
Evolution and Developmental Sex Differences

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Abstract

From an evolutionary perspective, childhood is the portion of the life span during which individuals practice and refine those competencies that facilitate survival and reproduction in adulthood. Although the skeletal structure of these competencies appears to be inherent, social interaction and play flesh them out during childhood so that they are adapted to local conditions. Darwin's principles of sexual selection, including male-male competition over mates and female choice of mating partners, successfully explain the acquisition and expression of reproductive competencies in hundreds of species. When this perspective

is applied to humans, it predicts sex differences that are, in fact, found in the childhood activities of boys and girls and that reflect sex differences in reproductive strategies in adulthood. A few of these differences are described, along with cultural factors that modify their expression. The article closes with a brief discussion of the social and scientific implications.

Keywords

sex differences; sexual selection; development; childhood; culture

Sex differences are inherently interesting to the scientist and layperson alike. They always have been and always will be. Although

the existence of such differences has been debated in the past, the scientific issue today concerns the source of these differences. The prevailing view in psychology is that most sex differences result from children's adoption of gender roles, roles that reflect society-wide differences in the daily activities of men and women (Eagly, 1987). The goal here is not to provide a review or appraisal of this position, but rather to offer an alternative view of developmental sex differences, a view based on the principles of evolution (Darwin, 1871).

From an evolutionary perspective, cultural and ecological factors are expected to influence the expression of developmental sex differences, and a few of these influences are described in the final section. Before they are discussed, though, a basic evolutionary framework for understanding sex differences in general and developmental sex differences in particular is provided in the first section, and the second provides a few examples of the usefulness of this approach for understanding human developmental sex differences.

EVOLUTION AND DEVELOPMENT

Sexual Selection

One of Darwin's (1871) seminal contributions was the observation that evolutionary pressures often differ for males and females and that many of these differences center around the dynamics of reproduction. These pressures are termed sexual selection and typically result from males competing with one another for social status, resources, or territory—whatever is needed to attract mates—and from females' choice of mating partners (Andersson, 1994). Although the dynamics of male-male competition can vary across species and social and ecological conditions, one common result is the evolution of physical (see Fig. 1), cognitive, and behavioral sex differences. Females' choice of mates has been studied most extensively in birds, although it is also evident in insects, fish, reptiles, and mammals, including humans (Andersson, 1994; Buss, 1994). Females typically choose mates on the basis of indicators of physical, genetic, or behavioral fitness, that is, on the basis of traits that signal a benefit to them (e.g., provisioning) or their offspring (e.g., good genes). One example of the evolutionary result of female choice is shown in Figure 2; the long and symmetric tail feathers of the male hummingbird are an indicator of his physical and genetic health.

Male-male competition and female choice are most evident in species in which males devote most of their reproductive energies to attracting mates, and females provide most or all of the parental care (Trivers, 1972), a pattern found in nearly 97% of mammalian species (Clutton-Brock, 1991). As is the case with other mammals, women

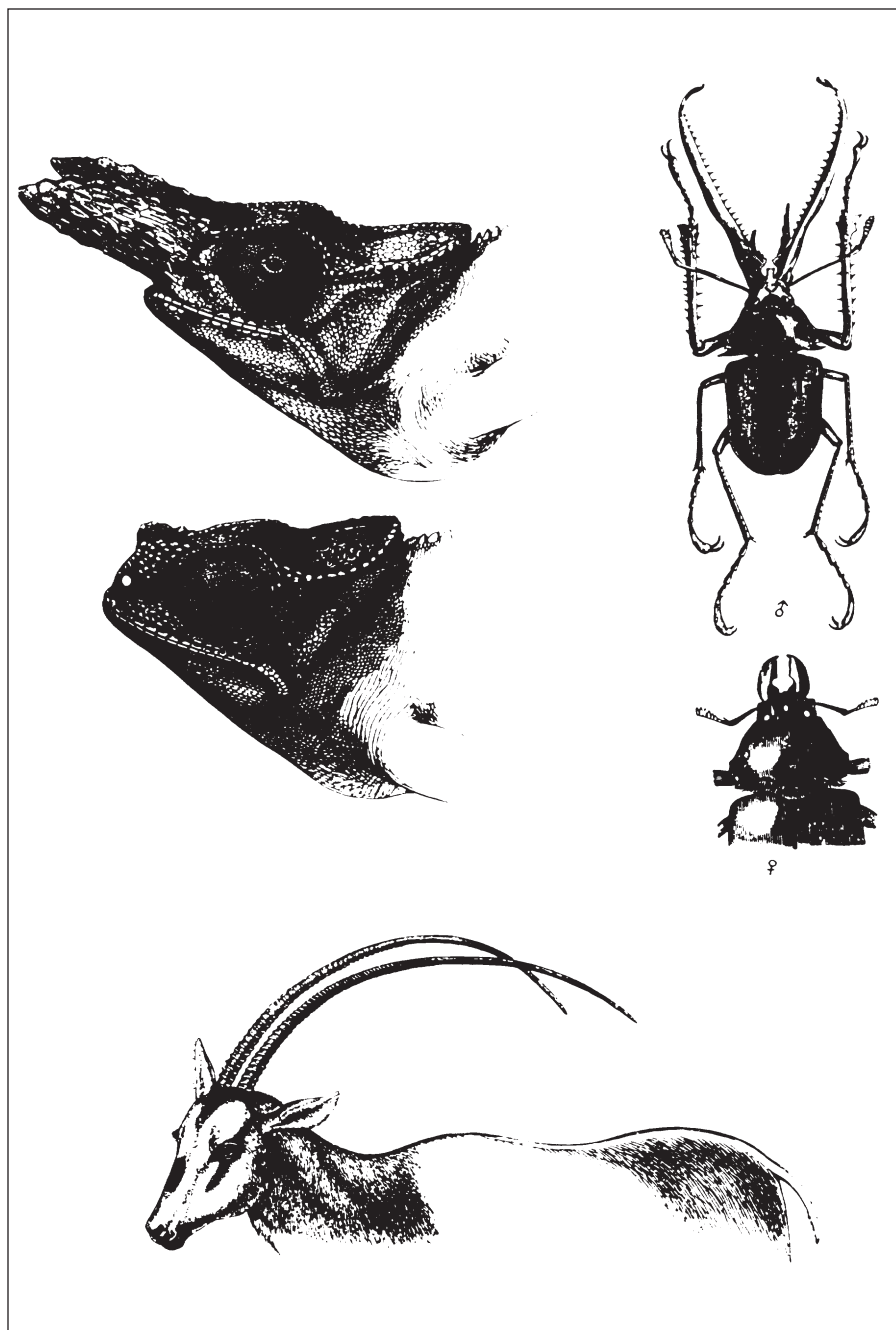


Fig. 1. Examples of sexually selected characteristics used in physical male-male competition. The pair in the upper left are the male (top) and female (bottom) of the *Chamaeleon bifurcus*; the pair in the upper right are the male and female of the beetle *Chiasognathus grantii*; at the bottom is a male *Oryx leucoryx*, a species of antelope (females do not have horns). From Darwin (1871, Vol. II, p. 35; Vol. I, p. 377; and Vol. II, p. 251, respectively). These exaggerated male characteristics are used in male-on-male aggression. For instance, two male *Oryx leucoryx* will compete by kneeling in front of each other, each then trying to maneuver the points of his horns under the body of his competitor. "If one succeeds in doing this, he suddenly springs up, throwing up his head at the same time, and can thus wound or perhaps even transfix his antagonist" (Darwin, 1871, Vol. II, pp. 251–252).

throughout the world invest more time and resources in the well-

being of their children than men do (Geary, 1998). Nonetheless, many



Fig. 2. Female (left) and male (right) hummingbirds (*Spathura underwoodi*). From Darwin (1871, Vol. II, p. 77). The long and symmetric tail feathers of the male appear to signal to the female that he has immune-system genes that can confer resistance to local parasites (e.g., worms). If she mates with this male, then her offspring will also be resistant to local parasites.

men do provide some investment in the well-being of their children, unlike most other mammalian males. Paternal care, in turn, results in female-female competition and male choice of mates, along with male-male competition and female choice of mates.

The sex difference in the level of parental investment, along with other features (see Geary, 1998), results in differences in the nature of male-male versus female-female competition, and in the criteria

used in mate choice (Geary, 1998). Throughout the world, men compete with one another for the control of culturally prized resources (e.g., status, money, or cows), and they often do so through physical contests (Keeley, 1996). Women compete with one another by means of relational aggression. They gossip, shun, and backbite their competitors (Crick, Casas, & Mosher, 1997). Both men and women want intelligent and cooperative spouses, but women more

than men focus on the cultural success (e.g., control of money or cows) of suitors and men more than women focus on physical attractiveness (indicators of fertility; Buss, 1994).

Development

Biologists study development by documenting species' life history and by discerning the function of childhood. Life history refers to the typical ages associated with developmental milestones, such as age of weaning and length of childhood. The function of childhood is to refine the competencies that will be needed to survive and reproduce in adulthood (Mayr, 1974). It appears that many cognitive and behavioral systems are initially skeletal in structure—the basic framework is inborn—but are fleshed out as juveniles play, explore the environment, and interact socially (Gelman, 1990). Fleshing out these competencies results in the refinement of those skills needed to survive and reproduce in the local ecology and social group.

Developmental sex differences are expected to the degree that reproductive demands differ for males and females in adulthood. In species in which male-male competition is more intense than female-female competition, the juvenile period is longer for males than for females. Male satin bowerbirds (*Ptilonorhynchus violaceus*), for instance, mature many years after females have matured. Although there is some physical competition, males largely compete behaviorally, through the construction of complex stick structures called bowers. (Females make their mate choices, in part, on the basis of the complexity of these bowers.) During development, "young males spend a great deal of time observing older males at their bower, and practice bower building and display behav-

iors 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. Thus, delayed maturation and associated play allow for the refinement of those physical, cognitive, and behavioral skills associated with reproductive demands in adulthood.

HUMAN DEVELOPMENTAL SEX DIFFERENCES

Play Patterns

Play, in one form or another, is found in most mammalian species. "The consensus that emerges from the scores of definitions is that play incorporates many physical components of adult behavior patterns, such as those used in aggression, but without their immediate functional consequences" (Walters, 1987, p. 360). Play provides delayed benefits because the individual practices those behaviors that are important for survival and reproduction in adulthood, as described earlier. Sex differences in play patterns are found in many species and mirror sex differences found in adulthood.

Like juveniles of other mammalian species, boys and girls exhibit sex differences in their play patterns, and these differences in play are a reflection of sex differences found in adulthood (Geary, 1998). One of the most consistently found differences is in the frequency and nature of rough-and-tumble play. Beginning at about 3 years of age, groups of boys engage in various forms of play fighting, such as wrestling, three to six times more frequently than groups of girls do. Boys also engage in group-level competitive play (e.g., football) more frequently than girls do. These patterns are found in every

culture in which play has been studied, are related to prenatal exposure to male hormones, and mirror the activities associated with primitive warfare (Keeley, 1996). The one-on-one and group-level play fighting of boys can be viewed as an evolved tendency to practice the competencies that were associated with male-male competition during human evolution (Geary, 1998).

Another sex difference, this one favoring girls, is in the frequency of play parenting (e.g., doll play): Play parenting is the norm in female primates and has been shown to significantly reduce the mortality rates of their first-born offspring. Again, this sex difference is found in all cultures in which play has been studied, is related to prenatal exposure to sex hormones, and mirrors the adult sex difference in investment in children. Play parenting can thus be understood as an evolved tendency to seek out activities that will enhance later parenting skills.

Social Development

Beginning in the preschool years and extending throughout the life span, girls and boys and women and men tend to segregate themselves into same-sex groups. One result is that boys and girls grow up in different social cultures. The tendency of boys to play fight and to organize themselves into competing groups is manifested in the context of the boys' culture. Social relationships among girls, in contrast, are more consistently communal: They manifest greater empathy; more concern for the well-being of other girls; and more nurturing, intimacy, and social and emotional support. In short, the social behavior of boys is focused on achieving status and dominance and developing coalitions for competing against groups of other boys. The social behavior of girls is

focused on developing and maintaining a network of personal relationships and social support. Similar sex differences have been found in our closest relative, the chimpanzee, suggesting that these are indeed evolved tendencies in humans (de Waal, 1993).

Nonetheless, girls and women can be quite competitive with one another. As noted earlier, this competition takes the form of relational aggression—attempting to disrupt the personal networks that are important to girls and women—and in adulthood, it is often associated with competition over resources (e.g., job promotion) and mates. As is the case with play fighting in boys, relational aggression emerges in the preschool years for girls and appears to be especially intense during early adolescence. It is likely, although not certain, that relational aggression has been shaped by sexual selection and in childhood is practice for later female-female competition.

CULTURAL AND ECOLOGICAL INFLUENCES

If the function of childhood is to adapt inherent skeletal competencies to local conditions, then cultural and ecological factors should influence the expression of developmental sex differences (Gelman, 1990; Mayr, 1974). Although research conducted within Western countries suggests that parents do not influence children's development as strongly as many people assume, cross-cultural studies suggest that there are important socialization influences on the expression (not creation) of developmental sex differences.

Although boys throughout the world engage in one-on-one and group-level competitive play, the nature and intensity of this play varies across cultures. The play

fighting of boys tends to be rougher in societies where male-on-male physical aggression is common in adulthood than in other societies. For instance, intergroup aggression occurs frequently among the Yanomamö Indians of South America, and young Yanomamö boys often play fight with clubs or bows and arrows, practices that are typically discouraged in suburban America. In such societies, boys' play fighting often involves inflicting physical pain and sometimes injury, and there are often social rules that discourage boys from expressing this pain. In other words, boys' play fighting is encouraged and channeled to increase the aggressiveness and physical endurance of boys, and decrease their sensitivity to the distress of other people. These practices prepare boys for the life-and-death male-male competition that they will experience as adults. In other societies, such as our own, boys also play fight, but this behavior is relatively subdued and symbolic, as in competitive sports.

In a study of 93 cultures, Low (1989) found that the socialization of girls and boys was systematically related to the cultures' social structures (e.g., stratified vs. nonstratified societies) and marriage systems (i.e., polygynous vs. monogamous). In nonstratified polygynous societies—where men could improve their social status and thus increase the number of women they could marry—the socialization of boys focused on fortitude, aggression, and industriousness, traits that would influence their cultural and reproductive success in adulthood. For these societies, there was a strong linear relation between the socialization of competitiveness in boys and the maximum harem size allowed within the society. The larger the maximum harem size, the more the competitiveness of boys was emphasized in parental socialization.

For girls, there was a relation between the amount of economic and political power held by women in the society and socialization practices. In societies where women could inherit property and hold political office, girls were socialized to be less obedient, more aggressive, and more achievement oriented than were girls who lived in societies in which men had control over economic and political resources. On the basis of these and other patterns, Low (1989) concluded that "there is thus some evidence that patterns of child training across cultures vary in ways predictable from evolutionary theory, differing in specifiable ways between the sexes, and varying with group size, marriage system, and stratification" (p. 318).

CONCLUSION

From an evolutionary perspective, early biases in the ways in which boys and girls orient themselves to other people, in their play patterns, and in how they interact with and explore the wider ecology are expected, and, in fact, such biases are found (Geary, 1998). They lead girls and boys to create different cultures for themselves, and within these cultures to engage in activities that prepare them for the adult life of our ancestors. At the same time, a long childhood and the associated sensitivity to environmental influences ensure that the differences between boys and girls and men and women are not fixed, but rather are responsive to changing social and ecological conditions.

The combination of biological biases and sensitivity to early environmental conditions has important scientific and social implications. For instance, although boys and men are biologically destined to compete, this competition need not be deadly nor even physical,

even if the evolutionary history of male-male competition was both physical and deadly (Keeley, 1996). One goal of psychological research, then, is to understand the social and ecological conditions that can push boys and men into deadly physical competition or to compete in ways that are socially beneficial (e.g., that lead to economic development). An evolutionary perspective on development highlights the importance of social and ecological factors in the expression of developmental sex differences and will provide an important theoretical framework for the study of the social and psychological aspects of these differences.

Recommended Reading

Buss, D.M. (1994). (See References)
 Darwin, C. (1871). (See References)
 Geary, D.C. (1998). (See References)
 Morbeck, M.E., Galloway, A., & Zihlman, A.L. (Eds.). (1997). *The evolving female: A life-history perspective*. Princeton, NJ: Princeton University Press.

Note

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References

- Andersson, M. (1994). *Sexual selection*. Princeton, NJ: Princeton University Press.
 Buss, D.M. (1994). *The evolution of desire: Strategies of human mating*. New York: Basic Books.
 Clutton-Brock, T.H. (1991). *The evolution of parental care*. Princeton, NJ: Princeton University Press.
 Collis, K., & Borgia, G. (1992). Age-related effects of testosterone, plumage, and experience on aggression and social dominance in juvenile male satin bowerbirds (*Ptilonorhynchus violaceus*). *Auk*, 109, 422-434.
 Crick, N.R., Casas, J.F., & Mosher, M. (1997). Relational and overt aggression in preschool. *Developmental Psychology*, 33, 579-588.
 Darwin, C. (1871). *The descent of man and selection in relation to sex* (2 vols.). London: J. Murray.
 de Waal, F.B.M. (1993). Sex differences in chimpanzee (and human) behavior: A matter of social values? In M. Hechter, L. Nadel, & R.E. Michod (Eds.), *The origin of values* (pp. 285-303). New York: Aldine de Gruyter.

- Eagly, A.H. (1987). *Sex differences in social behavior: A social-role interpretation*. Hillsdale, NJ: Erlbaum.
- Geary, D.C. (1998). *Male, female: The evolution of human sex differences*. Washington, DC: American Psychological Association.
- Gelman, R. (1990). First principles organize attention to and learning about relevant data: Number and animate-inanimate distinction as examples. *Cognitive Science*, 14, 79–106.
- Keeley, L.H. (1996). *War before civilization: The myth of the peaceful savage*. New York: Oxford University Press.
- Low, B.S. (1989). Cross-cultural patterns in the training of children: An evolutionary perspective. *Journal of Comparative Psychology*, 103, 311–319.
- Mayr, E. (1974). Behavior programs and evolutionary strategies. *American Scientist*, 62, 650–659.
- Trivers, R.L. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and the descent of man 1871–1971* (pp. 136–179). Chicago: Aldine Publishing.
- Walters, J.R. (1987). Transition to adulthood. In B.B. Smuts, D.L. Cheney, R.M. Seyfarth, R.W. Wrangham, & T.T. Struhsaker (Eds.), *Primate societies* (pp. 358–369). Chicago: University of Chicago Press.