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# **The Cognitive Animal**

## **Empirical and Theoretical Perspectives on Animal Cognition**

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Marc Bekoff and Colin Allen

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### The Value of Social Play

Progress in understanding animal cognition requires interdisciplinary collaboration among biologists, psychologists, cognitive scientists, neuroscientists, and philosophers. In our own case, as a biologist and a philosopher, our work has combined empirical and conceptual studies of social play. In this essay we describe how our personal interests have contributed to our cooperative efforts.

Our work is rooted in a series of long-term empirical studies of social play. When Marc Bekoff decided to study social play for his doctoral research, many people told him that it was a waste of time, for it was impossible to define and many others had tried to study it and failed. While this provided the perfect challenge for a graduate student who had the full support of his advisor, Michael W. Fox, Marc frankly thought that his research on play would end when he received his degree. He was very wrong indeed.

Social play is a fascinating topic because it combines many elements of cooperation, communication, and learning (see Pellis, chapter 52 in this volume), as well as providing a possible prototype for the evolution of morality (playing fair). According to the social intelligence hypothesis, intelligence is an adaptation for social living (Jolly 1966; Humphrey 1976; Byrne and Whiten 1988), which suggests that social play might be an excellent domain for the investigation of cognitive abilities in a variety of animal species (see also Power 2000; Burghardt 2002).

Marc's main interests have been in what animals do when they play (the structure of play), the development of play, how animals communicate their intentions to play, and what possible functions play may serve—why play has evolved. The animals he has studied in depth are all members of the family Canidae—domestic dogs, coyotes, wolves, foxes, and hybrids. The pri-

mary approach has been to take detailed notes while observing animals playing, along with videotaping them for later analysis. These early efforts clearly showed that there were species differences in social play as well as significant individual differences, even among littermates. Individual differences were especially apparent for animals of different social ranks. Sex differences were few. Marc also came to realize that there was something unique about how animals communicated their intentions to engage in or to continue social play, and became interested in Gregory Bateson's (Bateson 1955) ideas about metacommunication—communication about communication.

Species differences in social play among canids permit one to study in more detail how play is communicated. First it was shown that a specific play signal, the bow, was highly stereotyped and necessarily so. Detailed measures of the duration and form of bows (Bekoff 1977a) showed that they clearly were a ritualized action, the result of which is the performance of a clear and unambiguous signal. There was very little variability in bows; this made sense in that when canids and other animals play, they use behavior patterns from various other contexts, namely, predation, aggression, and reproduction, and individuals need to know that “this is play and not attempts at predation, aggression, or reproduction.”

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### Ethology Meets Philosophy

Work on conceptual issues has always been carried on alongside Marc's empirical work. Bekoff and Byers (1981) formalized a well-received working definition of play. Subsequently Marc worked with philosopher Dale Jamieson, who put him in touch with Colin Allen, leading to collaboration on a series of articles on conceptual issues in play, bridging the gap between ethological and philosophical inquiries (Bekoff

and Allen 1992, 1998; Allen and Bekoff 1994, 1997).

Philosophical interest in ethology often centers on why it may or may not be scientifically useful and important for ethologists to ascribe meaning and content to animal communication (Dennett 1987), and how to characterize concepts in non-human animals. When Colin met Marc Hauser, Dorothy Cheney, and Robert Seyfarth at the University of California, Los Angeles, he rapidly became fascinated by the problems of describing animal concepts (Allen and Hauser 1991; Allen 1999) and specifying what the vocalizations of vervet monkeys mean (Cheney and Seyfarth 1990; Allen 1992a; Allen and Saidel 1998). Saying that a call means “Leopard coming!” potentially tells us about the function of that call, but articulating the correct relationship between meaning and biological function is a far from trivial task; indeed it is a task that some philosophers dismissed as hopeless, albeit on questionable grounds (Allen 1992b; Allen and Bekoff 1995, 1997). These interests converged with Marc’s interests on the questions of how to define play (Allen and Bekoff 1994) and how to describe the function and content of the signals used during play (Bekoff and Allen 1992).

While we all seem to be able to recognize play when we see it, the problem of defining play is illustrated by the fact that many behavioral biologists have been tempted to define it in terms of what it is *not*—it is not aggression, predation, or reproduction—rather than what it *is*. Despite expressing doubt about the merits of providing a definition of play, Bekoff and Byers (1981) went ahead and attempted to give one. Rather than use this short essay to go into the details of definitions, we refer readers to Bekoff and Allen (1998) for a summary. However, the position we take is that working definitions are just that—*working* definitions (see also Fagen 1981 and Burghardt 2002). Such definitions are bound to be imperfect in the absence of the empirical research needed to refine them. Thus we criticized Rosenberg’s (1990) effort to call the biological

study of play into question on the basis of his definition of play, which required the players to possess a concept of pretense, which in turn required second-order intentionality—a restrictive definition that would rule out playing even in young human children (Allen and Bekoff 1994). Rosenberg’s views were based upon arguments about the impossibility of accurately specifying the meaning of animal concepts; identical arguments were criticized by Allen (1992b) and Allen and Bekoff (1994).

Although the difficulties of specifying meaning should not be understated, assigning meanings to animal signals can help us to understand their functions (however, see Rendall and Owren, chapter 38 in this volume, for a contrary view). For instance, because the behavior patterns seen during social play also occur during aggression, predation, or sexual behavior, the signals exchanged during play might be characterized as telling others “I want to play,” “This is still play no matter what I am going to do to you,” or “This is still play regardless of what I just did to you.” These interpretations raise questions that have not yet been answered, such as whether canids or other animals are capable of attributing intentional states to each other during play—perhaps a limited application of a “theory of mind” in a specific domain (Allen and Bekoff 1997, chapter 6).

Nevertheless, conceiving the meaning of play signals in this way prompted a study that re-analyzed the production of play bows during play sequences by infant canids (domestic dogs, wolves, and coyotes) (Bekoff 1995). It was found that play bows were used nonrandomly, especially when biting accompanied by rapid side-to-side shaking of the head was performed. This kind of biting takes place during serious aggressive and predatory encounters and can easily be misinterpreted if its meaning is not modified by a play signal.

Individuals also engage in role reversing and self-handicapping (Bekoff and Allen 1998) to maintain social play. Each can serve to reduce

asymmetries between the interacting animals and foster the reciprocity that is needed for play to occur. Self-handicapping occurs when an individual performs a behavior that might compromise her on himself. For example, a coyote might not bite her play partner as hard as she can, or she might not play as vigorously as she can. Watson and Croft (1996) found that red-necked wallabies adjusted their play to the age of their partner. When a partner was younger, the older animal adopted a defensive, flat-footed posture, and pawing rather than sparring occurred. In addition, the older player was more tolerant of its partner's tactics and took the initiative in pro-longing interactions.

Role reversing occurs when a dominant animal performs an action during play that would not normally occur during real aggression. For example, a dominant animal might voluntarily not roll over on his back during fighting, but would do so while playing. In some instances role reversing and self-handicapping might occur together. For example, a dominant individual might roll over while playing with a subordinate animal and inhibit the intensity of a bite. From a functional perspective, self-handicapping and role reversing, similar to using specific play invitation signals or altering behavioral sequences, might signal an individual's intention to continue to play.

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### The Meaning of Play Signals

There are likely to be questions about whether information about intentions is really being signaled during play sequences. Even if signals indicate to a human observer an individual's intention to play, it is a separate question whether they do so to a conspecific playmate. Here our work has been guided by Ruth Millikan's (1984) ideas about signal content. Bekoff and Allen (1992) argue that play bows meet the definition of an "intentional icon," the basic kind of meaningful signal in Millikan's theory, because play

bows have the function of conveying information about intentions to play partners. Unlike other approaches to a theory of mind, Millikan's approach allows play signals to have this role even if canids, or other animals, lack a fully general capacity for reasoning about the mental states of others (Allen and Bekoff 1997). Such a functional approach to meaning can seem less natural than the more familiar approaches to meaning based on folk psychology (e.g., Dennett 1987), which tend to assume fully conscious, rational processing of meanings. However, these differing approaches may in fact be complementary, representing different forms of explanation of animal behavior (Allen, in press).

Whether the animals are psychologically aware of these meanings requires an investigation of their cognitive abilities with respect to signal function. Such a study might be attempted in connection with how they handle erroneous or false signals such as those that might occur during deception (Allen and Hauser 1993; Allen and Bekoff 1997). However, in the specific context of play, such studies are likely to be very difficult. There is little evidence that play signals are used to deceive others in canids or other species. Cheaters are unlikely to be chosen as play partners because others can simply refuse to play with them and choose others, and limited data on captive and wild infant coyotes show that cheaters have difficulty getting other young coyotes to play (Bekoff, personal observations). It is also not known if individuals select play partners based on what they have observed during play by others.

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### Neurobiological Bases of Sharing Intentions

It is useful to ask how a play bow (or other action) might provide the recipient with information about the sender's intentions. Perhaps an individual's experiences with play can promote learning about the intentions of others. Perhaps it is possible that the recipient shares the inten-

tions (beliefs, desires) of the sender based on the recipient's own prior experiences of situations in which he or she performed play bows.

Recent research suggests a neurobiological basis for sharing intentions. "Mirror neurons," found in macaques, fire when a monkey executes an action and also when the monkey observes the same action being performed by another monkey (Gallese et al., chapter 56 in this volume). Frith and Frith (1999) report the results of neural imaging studies in humans that suggest a neural basis for one form of social intelligence: understanding others' mental states (mental state attribution). More comparative data are needed to determine if mirror neurons (or their functional equivalents) are found in other taxa and if they might actually play a role in the sharing of intentions between individuals engaged in an ongoing social interaction such as play. Neuroimaging studies will also be useful.

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### **Why Cooperate and Play Fairly? Fine-Tuning Play**

Playtime generally is a safe time during which transgressions are accepted by others, especially when one player is a youngster who is not yet a competitor for social status, food, or mates. Individuals must cooperate with one another when they play; they must negotiate agreements to play (Bekoff 1995). Fagen (1993, p. 192) noted that "Levels of cooperation in play of juvenile primates may exceed those predicted by simple evolutionary arguments." The highly cooperative nature of play has evolved in many other species (Fagen 1981; Bekoff 1972, 1995; Bekoff and Allen 1998; Power 2000; Burghardt 2002). Detailed studies of play in various species indicate that individuals trust others to maintain the rules of the game (Bekoff and Byers 1998). While there have been numerous discussions of cooperative behavior in animals (e.g., Axelrod 1984; Ridley 1996; Dugatkin 1997), none has considered social play—the requirement for coopera-

tion and reciprocity—and its possible role in the evolution of social morality, namely, behaving fairly (Bekoff 2001).

Individuals of different species appear to fine-tune ongoing play sequences to maintain a play mood and to prevent play from escalating into real aggression. Detailed analyses of films show that there are subtle and fleeting movements and rapid exchanges of eye contact that suggest that players are exchanging information on the run, from moment to moment, to make certain everything is all right—that this is still play. Why might they do this? Play in most species does not take up much time and energy (Bekoff and Byers 1998; Power 2000), and in some species only minimal amounts of social play during short windows of time early in development are necessary to produce socialized individuals. [For example, two 20-minute play sessions with another dog, twice a week, are sufficient for domestic dogs from 3 to 7 weeks of age (Scott and Fuller 1965).] Play appears to be very important in social, cognitive, and/or physical development, and may also be important for training youngsters for unexpected circumstances (Spinka et al. 2001). We know of no data concerning the actual benefits of social play in terms of survival and reproductive success. However, it generally is assumed that short-term and long-term benefits vary from species to species, among different age groups, and between the sexes within a species. No matter what the functions of play may be, there seems to be little doubt that it has some benefits and that the absence of play can have devastating effects on social development (Power 2000; Burghardt 2002).

During early development there is a small time window when individuals can play without being responsible for their own well-being. This time period is generally referred to as the socialization period, for this is when species-typical social skills are learned most rapidly. It is important for individuals to engage in at least some play. All individuals need to play and there is a pre-

mium for playing fairly if one is to be able to play at all. If individuals do not play fairly, they may not be able to find willing play partners. As indicated, in coyotes, for example, youngsters are hesitant to play with an individual who does not play fairly or with an individual whom they fear (Bekoff 1977b). In many species, individuals also show play partner preferences, and it is possible that these preferences are based on the trust that individuals place in one another.

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### **Social Play and Social Morality: Some Possible Connections between Structure and Function**

Bekoff (2001) suggested that during social play, while individuals are having fun in a relatively safe environment, they learn ground rules that are acceptable to others—how hard they can bite, how roughly they can interact—and how to resolve conflicts. He argues that there is a premium on playing fairly (see Pellis, chapter 52 in this volume, for a discussion of the 50:50 rule in social play) and trusting others to do so as well. What could be a better atmosphere in which to learn social skills than during social play, where there are few penalties for transgressions? Individuals might also generalize codes of conduct learned in playing with specific individuals to other group members and to other situations, such as food sharing, hunting, and grooming (Dugatkin and Bekoff submitted).

To stimulate further comparative research on a wide array of species and the development of suitable models (Dugatkin and Bekoff submitted), Bekoff (2001) offered the hypothesis that social morality, in this case behaving fairly, is an adaptation that is shared by many mammals, not only by nonhuman and human primates. Behaving fairly evolved because it helped young animals acquire social (and other) skills needed as they matured into adults.

Group-living animals may provide insight into the evolution and expression of animal morality. Mech (1970) reported that the number of wolves

who could live together in a coordinated pack was governed by the number of wolves with whom individuals could closely bond (social attraction factor) balanced against the number of individuals from whom an individual could tolerate competition (social competition factor). Codes of conduct, and consequentially packs, broke down when there were too many wolves. Whether pack structure was affected by individuals behaving fairly or unfairly is not known, but this would be a valuable topic for future research in wolves and other social animals.

In summary, we argue that mammalian social play is a useful behavioral phenotype on which to concentrate in order to learn more about the evolution and development of cognitive skills and perhaps social morality. There is strong selection for playing fairly because most if not all individuals benefit from adopting this behavioral strategy (and group stability may be also be fostered). Numerous mechanisms (play invitation signals, variations in the sequence of actions performed during play compared with other contexts, self-handicapping, role reversing) have evolved to facilitate the initiation and maintenance of social play in numerous mammals—to keep others engaged—so that an agreement to play fairly and the resulting benefits of doing so can be readily achieved.

Future comparative research that considers the nature and details of the social exchanges that are needed for animals to engage in play—reciprocity and cooperation—will undoubtedly produce data that bear on the questions raised in this brief essay. These are empirical questions for which there are few comparative data. Learning about the taxonomic distribution of animal morality involves answering many difficult questions. Perhaps it will turn out that the best explanation for existing data in some taxa is that some individuals do indeed on some occasions modify their behavior to play fairly.

Play may be a unique category of behavior in that asymmetries are tolerated more than they

are in other social contexts. Play cannot occur if the individuals choose not to engage in the activity, and the equality (or symmetry) needed for play to continue makes it different from other forms of seemingly cooperative behavior (e.g., hunting, care giving, grooming, food sharing). This sort of egalitarianism is thought to be a precondition for the evolution of social morality in humans (Bekoff 2001).

All in all, our interdisciplinary collaboration has been a fruitful one in which each of us has brought to the table different skills and perspectives on common interests, namely, the evolution and development of cognitive skills in general and more specifically, how animals communicate their intentions to play and engage in the cooperative exchanges needed to maintain this activity. Social play is difficult to characterize but easily recognized, and its wide taxonomic distribution suggests that there is much potential for future comparative cognitive work, but that it will require more interdisciplinary collaboration.

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