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## CHAPTER 2

# Sexual Selection and Sex Differences in Social Cognition

David C. Geary

For the most part, the psychological study of cognitive sex differences has been an empirically driven endeavor, that is, sex differences were found on certain cognitive measures and the field has coalesced around these findings. Traditionally, the associated studies and theoretical models have focused on the advantage of men in the general domains of spatial and mathematical cognition and the advantage of women in verbal cognition (e.g., chapter 6; Halpern, 1992). The search for the origin of these sex differences has sometimes focused on biological factors, particularly sex hormones (chapter 3) (Kimura, 1999). Most theories, however, have focused on presumed culturally mediated (e.g., parental socialization) differences in the activities and experiences of boys and girls and later of men and women (chapter 7) (Baenninger & Newcombe, 1995; Eagly, 1987). The goal here is to provide a unifying framework based on the principles of sexual selection for incorporating hormonal, experiential, as well as evolutionary influences on human cognitive sex differences.

Sexual selection is an advantaged theoretical perspective for studying cognitive and other sex differences, for many reasons. The ultimate (evolutionary) and proximate (here and now, such as sex hormones) mechanisms associated with sexual selection have been studied in hundreds of species and are well understood (Andersson, 1994; Darwin, 1871). Basically, sexual selection provides a theoretical framework for understanding human cognitive sex differences in the context of sex differences found in other species and, at the same time, allows for hormonal, developmental, and experiential influences on the expression of these differences. Sex differences in social cognition will be discussed to illustrate the util-

ity of the perspective of sexual selection. Discussion of a wide range of cognitive sex differences from the perspective of sexual and natural selection is provided by Geary (1998), and by Pinker (1994) for language, Gaulin (1992, 1995; see also Geary, 1995) for space, and Geary (1996) for mathematics. Before sex differences in social cognition are discussed, a brief overview of the basic mechanisms of sexual selection is in order and presented in the following section. The second section provides an evolutionary taxonomy of sociocognitive modules and the final section provides an overview of sexual selection as related to sex differences in these sociocognitive competencies.

## **SEXUAL SELECTION**

Sexual selection refers to the processes associated with competition with members of the same sex and species (intrasexual competition) over mates and the processes associated with choosing mates (intersexual choice) (Darwin, 1871). Depending on reproductive and social dynamics, sexual selection can be manifest in terms of male-male competition, female-female competition, female choice, male choice, or some combination (Andersson, 1994; Geary, 1998). The following section briefly outlines these basic dynamics, whereas the second provides a few examples of intrasexual competition.

### **Mating or Parenting?**

The dynamics of sexual selection are driven by the degree to which females and males focus their reproductive effort on parenting or on mating (Clutton-Brock, 1991; Trivers, 1972; Williams, 1966). The sex difference in reproductive effort, in turn, is related to sex differences in the potential rate of reproduction and to social and ecological influences on mating opportunities, in particular the operational sex ratio (OSR) (Clutton-Brock & Vincent, 1991; Emlen & Gring, 1977; Krebs & Davies, 1993). Reproductive rates and the OSR are related. They are described in separate sections below.

### ***Reproductive Rates***

Any sex difference in the potential rate of reproduction can create a sex difference in the relative emphasis on mating or on parenting. Most generally, the sex with the higher potential rate of reproduction invests more in mating effort than in parental effort, whereas the sex with the lower rate of reproduction invests more in parental effort than in mating effort (Clutton-Brock & Vincent, 1991). This pattern arises because members of the sex with the higher potential rate of reproduction can rejoin the mating pool more quickly than can members of the opposite sex and it is often in their reproductive best interest to do so (Parker & Simmons, 1996).

For species with internal gestation and obligatory postpartum female care, as with suckling in mammalian species, the rate with which females can produce offspring is considerably lower than the potential rate of reproduction of conspecific males (Clutton-Brock, 1991). At the same time, internal gestation and the need for postnatal care creates a strong female bias in mammals toward parental investment and results in a sex difference in the benefits of seeking additional mates (Trivers, 1972). Males can benefit, reproductively, from seeking and obtaining additional mates, whereas females cannot. Thus, the sex difference in reproductive rate, combined with offspring that can be effectively raised by the female, creates the potential for large female-male differences in the mix of mating and parenting, and this difference is realized in 95-97% of mammalian species. In these species, females can provide the majority of parental care effectively, and do so (Clutton-Brock, 1991). Female care, in turn, frees males to invest in mating effort, which typically takes the form of male-male competition over access to mates or for control of the resources (e.g., territory) that females need to raise their offspring.

### ***Operational Sex Ratio***

The OSR is defined as the ratio of sexually active males to sexually active females in a given breeding population at a given point in time, and is related to the rate of reproduction (Emlen & Oring, 1977). For instance, in a population where there are as many sexually mature females as there are sexually mature males---an actual sex ratio of 1: 1---any sex difference in the rate of reproduction will skew the OSR. As noted, for mammalian species, males necessarily have a faster potential rate of reproduction and thus there are typically more sexually receptive males than sexually receptive females in most populations. This biased OSR creates the conditions that lead to intense male-male competition over access to a limited number of potential mates. Although these patterns are most evident in mammals, they are also found in many species of bird, fish, and reptile (Andersson, 1994), but are not limited to males.

When females have a faster rate of reproduction than males, then female-female competition is often more salient than male-male competition. As an example, consider the red-necked phalarope (*Phalaropus lobatus*), a polyandrous shorebird (i.e., females potentially have more than one mate) (Reynolds, 1987; Reynolds & Szekely, 1997). In this species, males provide most or all of the parental care, specifically, the building of the nest and the incubation of the eggs; the fledglings fend for themselves once hatched. The high level of paternal care makes it possible for the female to pursue other mating opportunities, and she typically does. Once the clutch is laid, the female often leaves in search of another male. The crucial feature of this mating system is that females are ready to produce another clutch about one week after laying their first clutch, whereas the incubation time for males is close to three weeks. The result is that the effective rate of reproduction is potentially higher in females than in males and the

OSR is skewed such that there are typically more sexually receptive females than males at any given point in time. The limiting factor in the number of offspring that can be produced by any given female is thus the number of unmatched males, that is, males available to incubate her eggs.

In theory, the females of this species should show many of the characteristics that are typically associated with the males of species in which males compete for mates and, in fact, they do. Red-necked phalarope females are slightly larger than conspecific males, have a brighter plumage, fight with other females for access to males, and, once paired, guard their mates against competitors; males, in contrast, rarely threaten or attack one another (Reynolds, 1987). Moreover, the evolutionary consequences of female-female competition in this species are the same as those found in species with intense male-male competition. The most important of these consequences—and the principal force driving the evolution of female-female competition in the red-necked phalarope—is that the reproductive success of females is more variable than the reproductive success of males. Some females produce two clutches per breeding season, each with a different male, and many other females go unmated; unmated males, in comparison, are rare. In short, females who capitalize on the high level of paternal care produce more offspring than females who assist the male in clutch incubation. As long as the male can effectively incubate the eggs himself, selection—through differential reproduction—favors females who pursue and are successful in gaining additional mates; that is, females who invest more in mating effort than in parental effort.

It appears that the same basic mechanisms, that is a sex difference in potential reproductive rate and a skewed OSR, are the ultimate sources of the male focus on mating effort and the female focus on parental effort in the vast majority of mammalian species (Emlen & Gring, 1977; Parker & Simmons, 1996). However, the biology of internal fertilization and gestation are not the only factors that influence the potential rate of reproduction and the OSR in mammals, social and ecological factors are sometimes important as well. As an example, male callitrichid monkeys (*Callithrix*) have a higher potential rate of reproduction than conspecific females do. However, shared territorial defense, concealed ovulation, female-on-female aggression that drives away the males' potential mating partners, and twinning negate this physiologically based sex difference and result in a more balanced OSR, monogamy, and high levels of paternal investment (Dunbar, 1995; Geary, 2000).

In any case, the dynamics of sexual selection in humans, as with other species, turns on the degree to which women and men focus their reproductive efforts on mating or on parenting, in particular whether parental investment is evident in men. In fact, there is evidence that men throughout the world invest in the well-being of their children, albeit not to the same degree as women do (Geary, 2000). Paternal investment, in turn, makes sexual selection in humans more complicated than is the case in most other mammals. Not only are the standard features of

male-male competition and female choice evident in humans, but so are female-female competition and male choice. With respect to sex differences in social cognition and their development, male-male competition and female-female competition appear to be more relevant than female choice and male choice and thus the following section focuses on intrasexual competition rather than on intersexual choice.

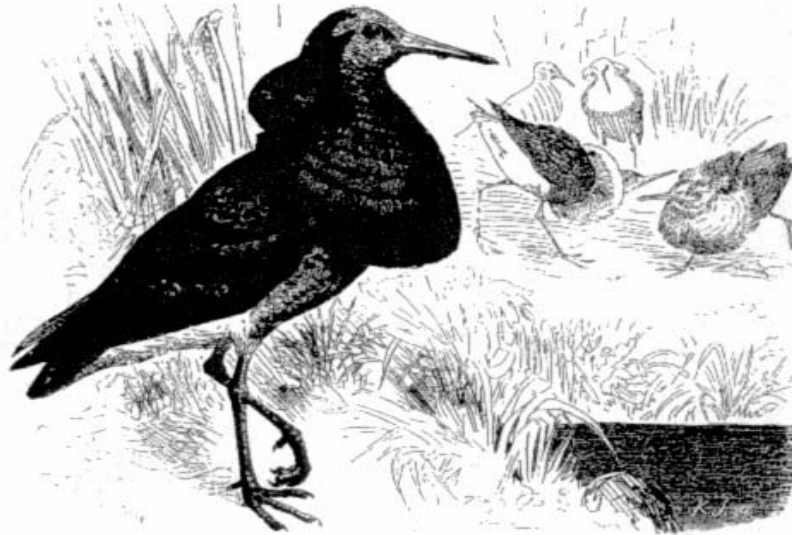
### **Intrasexual Competition**

Intrasexual competition over mates, whether it is male-male competition or female-female competition, will result in the evolutionary emergence of sex differences for those traits that facilitate this competition (Andersson, 1994; Darwin, 1871). Studies of intrasexual competition have revealed that the associated sex differences can be physical, behavioral, or cognitive (including neural) and only affect those features actually involved in the competition (Geary, 1998). Moreover, these sex differences are often associated with developmental sex differences, illustrated as follows (Geary, 1999).

One of the more common expressions of intrasexual competition, as with the red-necked phalarope, involves physical threats and fights over access to mates or for control of the territory that members of the opposite sex need to raise offspring (e.g., nesting spots). The result is typically a sex difference in physical size and aggressiveness. The polygynous ruff (*Machetes pugnax*) provides one example of such competition among males and is illustrated in Figure 2.1. Of this species, Darwin stated:

The [polygynous] Ruff. . . is notorious for his extreme pugnacity; and in the spring, the males, which are considerably larger than the females, congregate day after day at a particular spot, where the females propose to lay their eggs. The fowlers discover these spots by the turf being trampled somewhat bare. Here they fight very much like gamecocks, seizing each other with their beaks and striking with their wings. The great ruff of feathers round the neck is then erected, and according to Col. Montagu "sweeps the ground as a shield to defend the more tender parts;" and this is the only instance known to me in the case of birds, of any structure serving as a shield. (Darwin, 1871, Part II, p. 41)

Sometimes the competition is more behavioral than physical, as is found in most species of bowerbird (Gilliard, 1969). In about three out of four of these species, the principal focus of male-male competition and female choice is bower building. The bower of one such species (*Chlamydera maculata*) was described by Darwin (1871) and is shown in Figure 2.2. More recently, the bower building of a related species, the satin bowerbird (*Ptilonorhynchus violaceus*), has been extensively studied by Borgia and his colleagues (Borgia, 1985a, 1985b; Collis & Borgia, 1992). These studies indicate that female choice of mating partners is strongly influenced by the complexity and symmetry of the male's bower, as well as by the number of decorations around the bower. Males thus compete



**Figure 2.1.** Physical male-male competition in the ruff (*Machetes pugnax*). From *The Descent of Man, and Selection in Relation to Sex* (Part II, p. 42), by C. Darwin, 1871, London: John Murray.

with one another through bower building and through the destruction of their competitors' bowers (Borgia, 1985a). The result is that about one out of six males sires most of the offspring, and these are the males with the most elaborate bowers and males who avoid (through male-male fighting) the destruction of their bower.

For satin bowerbirds, and many other species in which the nature of intrasexual competition differs, sex differences are also evident in growth patterns and activities during development (Darwin, 1871; Geary, 1998). These developmental sex differences directly reflect and are preparation for intrasexual competition. Male satin bowerbirds, for instance, mature many years after females have matured. During development, "young males spend a great deal of time observing older males at their bower, and practice bower building and display behaviors when the owner is absent from the bower site" (Collis & Borgia, 1992, p. 422). Young males also engage in play fighting, which provides the experience needed for dominance-related encounters in adulthood. The delayed maturation of male satin bowerbirds provides the opportunity to practice and refine the bower construction and physical competition skills that will be needed in adulthood. For this opportunity to be achieved, there must be inherent biases in the types of information young male bowerbirds attend, such as the activities of mature males

and the social behaviors they are likely to imitate, suggesting some accompanying sex differences in brain and cognition.

In fact, in some species, intrasexual competition can be more dependent on cognitive and brain specializations than on behavioral or physical specializations. Gaulin and Fitzgerald have provided one of the best-documented examples of the influence of intrasexual competition on such differences (Gaulin, 1992; Gaulin & Fitzgerald, 1986, 1989); bird song is another example (Ball & Hulse, 1998; Hauser, 1996). The approach in these studies is to compare evolutionarily related species—those with a recent common ancestor—of voles (small rodents, *Microtus*). The comparison of species with a recent common ancestor is important because existing differences across related species cannot be attributed to their distant evolutionary history. Rather, these differences are more likely to reflect current differences in reproductive strategy or adaptations to different ecological niches (e.g., Grant & Grant, 1993). The primary difference across these species of vole is that some are monogamous and some polygynous. By comparing related species of monogamous and polygynous voles, Gaulin and Fitzgerald have studied the effects of sexual selection—which will operate more strongly in



**Figure 2.2.** Bower building and behavioral male-male competition in the bowerbird (*Chlamydera maculata*). From *The Descent of Man, and Selection in Relation to Sex* (Part II, p. 70), by C. Darwin, 1871, London: John Murray.

polygynous than in monogamous species (Andersson, 1994; Darwin, 1871; Geary, 1998)---on sex differences in spatial cognition and at least one underlying brain region.

In the polygynous meadow vole (*Microtus pennsylvanicus*), males compete with one another by searching for and attempting to mate with females who are dispersed throughout the habitat, rather than through physical contest. Prairie and pine voles (*Microtus ochrogaster*, *Microtus pinetorum*), in comparison, are monogamous and males do not search for additional mates, once paired. For meadow voles, intrasexual competition---through differential reproduction---will favor males who court the most females, which is possible only through an expansion of the home range. Thus, this form of male-male competition should result in larger home ranges for male than female meadow voles but no such sex difference should be evident in prairie or pine voles. Indeed, field studies indicate male meadow voles have home ranges that cover four to five times the area of the home ranges of females, but only during the breeding season and only in adulthood (Gaulin, 1992; Gaulin & Fitzgerald, 1986). The latter pattern indicates that the sex difference in the size of the home range is related to the reproductive strategy of the male (i.e., searching for females) and suggests that this difference is mediated by sex hormones. As predicted, the home ranges of male and female prairie and pine voles overlap and do not differ in size (Gaulin & Fitzgerald, 1986).

The sex difference in the size of the home range means that male meadow voles should have better developed spatial abilities---those abilities needed for navigation (Shepard, 1994 )---than female meadow voles and male prairie and pine voles. Moreover, there should be no sex difference in the spatial abilities of monogamous prairie and pine voles. A series of laboratory and field studies confirmed these predictions. The polygynous male meadow vole shows better navigational skills than conspecific females and better navigational skills than the males of evolutionarily related monogamous species (Gaulin, 1992; Gaulin & Fitzgerald, 1986, 1989). An equally important finding is that this same pattern of differences is found for the overall and relative volume of the hippocampus, which supports spatial cognition, among other cognitive abilities (Jacobs, Gaulin, Shen, & Hoffman, 1990). The hippocampus of male meadow voles is larger than that of female meadow voles and larger than that of male prairie and pine voles.

Although these examples have focused on male-male competition, the same effect is evident for female-female competition. Intrasexual competition results in the evolutionary elaboration and an hormonally influenced proximate expression of those traits associated with this competition, whether the traits are physical, behavioral, cognitive and neural, or some combination (Andersson, 1994; Geary, 1998). Moreover, based on the principles of sexual selection, sex differences are predicted in only those areas that are directly related to intersexual choice and intrasexual competition, although natural selection could result in sex differences as well. Enhanced spatial abilities in males are not expected in all

species, only species in which males have larger territories or use these territories in more complex ways than conspecific females, which includes humans, at least for navigation in unfamiliar territory (e.g., Geary, 1998). When females have larger territories or use territories in more complex ways than males, a female advantage is expected.

Studies of the brown-headed cowbird (*Molothrus ater ater*) nicely illustrate this point (Sherry, Forbes, Khurgel, & Ivy, 1993). Brown-headed cowbirds are brood parasites, that is, females lay their eggs in the nests of other species who then hatch and feed the cowbird nestlings. Female cowbirds must utilize the home range in more complex ways than male cowbirds because the females must locate suitable hosts for their eggs. Moreover, many hosts will only accept cowbird eggs after they have started laying eggs of their own. Thus, female cowbirds not only need to locate potential hosts, they must remember their locations and return to them at suitable times. The sex difference in the spatial demands of reproduction should then result in a larger hippocampus in female relative to male cowbirds. This is exactly the pattern found by Sherry and his colleagues (Sherry et al., 1993). As with voles, no sex differences in hippocampal size were found for species of monogamous birds--where males and females share a home range--that are evolutionarily related to the cowbird (e.g., the red-winged blackbird, *Agelaius phoeniceus*).

#### **SOCIAL COGNITION AND THE EVOLUTION OF THE HUMAN MIND**

As noted earlier, the study of human cognitive sex differences has been largely driven by empirical findings, not theory-driven predictions. The principles of sexual selection enable theoretically driven predictions about the loci of human cognitive sex differences and thus provides a broader perspective than is typically employed for understanding these differences (Gaulin, 1992). In short, sex differences are predicted for those physical, behavioral, cognitive, and neural traits that facilitate intrasexual competition and intersexual choice (Buss, Larsen, Westen, & Semmelroth, 1992; Geary, 1998). Nonetheless, a common objection to evolutionary theories of human sex differences is that they are post hoc "just so stories" (Halpern, 1997). Certainly, care must be exercised when constructing models of evolutionary influences on human functioning, but, at the same time, it must be recognized that the vast literature on sexual selection in other species the use comparative studies place empirically derived constraints on evolutionary models (e.g., Foley & Lee, 1989).

As an example, comparative studies of primate species, including humans, have consistently found relations among the size of the neocortex, the length of

the developmental period, and the species' social system (Barton, 1996; Dunbar (1993; Joffe, 1997; Sawaguchi, 1997). Neocortex size---after controlling for body size---is largest in those species that live in the most complex social systems and these same species have the longest developmental periods. These comparative patterns suggest that social factors, such as social competition, contributed to the evolution of mind and brain and that a long developmental period is needed to practice and refine the associated social skills, as with male satin bowerbirds. Sawaguchi's analysis revealed that neocortex size across primate species is related to the intensity of intrasexual competition, suggesting that one important feature of the complexity of a species' social system is the intensity of the competition for mates. The latter conclusion is an inference based on the principles of sexual selection and the empirical finding across species that as the intensity of intrasexual competition increases, the size of the neocortex increases as well. In short, the principles of sexual selection and comparative studies provide necessary constraints on evolutionary models of human sex differences. When these principles and constraints are used judiciously, the associated explanations of human sex differences are not simply "just so stories."

The author used this comparative approach and principles of evolutionary selection, combined with empirical studies in cognitive anthropology, cognitive neuroscience, ethnobiology, and psychology, to develop a taxonomy of evolved human cognitive competencies (Geary, 1998). In this taxonomy, evolved cognitive competencies are conceptualized as systems of domain-specific modules for processing information about other people, flora and fauna in the local ecology, and for moving about, representing (e.g., navigating), and using (e.g., tools) resources in the physical world (see Geary, 1998; Geary & Bjorklund, 2000). These modules correspond to the notions of folk psychology, folk biology, and folk physics. The following section describes the taxonomy for sociocognitive competencies (i.e., folk psychology) and the second section presents a model for how these competencies might be elaborated during development. The last section of the chapter describes the application of this taxonomy and developmental model to human sociocognitive sex differences.

### **Sociocognitive Modules**

A current and yet unresolved debate in evolutionary psychology and the cognitive neurosciences centers on whether human cognitive competencies are inherently specified (e.g., Elman et al., 1996; Pinker, 1994, 1997). One perspective is that the human mind is a constellation of domain-specific modules that have been shaped by natural selection to address specific and recurring problems of adaptation in ancestral environments (Tooby & Cosmides, 1995). In this view, evolved domains, such as language, emerge from genes that code for the construction of modular neurocognitive systems that process domain-specific information (Pinker, 1994, 1997). Although not always emphasized, this position

consistent with an epigenetic expression of these genes; that is, gene expression is contingent on exposure to evolutionarily expectant information (Geary & Bjorklund, 2000; Gelman & Williams, 1998; Greenough, Black, & Wallace, 1987). An alternative view is that the functional capacity of the human neocortex is initially underspecified, resulting in a general-purpose learning organ. From this perspective, language and other domains of mind emerge from an interaction between innate general purpose learning mechanisms and environmental experiences that act to shape the associated neuronal circuits (Elman et al., 1996).

The assumption is that there is some degree of inherent specificity to the human mind and brain, but that the associated competencies are elaborated and adapted to local conditions during development (see the section "Ontogenetic Development and Sex Differences in Brain and Cognition"). As noted previously, inherent specificity can be understood as a system of hierarchically organized cognitive modules, that is, brain and cognitive systems that process domain specific information (Tooby & Cosmides, 1995). The focus is on the sociocognitive modules shown in Figure 2.3, which in turn can be subdivided into individual-level and group-level systems. The associated taxonomy was developed based on studies of the forms of information, such as facial expressions and gestures, used in social communication across species and on associated patterns of group dynamics, such as group fission and fusion

#### *Individual-Level Modules*

The function of individual-level modules is to moderate the dynamics of one-on-one social interactions, to develop and maintain long-term relationships with kin and friends (i.e., nonkin), to support attempts to obtain social and material resources from other people, and to avoid being exploited by other people. Before discussion of the modules that support these functions, brief mention is needed of differences between relationships with kin and friends, as these differences are relevant to several later described sex differences.

Kin-based relationships are found across many species, ranging from invertebrates to primates, and are understood in terms of inclusive fitness (e.g., Altmann et al., 1996; Hamilton, 1964). Inclusive fitness refers to an individual's overall genetic contribution to the next generation, which is represented by the combination of one's children and the children of kin (e.g., nephews). Natural selection will strongly favor individuals who aid kin in ways that facilitate their reproduction and survival because the reproductive success of kin will perforce increase the altruist's genetic contributions to the next generation (Hamilton, 1964, 1975). More simply, selection pressures will quickly favor individuals who selectively provide social and material support to their kin (Hamilton, 1975). The primary distinction between the social relationships among kin and among friends is reciprocity. Relationships with kin are not always reciprocal, whereas long-term friendships are defined by reciprocity (Hartup & Stevens, 1997; Trivers, 1974). Of friends, Hartup and Stevens concluded that children "and adults of all ages

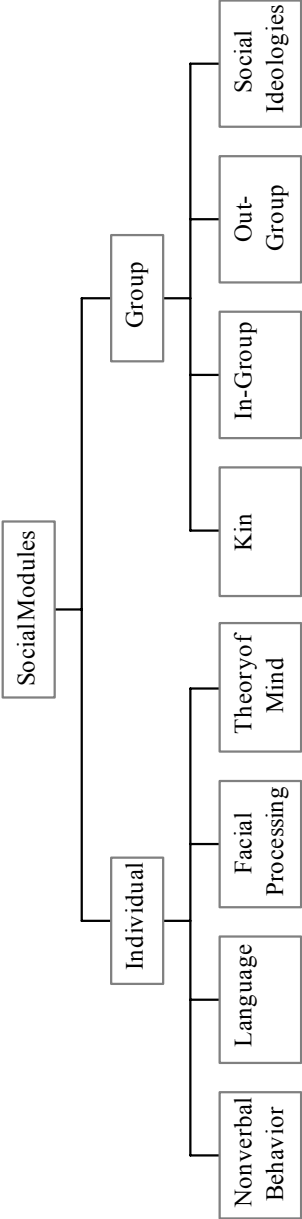


Figure 2.3 Proposed sociocognitive modules  
Adapted from *Male, female: The evolution of human sex differences* (pg. 180), by D.C. Geary, 1998, Washington, DC: American Psychological Association. Reprinted with permission.

consider these relationships to be marked by reciprocation, that is, *mutuality*---the giving and taking, and returning in kind or degree. On this basis, we argue that the friendship deep structure. . . is best described as ‘symmetrical reciprocity’” (Hartup & Stevens, 1997, p. 356).

The sociocognitive modules that support relationships with kin, friends, and competitors include the ability to read nonverbal communication signals and facial expressions, language, and theory of mind (Adolphs, 1999; Brothers & Ring, 1992; Leslie, 1987; Moscovitch, Winocur, & Behrmann, 1997; Premack & Woodruff, 1978; Pinker, 1994). Language and theory of mind appear to be of central importance in human social relationships (Povinelli & Preuss, 1995). Most generally, theory of mind represents the ability to "mind read" or make inferences about the intentions, beliefs, emotional states, and likely future behavior of other individuals (Baron-Cohen, 1995; Gopnik & Wellman, 1994). Facial processing and the processing of other nonverbal forms of communication (e.g., body posture), along with changes in vocal intonation and language itself, appear to provide the basic information that feeds into theory of mind. At the same time, these signals (e.g., facial expressions) modulate the dynamics of one-on-one social interactions, providing cues to the on-line emotional states and intentions of other people and sometimes to manipulate and deceive other people.

Of these, language and theory of mind appear to be the most highly developed, evolutionarily. Other primates respond to conspecific facial expressions, vocalizations, and body language (Hauser, 1996) but none of these primates, or any other species for that matter, has a vocal communication system as complex as human language (Pinker, 1994). Theory of mind is also highly elaborated in comparison to other primates. In fact, most primates---except perhaps other great apes but this is debated (e.g., Povinelli & Preuss, 1995; Premack & Woodruff, 1978)---do not show consistent evidence of a theory of mind. These findings are important because they provide a link between the earlier described comparative studies of social complexity and brain size (Barton, 1996) and the proposed sociocognitive modules. Rilling and Insel's (1999) neuroimaging study of individuals from 11 primate species indicated that the human neocortex is larger than expected, based on overall body and brain size, in just those areas that support human language (i.e., the left temporal cortex) and theory of mind (i.e., portions of the prefrontal cortex) (see Adolphs, 1999; Baron-Cohen, Ring, Moriarty, Schmitz, Costa, & Ell, 1994). These patterns support the position that social competition and cooperation contributed to the evolution of the human mind and brain, particularly the evolutionary elaboration of the neurocognitive systems that support language and theory of mind.

### **Group-Level Modules**

In addition to specialized modules for maintaining and regulating dyadic relationships and interactions, there are almost certainly complementary systems---the group-level modules shown in Figure 2.3---designed to parse the social uni-

verse. Bugental (2000) provides a model of the potential cognitive mechanisms underlying this parsing. However it is achieved, the parsing of people into social groups appears to reflect the previously described categorical significance of kin, the formation of in-groups and out-groups, and ideologically based social identification, as exemplified by nationality, religious affiliation, and so forth (Alexander, 1979; Geary, 1998). The proposal is that coalition-based competition is essential to understanding the evolution and expression of social parsing, especially as related to in-groups and out-groups and associated ideologies (Alexander, 1990; Geary, 1998). In other words, one function of social parsing is to facilitate the formation of competition-related coalitions.

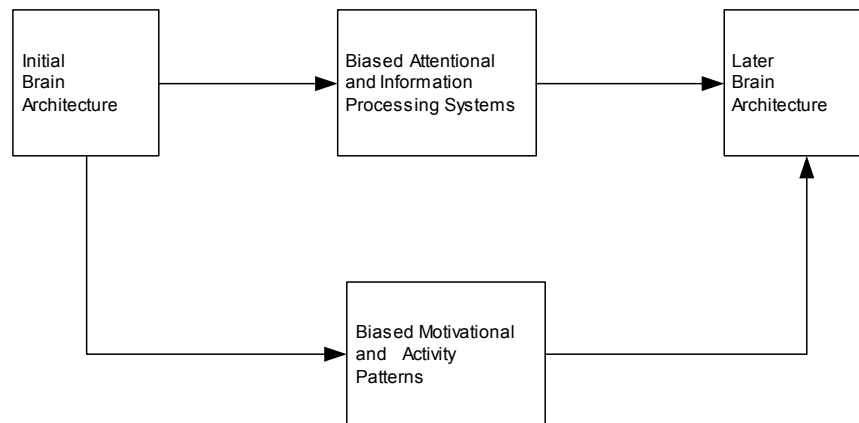
In preindustrial cultures, and most likely during the course of human evolution, functional group size appears to be constrained by the number of individuals with whom personal relationships can be maintained without the existence of formal laws and a formal police force to enforce these laws (Dunbar, 1993). The size of such groups varies in response to the opportunities and demands of the local habitat that supports the group (Alexander, 1990), but typically does not exceed 150 to 200 individuals (Dunbar, 1993). The individuals who comprise these groups are typically kin and share beliefs, such as origin myths, that not only distinguish them from other groups but often, if not always, assign special significance to their own group (Brown, 1991).

Cognitive constraints (e.g., on the number of people with whom personal relationships can be maintained) on the functional size of social groups and ecological constraints that resulted in competition over limited resources are likely to have contributed to the evolution of an in-group/out-group social psychology (Alexander, 1979); this form of social parsing almost certainly predated the emergence of hominids (Goodall, 1986). In-groups and out-groups are defined by differing social and moral ideologies that favor in-group members—kin and friends—and, under extreme conditions, devalue and even dehumanize out-group members. In fact, one important condition for effective competition against an out-group is the disengagement of the emotional and moral mechanisms that appear to be designed to reduce conflict and foster cooperation within in-groups. Although some level of in-group conflict is anticipated—especially when there are no current competing out-groups—it appears that emotional reactions, such as guilt and empathy, moderate this conflict in the service of mutually beneficial cooperative exchanges (Trivers, 1971).

When directed toward out-groups, the same moderating emotional reactions would result in a competitive disadvantage. In other words, when the competition between groups affected reproduction and survival—and it likely did in throughout the course of human evolution (Alexander, 1990; Chagnon, 1988; Keeley, 1996)—individuals who were able to dehumanize, in extreme cases, members of out-groups were likely at a competitive advantage. Stephan's (1985) review of the social psychology of intergroup relations supports this position, as do numerous studies on the social identification processes underlying group formation and

competition (e.g., Sherif, Harvey, White, Hood, & Sherif, 1961). Humans readily form in-groups and out-groups and process information about members of these groups in ways that are favorably biased toward the in-group, particularly when the comparisons are made between competing groups. Moreover, "anticipated competition caused in group members to feel more hostility toward the out-group than did anticipated cooperation" (Stephan, 1985, p. 675); the seminal Robbers Cave experiment nicely illustrates the process of in-group/out-group formation and intergroup competition (Sherif et al., 1961).

An in-group/out-group social psychology that likely evolved in the context of competition between relatively small kin-based groups more likely than not provided the foundation for the evolution of social ideologies (Alexander, 1990). These ideologies are particularly important, because they appear to be the basis for the formation of large nation-states, that is, the social organization of individuals who have never met, and never will, and thus are unable to develop one-on-one personal relationships (Geary, 1998). Such ideologies define the mutual self-interest of individuals who comprise groups that are larger than functional villages in preindustrial societies and are the basis for large-scale between-group conflict. In fact, the competitive advantage associated with group size was the likely pressure, after the emergence of language and shared belief systems (e.g., origin myths), that resulted in the evolution of the tendency of humans to form and rally around such ideologies (Alexander, 1990). In support of this view is the finding that people show an enhanced endorsement of in-group ideologies and harsher evaluations of out-group members under conditions that imply a threat to one's mortality (Arndt, Greenberg, Pyszczynski, & Solomon, 1997).



**Figure 2.4.** Proposed pattern of relations among evolved but skeletal cognitive and brain systems, biased attentional, information processing, motivational, and activity patterns, and later cognitive and brain systems.

### **Ontogenetic Development and Sex Differences in Brain and Cognition**

Evolution will relentlessly select for a short developmental period and therefore faster reproduction, unless there are strong advantages to maturational delays; these advantages must reproductively outweigh the risk associated with death before the age of reproduction. Comparative studies suggest that the basic adaptive benefit of delayed maturation is the accompanying ability to refine the physical, social, cognitive, and neural competencies that support survival and reproduction in adulthood (Mayr, 1974). The earlier described relation between neocortex size and length of the developmental period supports the view that one function of delayed maturation is to allow juveniles to practice and refine the sociocognitive competencies associated with survival and reproduction (e.g., competing for mates) in adulthood (Geary, 1999; Joffe, 1997). An extended developmental period is also related to enhanced tool use in some species and greater knowledge of the local ecology, both of which facilitate later foraging (Byrne, 1995; Geary, 1998).

For humans, play, social interactions, and exploration of the environment and objects appear to be the mechanisms through which these emerging competencies, including the sociocognitive competencies shown in Figure 2.3, are practiced and refined during development (e.g., Pellegrini & Smith, 1998). In theory, these child-initiated activities provide experiences with the social, biological (e.g., prey species), and physical world that interact with underlying genetic systems to produce the physical, social, cognitive, and neural phenotypes that were associated with the survival and reproduction of our ancestors (Geary, 1998; Scarr & McCarthy, 1983). In other words, child-initiated social play and exploration are intimately linked to cognitive and neural development, in that these activities result in the environmental experiences that are an integral part of the epigenetic processes that result in adult phenotypes (Greenough et al., 1987). The basic pattern is shown in Figure 2.4, whereby the initial, or skeletal, architecture of evolved modules is associated with motivational, attentional, information processing, and activity biases. These biases result in child-initiated experiences that further shape neurocognitive systems such that these systems are adapted to the local ecology (e.g., the local language) (Geary, 1998; Gelman & Williams, 1998). When considered in the context of sexual selection, developmental sex differences are expected only in those areas in which the reproductive activities of males and females differ (Geary, 1999). As described below, female-female competition is more interpersonal, involving relational aggression, than is male-male competition (Crick, Casas, & Moser, 1997). For this reason and others described later, early sex differences, favoring girls, are expected and found in the associated sociocognitive domains, such as the processing of facial expressions (Haviland & Malatesta, 1981). An early bias in the focus on and processing of such cues would provide the experiences necessary to practice and refine the

skills needed to effectively compete in the subtle and complex dynamics of female-female competition in adulthood.

At a more proximate level, it is expected that the expression of the accompanying sex differences in motivational, attentional, activity, and information-processing biases, as well as underlying sexually dimorphic brain structures, will be related to prenatal and circulating hormone levels (see chapter 3) (Geary, 1999; Kimura, 1999). Sex differences in attentional and information-processing biases and associated motivational and activity differences are predicted to interact with prenatal sexual dimorphisms in brain structure and with circulating sex hormone levels in ways that will lead to the emergence, or increase in magnitude, of sex differences in brain and cognition. Stated differently, the prediction is that cognitive sex differences will result from a hormonally moderated epigenetic process (Gilbert, Opitz, & Raff, 1996). The epigenetic process results from an interaction between hormonally induced cognitive and behavioral biases that act on early cognitive and brain sex dimorphisms such that the resulting experiences further modify the associated sex differences in social, cognitive, and brain systems.

## **HUMAN SEX DIFFERENCES**

The primary goal in this section is to use the system of sociocognitive competencies shown in Figure 2.3, in combination with the principles of sexual selection, as the theoretical framework for organizing sex differences research in the associated domains. However, to fully understand the utility of this approach, brief discussion of sexual selection in humans is required.

### **Sexual Selection**

In addition to the earlier mentioned fact that men throughout the world show some level of parental investment, thus creating the conditions for the evolution of female-female competition in humans (Geary, 2000), the social structure of our hominid ancestors is highly relevant to interpreting current sociocognitive sex differences.

### ***Hominid Social Structure***

In most species of primate, females stay in their birth group--they are the philopatric sex--and males migrate to other groups, as a mechanism of inbreeding avoidance. The social structure of these species is centered on coalitions of related females who defend territory and important food sources (e.g., fruit trees) from coalitions of other females (Wrangham, 1980). Males of these species tend not to form coalitions but compete one-on-one with other males to become the dominant (i.e., reproductive) male of the female coalition. Humans and all other great apes are an exception to this pattern, as males, not females, are the

philopatric sex (Manson & Wrangham, 1991). Consistent with the social structure found in other great apes, in the majority of preindustrial human cultures, men stay in their birth group and women migrate to the group of their husband (Pasternak, Ember, & Ember, 1997). A recent study of sex differences in genetic variability in 14 such cultures indicated a “higher female than male migration rate (through patrilocality, the tendency for a wife to move into her husband's natal household)” (Seielstad, Minch, & Cavalli-Sforza, 1998, p. 278).

There are two critical corollaries to this pattern. First, because coalition formation is most common in the philopatric sex, coalition-based intrasexual competition was likely to have been much more common in our male than in our female ancestors. In fact, coalition-based male-male competition is common in the chimpanzee (*Pan troglodytes*), a close relative, and is found to some degree in all human cultures in which group-level conflict is found (Geary, 1998; Goodall, 1986; Keeley, 1996). Large-scale coalition-based female-female competition, in contrast, has not been documented for any culture that has been studied, or in other great apes (Geary, 1998; Manson & Wrangham, 1991). Second, it is very likely that our female ancestors were forced to develop social alliances with nonkin more frequently than were our male ancestors, given that they migrated to the social group of their male mates. The development of relationships with nonkin likely provided a system of social support for our female ancestors. In extant societies, greater social stability is associated with improved health and reduced mortality risks for children (Geary, 1998, 2000). If this same pattern was evident during the course of human evolution, then social, cognitive, and emotional mechanisms associated with developing and maintaining relationships with nonkin were more likely to have been elaborated in hominid females than males.

If so, then sex differences, favoring women, should be found for many, perhaps all, of the individual-level sociocognitive competencies shown in Figure 2.3, that is, language, the processing of facial and nonverbal communication signals, and theory of mind. This is because relationships with nonkin are generally less stable than those with kin and likely require a higher level of social competencies to develop and maintain. Pressures for refined social competencies in turn would result in the evolutionary elaboration of the supporting sociocognitive competencies. Sex differences are also predicted in social motives, with women more than men favoring equality and reciprocity in interpersonal relationships--the features of relationships that characterize friendships, that is, relationships with nonkin (Hartup & Stevens, 1997).

### **Intrasexual Competition**

The nuances of intrasexual competition are many and complex. Detailed discussion of these nuances has been presented elsewhere (see Andersson, 1994; or Geary, 1998), but the observation that certain general features of intrasexual competition are more common for one sex than the other has important implica-

tions for the development of sex differences in human social cognition. As found in nearly all other species in which males compete for mates, male-male competition in humans is focused on issues of social dominance and resource control and often involves a physical component (Andersson, 1994; Geary, 1998). For humans, this competition occurs within and between groups. Beginning in childhood and extending throughout the lifespan, boys and men form relatively large in-groups, most typically to compete with other groups of males (e.g., sports) (Lever, 1978), and compete for status---the ability to influence other boys and men---within these groups. Once the resulting dominance hierarchy is formed, the behavior of boys and men becomes cooperative and focused on competing with the out-group (for an example see Savin-Williams, 1987). As noted earlier, this male-male competition is common in preindustrial societies and is related to reproductive issues (Chagnon, 1988; Keeley, 1996). In this view, the rough and tumble play of boys and the sex difference, favoring boys, in the engagement in group-level competition (e.g., team sports) are a reflection of evolved mechanisms that result in the practice and refinement of competencies associated with the forms of male-male competition---one-on-one and coalition based---that prevailed during human evolution (Geary, 1998, 1999).

Although girls and women do occasionally compete physically, they do so much less frequently than do boys and men (Geary, 1998); there are also qualitative differences (e.g., in focus and intensity) in this physical competition (Savin-Williams, 1987). More typically, girls and women compete relationally, that is, they back bite, shun, and ridicule their competitors (called relational aggression) (Crick et al., 1997). One function of this competition is to make these competitors look unattractive ("she's a real slut") to males and perhaps drive these women out of the social group, thus making them unavailable as mating partners to the men in the group (Buss, 1994; Geary, 2000). Another function appears to be to disrupt the formation of the above-mentioned network of interpersonal support (Geary, 1999).

One possibility is that this form of female-female competition evolved, in part, in the context of polygynous marriages---polygyny is very common in preindustrial societies and almost certainly throughout human evolution (Murdock, 1981). In these contexts, co-wives compete for the attention and resources of their husband. A recent study of polygynous versus monogamous marriages in a pastoral society in Tanzania provides some support for this thesis (Sellen, 1999), as do other studies of similar societies (e.g., Borgerhoff Mulder, 1990). Most generally, children of polygynous marriages show poor growth patterns and thus increased morbidity and mortality risks than do children of monogamous marriages. These conditions would promote female-female competition over the husband's resources, as gaining control of additional resources would improve the health of and reduce the mortality risks to her children. In any case, relational aggression would still be expected over potential mates, even in monogamous societies (Geary, 2000). This is because all men are not equal in terms of their

value as potential mates and female-female competition is expected and found over the most desirable mates (Buss, 1994).

Sex differences in the nature of intrasexual competition are predicted to result in sex differences in the sociocognitive competencies that support this competition. Sex differences in the nature of in-group and out-group dynamics are expected, with greater in-group bias and hostility toward the out-group in boys and men than in girls and women. Relational aggression would again favor the evolutionary and developmental elaboration of the individual-level sociocognitive competencies more in girls and women than in boys and men, as this form of aggression is focused on interpersonal relationships. The nature of intrasexual competition would also operate to create a sex difference in social motives, with boys and men being more concerned with issues of social dominance than girls and women.

### **Social Cognition**

The first and second sections that follow provide a brief review of respective sex differences in the individual-level and group-level sociocognitive competencies shown in Figure 2.3. The final section provides discussion of social motives and developmental issues.

### ***Individual-Level Modules***

As predicted, there are sex differences, largely favoring girls and women, in most, perhaps all, of the individual-level sociocognitive modules shown in Figure 2.3 (see also chapter 8). Relative to boys and men, girls and women show advantages for a number of basic language-related skills. More frequently than boys and men, girls and women show standard grammatical structure and a correct pronunciation of language-sounds in their utterances; have a better memory for words; are better at generating strings of words; and are better at discriminating basic language sounds (e.g., consonants and vowels) from one another (Block, Armott, Quigley, & Lynch, 1989; Halpern, 1992, 1997; Halpern & Wright, 1996; Hampson, 1990; Hyde & Linn, 1988; Kimura, 1999). Girls and women also show many fewer pauses (e.g., filled with "uhh") in their utterances than do boys and men (Hall, 1984), and, at the same time, boys and men manifest language-related disorders, such as stuttering, two to four times more frequently than do girls and women (Tallal, 1991).

Girls and women also show consistent advantages over boys and men in the ability to read facial expressions and nonverbal communication signals. The most ambitious and comprehensive study of these differences was conducted by Rosenthal and his colleagues (Rosenthal, Hall, DiMatteo, Rogers, & Archer, 1979; see also Buck, Savin, Miller, & Caul, 1972). The associated test--Profile of Nonverbal Sensitivity (PONS)--was initially administered to 492 high school

students, but in follow-up studies the entire PONS or portions of it were administered to more than 4,000 other individuals, including elementary and junior high school students, college students, and older adults from a variety of occupations. Testing was also done on three or more samples of individuals from Australia, Canada, Israel, and New Guinea and smaller numbers of individuals were assessed in Northern Ireland, Mexico, New Zealand, Hong Kong, West Germany, and Singapore.

Across these samples, girls and women showed an advantage over boys and men for accuracy in judging emotion cues-when the cues were assessed separately-based on facial expressions, body posture, and vocal intonation. The magnitude of the overall advantage of girls and women did not vary with age and was moderate in size; about 2 out of 3 girls and women outperformed the average same-age boy or man on these measures (Rosenthal et al., 1979). The advantage of girls and women was found in all nations in which three or more samples were obtained-Australia, Canada, the United States, Israel, and New Guinea--and was of the same general magnitude in all of these nations (Hall, 1984). When facial, body language, and vocal intonation cues are presented simultaneously, about 17 out of 20 girls and women are more accurate at decoding the emotion cues of another individual than is the average same-age boy or man (Hall, 1984). This finding is of considerable practical significance, as these combined cues represent a more accurate assessment of nonverbal decoding skills in "real world" settings.

Nonetheless, there are some contexts in which men are as skilled, perhaps more skilled, than women in reading facial expressions and some other cues (e.g., vocal intonation). It appears that men are relatively more sensitive to negative-emotion cues signaled by other men, especially anger, than they are to the same cues signaled by women or to more positive-emotion cues signaled by men (Rosenthal et al., 1979; Rotter & Rotter, 1988). Two studies conducted by Rotter and Rotter (1988) found that women were consistently more accurate than men in judging the emotion cues signaled by the facial expressions of other women and men, when these expressions conveyed the emotions of disgust, fear, or sadness. Men, in contrast, were more accurate than women in detecting an angry expression on the face of other men, especially if the expression was directed toward them. The latter finding might be interpreted as an evolved sensitivity to the facial cues associated with male-male competition.

Theory of mind goes at least one step beyond the ability to "read" facial expressions and other nonverbal communication cues (Baron-Cohen, 1995). Among other things (e.g., making inferences about the intentions of other people), theory of mind represents the ability to infer whether the emotions signaled by these facial expressions are or are not an accurate reflection of the actual emotional state of the individual. In other words, people often signal or suppress emotion cues independent of their actual emotional state (e.g., with social deception).

Sensitivity to the social and emotion cues signaled by nonverbal behavior and the ability to make inferences about the underlying emotional state of another individual are thus two relatively distinct classes of ability.

Sex differences research on theory of mind is less extensive and conclusive than the just described studies of language and sensitivity to facial and nonverbal communication signals. Most theory of mind studies have not assessed sex differences because, according to Baron-Cohen and colleagues, the associated tests are not sensitive enough to detect subtle individual differences, including sex differences (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997). A few studies, nonetheless, suggest an advantage of girls and women in the ability to make inferences about the emotional states of other people and to adjust their social behavior accordingly (Banerjee, 1997; Baron-Cohen et al., 1997; Happé, 1995). Moreover, it has been hypothesized that a lack of theory of mind is a defining characteristic of autism (Baron-Cohen, 1995) and three to four times more boys and men are diagnosed as autistic than are girls and women (Klinger & Dawson, 1996). Although not definitive, these studies suggest that a sex difference, favoring girls and women, may exist for certain aspects of theory of mind.

#### *Group-Level Modules*

Sex differences in patterns of relationships with kin have been discussed in a variety of contexts by Geary (1998) and Pasternak et al. (1997). The discussions here focus specifically on sex differences in the dynamics of in-group/out-group social psychology and adherence to group ideologies. Recall, on the basis of coalition-based male-male competition, the prediction is that boys and men will show more cohesive in-groups, including ideologically formed in-groups, and more hostility toward out-groups than girls and women. However, these differences are only anticipated during periods of group-level competition. Unfortunately, sex-differences research in this area is meager, in comparison to the quantity of studies on individual-level sociocognitive sex differences. The research that has been conducted suggests that boys and girls and men and women are more similar than different (Davis, Cheng, & Strube, 1996; Schaller, 1992). Both boys and girls as well as men and women readily form in-groups and out-groups and generally make judgments about in-group members that are more favorable than their judgments about out-group members (e.g., Schaller, 1992). Under conditions that implicitly or explicitly provide a reminder of one's mortality (e.g., being exposed to issues associated with death), both men and women show a marked increase in their endorsement of the in-group's social ideology and more negative attitudes toward people who question this ideology (Arndt et al., 1997).

Nonetheless, it appears that sex differences in the dynamics of in-group and out-group formation do emerge under some conditions and as early as the pre-school years (e.g., Benenson, 1993; Bugental, 2000; Davis et al., 1996; Yee & Brown, 1992). Relative to girls and women, boys and men appear to exert more

intense social pressures on in-group members to adhere to group norms and typical group behaviors. These differences are evident in childhood play (e.g., boys tease other boys more intensely about interacting with girls than vice versa) (Maccoby, 1988), in the context of competitive sports (Savin-Williams, 1987), and in attitudes in adulthood (e.g., toward homosexuality) (Geary, 1998). Moreover, boys and men appear to develop relatively more negative attitudes about out-group members during periods of competition and conflict and are less likely to compromise during conflict than are girls and women (Davis et al., 1996; Towson, Lerner, & de Carufel, 1981; Yee & Brown, 1992). In other words, in comparison to girls and women, boys and men appear to be relatively intolerant of in-group members who deviate from group norms and more readily develop agonistic attitudes and behaviors toward out-group members. There has been little research on sex differences in adherence to social ideologies during periods of group conflict and thus it is not currently known if sex differences exist on this dimension.

### *Social Motives and Development*

On the basis of the sex difference in hominid social structure, girls and women are predicted to favor greater levels of reciprocity and equality in social relationships--those motives associated with the maintenance of relationships with nonkin (Hartup & Stevens, 1997)--than are boys and men. On the basis of the general cross-species pattern of male-male competition over mates and because male-male competition has almost certainly been more intense than female-female competition throughout human evolution (Geary, 1998), the prediction is that boys and men will evince more dominance-related social motives than girls and women. Studies of these motives across age levels and societies support these predictions. The social relationships that develop among girls are more consistently communal--manifesting greater empathy, more concern for the well-being of other girls, more nurturing, intimacy, social/emotional support, concern for equality and so on--than are the relationships that develop among boys, whereas relationships among boys are more consistently instrumental or agentic--more concern for the establishment of dominance and control of group activities (e.g., Feingold, 1994; Knight & Chao, 1989; Maccoby, 1988; Savin-Williams, 1987; Whiting & Edwards, 1988).

As predicted in the developmental section, many of the sociocognitive sex differences are evident early in life, are manifested in social and play patterns, and some of these have been linked to prenatal exposure to sex hormones. For instance, a greater orientation of girls toward people is evident in infancy and likely results from and contributes to the sex differences in individual-level sociocognitive competencies (Haviland & Malatesta, 1981; McGuinness & Pribram, 1979). One indicator of orientation toward other people is the duration of eye contact. Haviland and Malatesta noted that "there is no doubt that girls and women establish and maintain eye contact more than boys and men. The earliest

age for which this is reported is one day” (Haviland & Malatesta, 1981, p. 189). Although many girls engage in group-level competition, as in team sports, many more boys than girls engage in these activities and by adolescence are more intensely focused in these contexts than are same-age girls (Lever, 1978; Savin-Williams, 1987). In fact, the sex difference in preferred social organization, that is, girls and women favoring dyadic interactions and boys and men favoring group-level interactions, is evident as early as 3 years (Benenson, 1993; Yee & Brown, 1992). The research of Berenbaum and Snyder (1995) suggests that the sex difference in this preferred social organization is influenced by prenatal exposure to male hormones, as appears to be the case with some other primates (Wallen, 1996).

## CONCLUSION

The principles of sexual selection provide a new and advantaged approach to the study of human cognitive sex differences. The primary advantages include a theoretical framework that enables us to systematically search for the connections and precursors to observed sex differences and the only perspective that allows these differences to be understood in the context of sex differences found in other species (Darwin, 1871). The latter is useful because the principles of sexual selection have provided a fruitful framework for the study of sex differences in literally hundreds of other species (Andersson, 1994). The evolutionary (e.g., male-male competition) and proximate (e.g., sex hormones) mechanisms associated with sexual selection are thus well understood. There is every reason to believe that these same principles will provide a useful tool for studying human cognitive sex differences (Gaulin, 1992; Geary, 1998). In fact, the mechanisms associated with sexual selection are arguably better understood than the mechanisms associated with other theoretical approaches to human sex differences. In any case, a complete understanding of human cognitive sex differences will require careful consideration of sexual, and in some cases natural, selection, even if other mechanisms (e.g., gender stereotypes) (Eagly, 1987) are also shown to contribute to these differences.

This chapter demonstrated why this is so. Rather than organizing sex differences in terms of empirical findings, the approach was to use a proposed taxonomy of evolved cognitive modules to provide an a priori framework for organizing what is known of sex differences in sociocognitive competencies (Geary, 1998). The framework was then combined with the principles of sexual selection and intrasexual competition, in particular, to make predictions about the loci of sex differences in sociocognitive competencies, including developmental sex differences. With respect to the latter, the specific prediction is that sex differences in intrasexual competition and intersexual choice will be mirrored in early sex differences in play styles, social motives, cognitive biases, and so forth, especially in slow developing species (Geary & Bjorklund, 2000). In theory, these

early biases enable boys and girls to practice and refine those physical, social, and cognitive competencies that were associated with the reproductive demands of our adult ancestors (Geary, 1999).

Existing empirical research is consistent with many of these predictions, such as the prediction--based on relational aggression and the hominid social structure--that girls and women will outperform boys and men on many of the sociocognitive competencies associated with individual relationships (e.g., reading facial expressions). A corollary prediction is that these sex differences will be evident developmentally and they in fact are: In infancy, girls show a greater orientation to other people and by 3 years of age favor a dyadic rather than a group-level social organization (Benenson, 1993; Haviland & Malatesta, 1981). In other cases, extant research was not conclusive. Sex differences, favoring girls and women, in theory of mind were predicted, but current studies do not provide definitive support for a sex difference in this area, although they are highly suggestive.

In short, sexual selection not only provides a framework for interpreting currently known sex differences, it also generates many testable predictions about other sex differences. As an example, future studies could easily pursue the prediction of a sex difference in theory of mind and the corollary prediction that any sex difference in theory of mind may vary with social context. For instance, if the hominid social structure and relational aggression resulted in a greater elaboration of theory of mind in our female than our male ancestors, then women should be especially skilled on theory of mind tasks that involve relationship formation and competition with other women. Similarly, if coalition-based male-male competition resulted in an in-group/out-group social psychology that facilitated this competition, then sex differences are expected in patterns of in-group formation and degree of hostility toward the out-group. Again, context is expected to be important in the demonstration of any such sex differences. Sex differences are expected to be the largest (e.g., in ease of coalition formation and willingness to compromise with the out-group) in contexts involving fairly large groups and competition over a prized resource (e.g., Sherif et al., 1961). Based on the assumption that the function of a long developmental period is to enable the practice and refinement of survival and reproduction related competencies, the just described sex differences are expected in childhood as well.

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