the core alliance were told that they would not be protected if raiders came to kill them. In contrast, shamans who focused on healing people within the alliance would be welcome, respected, and protected by force of arms.

CROSS-CULTURAL EVIDENCE OF SKILL-ASSESSMENT PSYCHOLOGY

Some men are good at playing on the flute; some are better than others.

—“The Berdache Coyote Story” (Goodwin 1939:156)

The human mind appears to keep track of which persons make/do which things and which persons make/do them exceptionally well. Among the Yamana, for example, Gusinde finds that “Everyone evaluates things that are excellently made or that have turned out particularly well no less accurately than he does inadequate and shabby articles” (1961 [1937]:211). Indeed, the Yamana have special expressions for manufacturing skill. The word *yetanakipa*, for example, refers to a capable basket-weaver (Gusinde 1961 [1937]:209), and the words *westagutes* and *yesmanu*, meaning “clever, expert, neat in work,” are used to designate “one whose manual skill in general overshadows others” (Gusinde 1961 [1937]:211). Sugiyama’s Shiwiar informants appraise the quality of ceramic bowls, manioc beer, blowguns, and canoes both in informal conversation and upon interview. Storytelling technique is subject to assessment as well. Biesele observes that (among the !Kung) “Most old people appear to feel reasonably qualified to tell the stories, though as a rule mediocre storytellers defer to the really good ones if they are present” (1993:19), and Guenther reports that one of his Nharo informants “was a most skilled and most appreciated storyteller who never failed to attract an audience whenever he sat down to tell a story” (1999:133). According to Forge, Abelam carvers and painters “carefully examine and discuss works by other artists and rate one another as more or less talented” (1967:82).

The ethnographic record indicates that group members can readily identify the persons among them who are the most skilled at a particular craft; moreover, there tends to be consensus among group members on this point. Opler reports that, among the Apache, “Significant personal differences are found in the ability to make and handle bows and arrows. Some men are acclaimed as experts; others are credited with fair performance; while still others are rated decidedly below average” (1941:39). Similarly, Wiessner notes that, among the San, “only 9 out of 55 (16%) arrow makers were considered to be experts producing arrow sets of excellent quality, quality being measured by symmetry and similarity of arrows in a set” (1983:271). Wiessner’s research indicates that, in addition to assessing the skill of others, individuals assess their own skill relative to their peers. She reports that “Nine out of 55 [San] hunters interviewed expressed pride in their arrow making abilities and stated that they were recognized by others as being ‘the professionals’. . . . Other hunters readily admitted that they ‘just made arrows’ or that they made arrows poorly”

(1983:262). Among the Shiwiar, there is widespread agreement among Sugiyama's informants on who makes the finest ceramic bowls, as well as the criteria upon which they are judged. The same can be said of canoes, blowguns, and houses.

In sum, anecdotal ethnographic observations suggest that, cross-culturally, virtuosity and quality of craftsmanship are both noted and noteworthy. The examples presented here can be seen as supporting both the fitness-indicator and the health-risk accounts of social niche specialization and thus do not rule out either of these explanations. However, they do provide evidence that humans have evolved a suite of cognitive mechanisms dedicated to tracking artifact and performance quality.

DISCUSSION

Both the fitness-indicator and health-risk accounts of social niche specialization involve costly signaling. What differs between these accounts is the content of the message: in the former case it is fitness attributes and in the latter it is generosity and utility that are being signaled. While virtuosity in a given craft or activity certainly appears to signal relevant fitness attributes of the virtuoso, it also appears to be the case that specialists cultivate niches that confer fitness benefits to others. A case in point is Smith and Bliege Bird's (2000) study of Meriam turtle hunting, in which they argue that this behavior functions as a costly signal of the hunter's fitness but must then explain why it is done to the benefit of a large group (i.e., by providing turtle meat for feasts). Their answer is telling: the fact that group members benefit from the turtle hunter's behavior causes them to pay more attention to the signal. Clearly, the suite of behaviors we address here is complex and may ultimately spring from multiple selection pressures. On this point, Gintis et al. (2001) provide a formal model indicating that, in an n -person public goods game without repeated interactions, signaling by providing benefits to others (e.g., food, raiding, defense) is selected for even when non-cooperation would be the dominant strategy in the absence of signaling. Potential benefits of this behavior include being preferred as allies or mates or having others defer to one's interests (Gintis et al. 2001).

Why then have we framed this discussion in terms of the adaptive problem of health risk, particularly when the hypothesized link between provision of benefits to others and receipt of health-care aid is not universally apparent in the ethnographic record? Firstly, both ethnographic and archaeological evidence indicate that health risk was a particularly intense adaptive problem (e.g., Alejandro 1996; Aufderheide and Rodriguez-Martin 1998; Bailey 1991; Berger and Trinkaus 1995; Bush and Zvebil 1991; Grauer and Stuart-Macadam 1998; Lambert 1993; Martin and Frayer

1997; Owsley and Jantz 1994; Rothschild and Martin 1993; Sugiyama 2002, n.d.; Sugiyama and Chacon 2000; Trinkaus 1983; Walker 1989; Webb 1995), the effective solution of which would provide large fitness benefits (Sugiyama n.d.). Secondly, we know that humans engage in behavior that helps to solve the health-risk problem (by reducing mortality rates; see, e.g., Bailey 1991; Sugiyama and Chacon 2000) because our long lifespan could not have evolved without it (e.g., Charnov 1993; Hawkes et al. 1997, 1998; Hill and Kaplan 1999; Kaplan et al. 2000). A key difference between human life history and that of our closest living relatives, the chimpanzees, is mortality reduction across the post-infant lifespan (Hawkes et al. 1998; Hill et al. 2001; Hill and Kaplan 1999; Kaplan et al. 2000), and this mortality reduction is due at least in part to extended support of sick/injured conspecifics (e.g., Bailey 1991; Hill and Kaplan 1999; Sugiyama 2002, n.d.). This behavior has not been observed among chimps (J. E. Lambert, Department of Anthropology, University of Oregon, personal communication 2002), nor are they known to engage in social niche specialization of the type and intensity found among humans. In short, both humans and chimps engage in mating and coalitional aggression, but only humans engage in extended health-care of conspecifics and intense social niche specialization: surely health-risk buffering is at least as plausible an explanation of social niche specialization as mate or ally attraction. Finally, health risk poses a uniquely intense banker's paradox for which reciprocal altruism does not provide an adequate solution. In contrast, the signaling of generosity and commitment to others appears to be requisite to solving the health-risk problem (Sugiyama and Chacon 2000; Tooby and Cosmides 1996), and Gurven et al. (2000) have shown the predicted effects of generosity on subsequent health-care aid among the Ache. For these reasons, then, we expect social niche specialization to be a key component in the solution of the health-risk problem.

The lack of a recurrent, explicit link between social niche specialization and health-care aid in the ethnographic literature is problematic, but it may be due to reporting biases. For example, the Ache are one of the most well-documented foraging groups in the world, yet until Gurven and colleagues' (2000) work testing the signaling generosity model, there was only one passing comment regarding conferral of benefits to others and health-care aid (Kaplan and Hill 1985:244). This comment initially stimulated Sugiyama (1996; Sugiyama and Chacon 2000) to look into the problem, and it was Sugiyama's work in part that then led Gurven et al. (2000) to develop a formal model of the problem. Tellingly, even though there was scarce mention of the problem in the literature on the Ache, Gurven et al. (2000) subsequently showed that over half the food transfers to temporarily disabled individuals were predicted by the relative generosity of the disabled person to specific others when he or she was healthy. At a minimum, this line of research should be duplicated elsewhere.

In making our argument, we are not ruling out the possibility that social niche specialization garners the specialist benefits in addition to health care (e.g., Sugiyama 1996; Sugiyama and Chacon 2000; Tooby and Cosmides 1996). Nor are we suggesting that costly signaling is used only to signal generosity and commitment to others. On the contrary, we envision costly signaling as operating on several frequencies, capable of sending a variety of messages. Given the wide array of adaptive problems that beset our ancestors and the variety of social relationships that were efficacious in their solution, it would have been adaptive at various points across the lifespan for an individual to signal his/her value as a mate, military ally, food-sharing partner, cooperative foraging partner, child-rearing ally, information source, healer, political strategist, and so on. For this reason, we believe that costly signaling hypotheses must move toward explicit predictions about the kind of signals relevant to a given task, and the psychological properties needed to assess them (e.g., Gurven et al. 2000; Tooby and Cosmides 1996).

In the thicket of anecdotal ethnographic evidence presented here, we believe we have discovered a research path that offers great potential to the broader study of cognitive adaptation and the generation of culture. Unfortunately, the evidence we have found to date—though compelling—does not lend itself to quantitative analysis. Ethnographers have not tended to rigorously document whether or not humans distinguish the best artisans in their group, whether or not these artisans enjoy certain privileges, and what the nature of these privileges is. Perhaps the answers to these questions strike them as obvious and therefore not worth mentioning. We hope to have shown that, on the contrary, the cross-cultural practice of social niche specialization cries out for adaptationist scrutiny. We have therefore presented our preliminary findings in the hope of stimulating others to join in building a data base for the study of this neglected phenomenon.

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REFERENCES

- Allen, L. H.
1984 Functional Indicators of Nutritional Status of the Whole Individual or the Community. *Clinical Nutrition* 3:169–175.
- Alejandro, P.
1996 *Notes on Populational Significance of Paleopathological Conditions: Health, Illness and Death in the Past*. Barcelona: Fundaci.
- Altmann, S. A.
1991 Diets of Yearling Female Primates Predict Lifetime Fitness. *Proceedings of the National Academy of Science USA* 88:420–423.
- Alvard, M. S., and D. A. Nolin
2002 Rousseau's Whale Hunt? Coordination among Big-Game Hunters. *Current Anthropology* 43:533–559.
- Aufderheide, A. C., and C. Rodriguez-Martin
1998 *The Cambridge Encyclopedia of Human Paleopathology*. Cambridge: Cambridge University Press.
- Axelrod, R. T., and W. D. Hamilton
1981 The Evolution of Cooperation. *Science* 211:1390–1396.
- Bailey, R. C.
1991 *The Behavioral Ecology of Efe Pygmy Men in the Ituri Forest, Zaire*. Ann Arbor: Museum of Anthropology, University of Michigan.
- Baksh, M., and A. Johnson
1990 Insurance Policies among the Machiguenga: An Ethnographic Analysis of Risk Management in a Non-Western Society. In *Risk and Uncertainty in Tribal and Peasant Economies*, E. Cashdan, ed. Pp. 193–228. Boulder: Westview.
- Berger, T. D., and E. Trinkaus
1995 Patterns of Trauma among the Neanderthals. *Journal of Archaeological Science* 22:841–852.
- Bliege Bird, Rebecca, and Douglas W. Bird
2002 Constraints of Knowing or Constraints of Growing? Fishing and Collecting by the Children of Mer. *Human Nature* 13:239–267.
- Bush, H., and M. Zvelebil
1991 *Health in Past Societies: Biocultural Interpretations of Human Skeletal Remains in Archaeological Contexts*. Oxford: Tempus Reparatum.

Biesele, Megan

1993 *Women Like Meat: The Folklore and Foraging Ideology of the Kalahari Ju/'hoan*.
Bloomington: Indiana University Press.

Blurton Jones, N., and F. Marlowe

2002 Selection for Delayed Maturity: Does It Take Twenty Years to Learn to Hunt and Gather? *Human Nature* 13:199–238.

Blurton Jones, N., K. Hawkes, and J. F. O'Connell

1997 Why Do Hadza Children Forage? In *Genetic, Ethological and Evolutionary Perspectives on Human Development*, N. L. Segal, G. E. Weisfeld, and C. C. Weisfeld, eds. Pp. 279–313. Washington, D. C.: American Psychological Association.

Bowlby, J.

1969 *Attachment and Loss, Vol. 1: Attachment*. New York: Basic Books.

Brown, Donald E.

1991 *Human Universals*. New York: McGraw-Hill.

Buzina, R., C. J. Bates, J. van der Beek, G. Brubacher, R. K. Chandra, L. Hallberg, J. Heseker, W. Mertz, K. Pietrzik, E. Pollitt, A. Pradilla, K. Subticanec, H. H. Sandstead, W. Schalch, G. B. Spurr, and J. Westenhofer

1989 Workshop on Functional Significance of Mild-to-Moderate Malnutrition. *American Journal of Clinical Nutrition* 50:172–176.

Cashdan, E., ed.

1990 *Risk and Uncertainty in Tribal and Peasant Economies*. Boulder: Westview.

Chagnon, N. A.

1975 Genealogy, Solidarity and Relatedness: Limits to Local Group Size and Patterns of Fissioning in an Expanding Population. *Yearbook of Physical Anthropology* 19:95–110.

1979 Mate Competition, Favoring Close Kin, and Village Fissioning among the Yanomamö Indians. In *Evolutionary Biology and Human Social Behavior: An Anthropological Perspective*, N. A. Chagnon and W. Irons, eds. Pp. 86–131. North Scituate, Massachusetts: Duxbury Press.

1997 *Yanomamo*, fifth ed. Fort Worth: Harcourt Brace College.

Charnov, E. L.

1993 *Life History in Variance: Some Explanations of Symmetry in Evolutionary Ecology*. Oxford: Oxford University Press.

Cosmides, L., and J. Tooby

1992 Cognitive Adaptations for Social Exchange. In *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*, J. Barkow, L. Cosmides, and J. Tooby, eds. Pp. 161–228. New York: Oxford University Press.

Fiddick, L.

1999 *The Deal and the Danger: An Evolutionary Analysis of Deontic Reasoning*. Ph.D. dissertation. Ann Arbor: UMI.

Fiddick, L., L. Cosmides, and J. Tooby

2000 No Interpretation without Representation: The Role of Domain-Specific Representations and Inferences in the Wason Selection Task. *Cognition* 77:1–79.

Forge, Anthony

1967 The Abelam Artist. In *Social Organization: Essays Presented to Raymond Firth*, M. Freedman, ed. Pp. 65–84. Chicago: Aldine.

Freuchen, P.

1961 *Book of the Eskimos*. Greenwich, Connecticut: Fawcett.

Frisch, R. E., and J. W. McArthur

1974 Menstrual Cycles: Fatness as a Determinant of Minimum Weight Necessary for Their Maintenance and Onset. *Science* 185:949–951.

Gintis H, E. A. Smith, and S. Bowles

2001 Costly Signaling and Cooperation. *Journal of Theoretical Biology* 213:103–119.

Goldschmidt, W.

1959 *Man's Way: A Preface to the Understanding of Human Society*. New York: Henry Holt.

Goodwin, Grenville

1939 *Myths and Tales of the White Mountain Apache*. New York: American Folk-Lore Society.

1942 *The Social Organization of the Western Apache*. Chicago: University of Chicago Press.

Grauer, A. L., and P. Stuart-Macadam, eds.

1998 *Sex and Gender in Paleopathological Perspective*. Cambridge: Cambridge University Press.

Green, B. B., J. S. Weiss, and J. R. Daling

1986 Risk for Ovulatory Infertility in Relation to Body Weight. *Fertility and Sterility* 50:721–726.

Gubser, Nicholas J.

1965 *The Nunamiut Eskimos, Hunters of Caribou*. New Haven: Yale University Press.

Guenther, Mathias

1999 *Tricksters and Trancers: Bushman Religion and Society*. Bloomington: Indiana University Press.

Curven, M., W. Allen-Arave, K. Hill, and A. M. Hurtado

2000 "It's a Wonderful Life": Signaling Generosity among the Ache of Paraguay. *Evolution and Human Behavior* 21:263–282.

Gusinde, Martin

1961 *The Yamana: The Life and Thought of the Water Nomads of Cape Horn*. New Haven: Human Relations Area Files. (originally published in 1937)

Hagen, E. H., R. B. Hames, N. M. Craig, M. T. Lauer, and M. E. Price

2001 Parental Investment and Child Health in a Yanomamo Village Suffering Short-term Food Stress. *Journal of Biosocial Science* 33:503–528.

Hamilton, W. D.

1964 The Genetical Evolution of Social Behavior, Parts 1 and 2. *Journal of Theoretical Biology* 7:1–52.

Hart, C. W. M., and Arnold R. Pilling

1979 *The Tiwi of North Australia*. New York: Holt, Rinehart and Winston.

Hawkes, K., J. F. O'Connell, and N. G. Blurton Jones

1997 Hadza Women's Time Allocation, Offspring Provisioning, and the Evolution of Long Post-Menopausal Lifespans. *Current Anthropology* 38:551–577.

- Hawkes, K., J. F. O'Connell, N. G. Blurton Jones, H. Alvarez, and E. L. Charnov
1998 Grandmothering, Menopause, and the Evolution of Human Life Histories. *Proceedings of the National Academy of Sciences USA* 95:1336–1339.
- Hill, K., and M. Hurtado
1996 *Ache Life History: The Ecology and Demography of a Foraging People*. New York: Aldine de Gruyter.
- Hill, K., and H. Kaplan
1999 Life History Traits in Humans: Theory and Empirical Studies. *Annual Review of Anthropology* 28:387–430.
- Hill, K., C. Boesch, J. Goodall, A. Pusey, J. Williams, and R. Wrangham
2001 Mortality Rates among Wild Chimpanzees. *Journal of Human Evolution* 40:437–450.
- Hodge, Fredrick Webb
1959 Maricopa. In *Handbook of American Indians North of Mexico*, Part I, F. W. Hodge, ed. Pp. 805–807. New York: Pagent Books.
- Kaplan, H. S., and K. Hill
1985 Food Sharing among Ache Foragers: Tests of Explanatory Hypotheses. *Current Anthropology* 26:223–240.
- Kaplan, H. S., K. Hill, J. B. Lancaster, and A. M. Hurtado
2000 A Theory of Human Life History Evolution: Diet, Intelligence, and Longevity. *Evolutionary Anthropology* 9:156–185.
- Karsten, Rafael
1923 *The Toba Indians of the Bolivian Gran Chaco*. Abo, Finland: Abo Academi.
- Kelly, Robert L.
1995 *The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways*. Washington, D.C.: Smithsonian Institution Press.
- Kohrs, M. B., A. E. Harper, and G. R. Kerr
1976 Effects of a Low-Protein Diet during Pregnancy of the Rhesus Monkey, 1: Reproductive Efficiency. *American Journal of Clinical Nutrition* 29:136–145.
- Lambert, P.
1993 Health in Prehistoric Populations of the Santa Barbara Channel Islands. *American Antiquity* 58:504–522.
- Levak, Zarko David
1934 Kinship System and Social Structure of the Bororo of Pobjari. Bororo (electronic resource): SP08. eHRAF Collection of Ethnography accessed via www.yale.edu/HRAF.
- Manocha, S. L., and J. Long
1977 Experimental Protein Malnutrition during Gestation and Breeding Performance of Squirrel Monkeys. *Primates* 18:923–930.
- Marks, I.
1987 *Fears, Phobias, and Rituals: Panic, Anxiety, and Their Disorders*. New York: Oxford University Press.
- Martin, D. L., and D. W. Frayer
1997 *Troubled Times: Violence and Warfare in the Past*. *War and Society*, Vol. 3. Amsterdam: Gordon and Breach.

Miller, Elmer Schaffer

1980 *Harmony and Dissonance in Argentine Toba Society*. New Haven: Human Relations Area Files.

Miller, Geoffrey

1997 Prorean Primates: The Evolution of Adaptive Unpredictability in Competition and Courtship. In *Machiavellian Intelligence II: Extensions and Evaluations*, A. Whiten and R. W. Byrne, eds. Pp. 312–340. Cambridge: Cambridge University Press.

1998 How Mate Choice Shaped Human Nature: A Review of Sexual Selection and Human Evolution. In *Handbook of Evolutionary Psychology: Ideas, Issues, and Applications*, C. Crawford and D. L. Krebs, eds. Pp. 87–129. Mahwah, New Jersey: Lawrence Erlbaum Associates.

2000 *The Mating Mind*. New York: Doubleday.

Mithen, Steven J.

1990 *Thoughtful Foragers: A Study of Prehistoric Decision Making*. Cambridge: Cambridge University Press.

Murdock, George Peter

1945 The Common Denominator of Cultures. In *The Science of Man in the World Crisis*, Ralph Linton, ed. Pp. 123–142. New York: Columbia University Press.

Nelson, Richard K.

1969 *Hunters of the Northern Ice*. Chicago: University of Chicago Press.

Opler, Morris E.

1941 *An Apache Life Way: The Economic, Social, and Religious Institutions of the Chiricahua Indians*. Chicago: University of Chicago Press.

Owsley, D. W., and R. L. Jantz

1994 *Skeletal Biology in the Great Plains: Migration, Warfare, Health, and Subsistence*. Washington, D.C.: Smithsonian Institution.

Pinker, S.

1997 *How the Mind Works*. New York: W. W. Norton.

Prentice, A. M., T. J. Cole, F. A. Foord, W. H. Lamb, and R. G. Whitehead

1987 Increased Birthweight after Prenatal Dietary Supplementation of Rural African Women. *American Journal of Clinical Nutrition* 46:912–925.

Ray, D. J.

1939 *Cultural Relations in the Plateau of Northwestern America*. Los Angeles: Southwest Museum.

Ridley, M.

1996 *The Origins of Virtue*. London: Viking.

Riley, A. P., J. L. Samuelson, and S. L. Huffman

1993 The Relationship of Age at Menarche and Fertility in Undernourished Adolescents. In *Biomedical and Demographic Determinants of Reproduction*, R. H. Gray, H. Leridon, and A. Spira, eds. Pp. 50–64. Oxford: Clarendon.

Roach, P.

2002 Birth Order Effects on Personality among the Shuar of Ecuador. Paper presented at the annual meeting of the Human Behavior and Evolution Society, June, Rutgers University, New Brunswick, New Jersey.

Rothschild, B. M., and L. D. Martin

1993 *Paleopathology: Disease in the Fossil Record*. Boca Raton: CRC Press.

Rozin, P., and A. Fallon

1987 A Perspective on Disgust. *Psychological Review* 94:23–41.

Rozin, P., M. Markwith, and B. Ross

1990 The Sympathetic Magical Law of Similarity, Nominal Realism and Neglect of Negatives in Response to Negative Labels. *Psychological Science* 1:383–384.

Rozin, P., L. Millman, and C. Nemeroff

1986 Operation of the Laws of Sympathetic Magic in Disgust and Other Domains. *Journal of Personality and Social Psychology* 50:703–712.

Rutherford, M. D., J. Tooby, and L. C. Cosmides

1996 Adaptive Sex Differences in Reasoning about Threat. Paper presented at the annual meeting of the Human Behavior and Evolution Society, June, Northwestern University, Evanston, Illinois.

Scalise Sugiyama, Michelle

1996 On the Origins of Narrative: Storyteller Bias as a Fitness-Enhancing Strategy. *Human Nature* 7:403–425.

2001 Food, Foragers, and Folklore: The Role of Narrative in Human Subsistence. *Evolution and Human Behavior* 22:221–240.

Schwartz, S. M., M. E. Wilson, M. L. Walker, and D. C. Collins

1988 Dietary Influences on Growth and Sexual Maturation in Premenarcheal Rhesus Monkeys. *Hormones and Behavior* 22:231–251.

Smith, E. A., and R. Bliege Bird

2000 Turtle Hunting and Tombstone Opening: Public Generosity as Costly Signaling. *Evolution and Human Behavior* 21:245–261.

Sosis, R.

2000 The Emergence and Stability of Cooperative Fishing on Ifaluk Atoll. In *Human Behavior and Adaptation: An Anthropological Perspective*, L. Cronk, N. Chagnon, and B. Irons, eds. Pp. 437–472. Hawthorne, New York: Aldine de Gruyter.

Spier, Leslie

1928 *Havasupai Ethnography*. New York: American Museum of Natural History.

1933 *Yuman Tribes of the Gila River*. Chicago: University of Chicago Press.

Steward, J. H.

1938 *Basin-Plateau Aboriginal Sociopolitical Groups*. Bureau of American Ethnology Bulletin 120. Washington, D.C. (reprinted in 1970 by University of Utah Press).

Sugiyama, Lawrence

1996 *In Search of the Adapted Mind: A Study of Human Cognitive Adaptations among the Shiwiar of Ecuador and the Yora of Peru*. Ph.D. dissertation. Ann Arbor, Michigan: UMI.

1999 Patterns of Pathology among the Shiwiar of Ecuadorian Amazonia. Paper presented at Risk Preference Roundtable, Risk Research Initiative, Economics Preferences Group, MacArthur Foundation. University of Utah, Salt Lake City.

2002 Shiwiar Illness, Injury and Disability: Implications for Human Life History Evolution. Paper presented at the annual meeting of the American Anthropological Association, New Orleans.

- n.d. Illness, Injury, and Disability among Shiwiari Forager-Horticulturalists: Health Risk in Ethno-bioarchaeological Perspective. *American Journal of Physical Anthropology*, in press.
- Sugiyama, L., and R. Chacon
 2000 Effects of Illness and Injury on Foraging among the Yora and Shiwiari: Pathology Risk as Adaptive Problem. In *Human Behavior and Adaptation: An Anthropological Perspective*, L. Cronk, N. Chagnon, and W. Irons, eds. Pp. 371–395. Hawthorne, New York: Aldine de Gruyter.
- Sulloway, Frank
 1997 *Born to Rebel: Birth Order, Family Dynamics, and Creative Lives*. New York: Pantheon.
- Tooby, J., and L. Cosmides
 1988 *The Evolution of War and Its Cognitive Foundations*. Institute for Evolutionary Studies Technical Report 88-1. Reprinted in *Evolutionary Psychology: Foundational Papers*, Cambridge: MIT Press, forthcoming.
 1996 Friendship and the Banker's Paradox: Other Pathways to the Evolution of Adaptations for Altruism. *Proceedings of the British Academy* 88:119–143.
- Tooby, John, and Irven DeVore
 1987 The Reconstruction of Hominid Behavioral Evolution Through Strategic Modeling. In *The Evolution of Human Behavior: Primate Models*, Warren G. Kinzey, ed. Pp. 183–237. Albany: SUNY Press.
- Trinkaus, E.
 1983 *The Shanidar Neandertals*. New York: Academic Press.
- Trivers, R. L.
 1971 The Evolution of Reciprocal Altruism. *Quarterly Review of Biology* 46: 35–57.
- Truswell, A. S., and J. D. L. Hansen
 1976 Medical Research among the !Kung. In *Kalahari Hunter-Gatherers: Studies of the !Kung San and Their Neighbors*, R. B. Lee and I. DeVore, eds. Pp. 166–194. Cambridge: Harvard University Press.
- Turnbull, Colin
 1965 *Wayward Servants*. New York: Natural History Press.
- Walker, P. L.
 1989 Cranial Injuries as Evidence of Violence in Prehistoric Southern California. *American Journal of Physical Anthropology* 80:313–323.
- Walker, R., K. Hill, H. Kaplan, and G. McMillan
 2002 Age-Dependency in Strength, Skill, and Hunting Ability among the Ache of Eastern Paraguay. *Journal of Human Evolution* 42:639–657.
- Webb, S.
 1995 *Palaeopathology of Aboriginal Australians: Health and Disease across a Hunter-Gatherer Continent*. Cambridge: Cambridge University Press.
- Wiessner, Polly
 1983 Style and Social Information in Kalahari San Projectile Points. *American Antiquity* 48:253–276.
- Wilbert, Johannes
 1972 The Fishermen: The Warao of the Orinoco Delta. In *Survivors of Eldorado: Four Indian Cultures of South America*, Johannes Wilbert, ed. Pp. 65–115. New York: Praeger.

- 1976 To Become a Maker of Canoes: An Essay in Warao Enculturation. In *Enculturation in Latin America: An Anthology*, Johannes Wilbert, ed. Pp. 303–358. Los Angeles: UCLA Latin American Center.
- Wilbert, Johannes, ed.
- 1975 *Folk Literature of the Selknam Indians: Martin Gusinde's Collection of Selknam Narratives*. Los Angeles: UCLA Latin American Center.
- Wilbert, Johannes, and Miguel Layrisse, eds.
- 1980 *Demographic and Biological Studies of the Warao Indians*. Los Angeles: UCLA Latin American Center.
- Winterhalder, B.
- 1996 Social Foraging and the Behavioral Ecology of Intragroup Resource Transfers. *Evolutionary Anthropology* 5:46–57.
- Zahavi, Amotz, and Avishag Zahavi
- 1997 *The Handicap Principle: A Missing Piece of Darwin's Puzzle*. New York: Oxford University Press.

