Animal Emotions: Exploring Passionate Natures

MARC BEKOFF

CURRENT INTERDISCIPLINARY RESEARCH PROVIDES COMPELLING EVIDENCE THAT MANY ANIMALS EXPERIENCE SUCH EMOTIONS AS JOY, FEAR, LOVE, DESPAIR, AND GRIEF—WE ARE NOT ALONE

Do elephants feel joy, chimpanzees grief and depression, and dogs happiness and dejection? People disagree about the nature of emotions in nonhuman animal beings (hereafter animals), especially concerning the question of whether any animals other than humans can feel emotions (Ekman 1998). Pythagoreans long ago believed that animals experience the same range of emotions as humans (Coates 1998), and current research provides compelling evidence that at least some animals likely feel a full range of emotions, including fear, joy, happiness, shame, embarrassment, resentment, jealousy, rage, anger, love, pleasure, compassion, respect, relief, disgust, sadness, despair, and grief (Skutch 1996, Poole 1996, 1998, Panksepp 1998, Archer 1999, Cabanac 1999, Bekoff 2000).

The expression of emotions in animals raises a number of stimulating and challenging questions to which relatively little systematic empirical research has been devoted, especially among free-ranging animals. Popular accounts (e.g., Masson and McCarthy's *When Elephants Weep*, 1995) have raised awareness of animal emotions, especially among nonscientists, and provided scientists with much useful information for further systematic research. Such books have also raised hackles among many scientists for being "too soft"—that is, too anecdotal, misleading, or sloppy (Fraser 1996). However, Burghardt (1997a), despite finding some areas of concern in Masson and McCarthy's book, wrote: "I predict that in a few years the phenomena described here will be confirmed, qualified, and extended" (p. 23). Fraser (1996) also noted that the book could serve as a useful source for motivating future systematic empirical research.

Researchers interested in exploring animal passions ask such questions as: Do animals experience emotions? What, if anything, do they feel? Is there a line that clearly separates those species that experience emotions from those that do not? Much current research follows Charles Darwin's (1872; see also Ekman 1998) lead, set forth in his book *The Expression of the Emotions in Man and Animals*. Darwin argued that there is continuity between the emotional lives of humans and those of other animals, and that the differences among many animals are in degree rather than in kind. In *The Descent of Man and Selection in Relation to Sex*, Darwin claimed that "the lower animals, like man, manifestly feel pleasure and pain, happiness, and misery" (p. 448).

Naturalizing the study of animal emotions

Field research on behavior is of paramount importance for learning more about animal emotions, because emotions have evolved in specific contexts. Naturalizing the study of animal emotions will provide for more reliable data because emotions have evolved just as have other behavioral phenotypes (Panksepp 1998). Categorically

Marc Bekoff (e-mail: marc.bekoff@colorado.edu) is a professor in the Department of Environmental, Population, and Organismic Biology at the University of Colorado, Boulder, CO 80309–0334.

denying emotions to animals because they cannot be studied directly does not constitute a reasonable argument against their existence. The same concerns could be mounted against evolutionary explanations of a wide variety of behavior patterns, stories that rely on facts that are impossible to verify precisely.

Here I discuss various aspects of animal emotions, provide examples in which researchers provide strong evidence that animals feel different emotions, and suggest that researchers revise their agenda concerning the study of passionate nature. In particular, I suggest that scientists pay closer attention to anecdotes along with empirical data and philosophical arguments as heuristics for future research. I agree with Panksepp (1998), who claims that *all* points of view must be tolerated as long as they lead to new approaches that expand human understanding of animal emotions. The rigorous study of animal emotions is in its infancy, and research will benefit greatly from pluralistic perspectives.

My goal is to convince skeptics that a combination of "hard" and "soft" interdisciplinary research is necessary to advance the study of animal emotions. I argue that researchers have already gathered ample evidence (and that data are continually accumulating) to support arguments that at least some animals have deep, rich, and complex emotional lives. I also posit that those who claim that few if any animals have deep, rich, and complex emotional lives—that they cannot feel such emotions as joy, love, or grief—should share the burden of proof with those who argue otherwise.

What are emotions?

Emotions can be broadly defined as psychological phenomena that help in behavioral management and control. Yet, some researchers argue that the word "emotion" is so general that it escapes any single definition. Indeed, the lack of agreement on what the word "emotion" means may well have resulted in a lack of progress in learning about them. Likewise, no single theory of emotions captures the complexity of the phenomena called emotions (Griffiths 1997, Panksepp 1998). Panksepp (1998, p. 47ff) suggests that emotions be defined in terms of their adaptive and integrative functions rather than their general input and output characteristics. It is important to extend our research beyond the underlying physiological mechanisms that mask the richness of the emotional lives of many animals and learn more about how emotions serve them as they go about their daily activities.

Generally, scientists and nonscientists alike seem to agree that emotions are real and that they are extremely important, at least to humans and, perhaps, to some other animals. While there is not much consensus on the nature of animal emotions, there is no shortage of views on the subject. Followers of René Descartes and of B. F. Skinner believe that animals are robots that become conditioned to respond automatically to stimuli to which they are exposed. The view of animals as machines explains so much about what they do that it is easy to understand why many people have adopted it.

However, not everyone accepts that animals are merely automatons, unfeeling creatures of habit (Panksepp 1998). Why then are there competing views on the nature of animal emotions? In part, this is because some people view humans as unique animals, created in the image of God. According to this view, humans are the only rational beings who are able to engage in self-reflection. Within contemporary scientific and philosophical traditions, there still is much debate about which animals are self-reflective.

Rollin (1990) notes that, at the end of the 1800s, animals "lost their minds." In other words, in attempts to emulate the up-and-coming "hard sciences," such as physics and chemistry, researchers studying animal behavior came to realize that there was too little in studies of animal emotions and minds that was directly observable, measurable, and verifiable, and chose instead to concentrate on behavior because overt actions could be seen, measured objectively, and verified (see also Dror 1999).

Behaviorists, whose early leaders included John B. Watson and B. F. Skinner, frown on any kind of talk about animal (and in some cases human) emotions or mental states because they consider it unscientific. For behaviorists, following the logical positivists, only observable behavior constitutes legitimate scientific data. In contrast to behaviorists, other researchers in the fields of ethology, neurobiology, endocrinology, psychology, and philosophy have addressed the challenge of learning more about animal emotions and animal minds and believe that it is possible to study animal emotions and minds (including consciousness) objectively (Allen and Bekoff 1997, Bekoff and Allen 1997, Panksepp 1998, Bekoff 2000, Hauser 2000a).

Most researchers now believe that emotions are not simply the result of some bodily state that leads to an action (i.e., that the conscious component of an emotion *follows* the bodily reactions to a stimulus), as postulated in the late 1800s by William James and Carl Lange (Panksepp 1998). James and Lange argued that fear, for example, *results* from an awareness of the bodily changes (heart rate, temperature) that were stimulated by a fearful stimulus.

Following Walter Cannon's criticisms of the James–Lange theory, nowadays researchers believe that there is a mental component that does not have to *follow* a bodily reaction (Panksepp 1998). Experiments have shown that drugs producing bodily changes like those accompanying an emotional experience—for example, fear—do not produce the same type of conscious experience of fear (Damasio 1994). Also, some emotional reactions occur faster than would be predicted if they depended on a prior bodily change that is communicated via the nervous system to appropriate areas of the brain (Damasio 1994).

The nature and neural bases of animal passions: Primary and secondary emotions

It is hard to watch elephants' remarkable behavior during a family or bond group greeting ceremony, the birth of a new family member, a playful interaction, the mating of a relative, the rescue of a family member, or the arrival of a musth male, and not imagine that they feel very strong emotions which could be best described by words such as joy, happiness, love, feelings of friendship, exuberance, amusement, pleasure, compassion, relief, and respect. (Poole 1998, pp. 90–91)

The emotional states of many animals are easily recognizable. Their faces, their eyes, and the ways in which they carry themselves can be used to make strong inferences about what they are feeling. Changes in muscle tone, posture, gait, facial expression, eye size and gaze, vocalizations, and odors (pheromones), singly and together, indicate emotional responses to certain situations. Even people with little experience observing animals usually agree with one another on what an animal is most likely feeling. Their intuitions are borne out because their characterizations of animal emotional states predict future behavior quite accurately.

Primary emotions, considered to be basic inborn emotions, include generalized rapid, reflexlike ("automatic" or hard-wired) fear and fight-or-flight responses to stimuli that represent danger. Animals can perform a primary fear response such as avoiding an object, but they do not have to recognize the object generating this reaction. Loud raucous sounds, certain odors, and objects flying overhead often lead to an inborn avoidance reaction to all such stimuli that indicate "danger." Natural selection has resulted in innate reactions that are crucial to individual survival. There is little or no room for error when confronted with a dangerous stimulus.

Primary emotions are wired into the evolutionary old limbic system (especially the amygdala), the "emotional" part of the brain, so named by Paul MacLean in 1952 (MacLean 1970, Panksepp 1998). Structures in the limbic system and similar emotional circuits are shared among many different species and provide a neural substrate for primary emotions. In his three-brain-in-one (triune brain) theory, MacLean (1970) suggested that there was the reptilian or primitive brain (possessed by fish, amphibians, reptiles, birds, and mammals), the limbic or paleomammalian brain (possessed by mammals), and the neocortical or "rational" neomammalian brain (possessed by a few mammals, such as primates), all packaged in the cranium. Each is connected to the other two but each also has its own capacities. While the limbic system seems to be the main area of the brain in which many emotions reside, current research (LeDoux 1996) indicates that all emotions are not necessarily packaged into a single system, and there may be more than one emotional system in the brain.

Secondary emotions are those that are experienced or felt, evaluated, and reflected on. Secondary emotions involve higher brain centers in the cerebral cortex. Although most emotional responses appear to be generated unconsciously, consciousness allows an individual to make connections between feelings and action and allows for variability and flexibility in behavior.

The study of animal minds: Cognitive ethology

The Nobel laureate, Niko Tinbergen (1951, 1963), identified four areas with which ethological investigations should be concerned, namely, evolution, adaptation (function), causation, and development. His framework also is useful for those interested in animal cognition (Jamieson and Bekoff 1993, Allen and Bekoff 1997), and can be used to study animal emotions.

Cognitive ethologists want to know how brains and mental abilities evolved—how they contribute to survival—and what selective forces resulted in the wide variety of brains and mental abilities that are observed in various animal species. In essence, cognitive ethologists want to know what it is like to be another animal. Asking what it is like to be another animal requires humans to try to think as they do, to enter into their worlds. By engaging in these activities much can be learned about animal emotions. In an attempt to expand Tinbergen's framework to include the study of animal emotions and animal cognition, Burghardt (1997b) suggested adding a fifth area that he called *private experience*. Burghardt's aim is to understand the perceptual worlds and mental states of other animals, research that Tinbergen thought was fruitless because he felt that it was impossible to know about the subjective or private experiences of animals.

Emotion and cognition

Perhaps the most difficult unanswered question about animal emotions concerns how emotions and cognition are linked, how emotions are felt, or reflected on, by humans and other animals. Researchers also do not know which species have the capacity to engage in conscious reflection about emotions and which do not. A combination of evolutionary, comparative, and developmental approaches set forth by Tinbergen and Burghardt, combined with comparative studies of the neurobiological and endocrinological bases of emotions in various animals, including humans, carries much promise for future work concerned with relationships between cognition and individuals' experiences of various emotions.

Damasio (1999a, 1999b) provides a biological explanation for how emotions might be felt in humans. His explanation might also apply to some animals. Damasio suggests that various brain structures map both the organism and external objects to create what he calls a second-order representation. This mapping of the organism and the object most likely occurs in the thalamus and cingulate cortices. A sense of self in the act of knowing is created, and the individual knows "to whom this is happening." The "seer" and the "seen," the "thought" and the "thinker" are one and the same.

Clearly, an understanding of behavior and neurobiology is necessary to understand how emotions and cognition are linked. It is essential that researchers learn as much as possible about animals' private experiences, feelings, and mental states. The question of whether and how animals' emotions are experienced presents a challenge for future research.

Private minds

One problem that plagues studies of animal emotions and cognition is that others' minds are private entities (for detailed discussion of what the privacy of other minds entails, see Allen and Bekoff 1997, p. 52ff). Thus, humans do not have direct access to the minds of other individuals, including other humans.

While it is true that it is very difficult, perhaps impossible, to know all there is to know about the personal or subjective states of other individuals, this does not mean that systematic studies of behavior and neurobiology cannot be undertaken that help us learn more about others' minds. These include comparative and evolutionary analyses (Allen and Bekoff 1997, Bekoff and Allen 1997). Nonetheless, with respect to emotions, there seem to be no avenues of inquiry or scientific data strong enough to convince some skeptics that other animals possess more than some basic primary emotions. Even if future research were to demonstrate that similar (or analogous) areas of a chimpanzee's or dog's brain showed the same activity as a human brain when a person reports that they are happy or sad, some skeptics hold tightly to the view that it is impossible to know what individuals are truly feeling, and that therefore these studies are fruitless. They claim that just because an animal acts "as if" they are happy or sad, humans cannot say more than merely "as if," and such "as if" statements provide insufficient evidence. The renowned evolutionary biologist, George Williams (1992, p. 4) claimed: "I am inclined merely to delete it [the mental realm] from biological explanation, because it is an entirely private phenomenon, and biology must deal with the publicly demonstrable." (See also Williams 1997 for a stronger dismissal of the possibility of learning about mental phenomena from biological research.)

Nonetheless, many people, including researchers studying animal emotions, are of the opinion that humans cannot be the only animals that experience emotions (Bekoff 2000). Indeed, it is unlikely that secondary emotions evolved only in humans with no precursors in other animals. Poole (1998), who has studied elephants for many years, notes (p. 90): "While I feel confident that elephants feel some emotions that we do not, and vice versa, I also believe that we experience many emotions in common."

It is very difficult to deny categorically that no other animals enjoy themselves when playing, are happy when reuniting, or become sad over the loss of a close friend. Consider wolves when they reunite, their tails wagging loosely to and fro and individuals whining and jumping about. Consider also elephants reuniting in a greeting celebration, flapping their ears and spinning about and emitting a vocalization known as a "greeting rumble." Likewise, think about what animals are feeling when they remove themselves from their social group at the death of a friend, sulk, stop eating, and die. Comparative, evolutionary, and interdisciplinary research can shed much light on the nature and taxonomic distribution of animal emotions.

Charles Darwin and the evolution of animal emotions

> *It is remarkable how often the sounds that birds make suggest the emotions that we might feel in similar circumstances: soft notes like lullabies while calmly warming their eggs or nestlings; mournful cries while helplessly watching an intruder at their nests; harsh or grating sounds while threatening or attacking an enemy...Birds so frequently respond to events in tones such as we might use that we suspect their emotions are similar to our own. (Skutch 1996, pp. 41–42)*

> *As long as some creature experienced joy, then the condition for all other creatures included a fragment of joy. (Dick 1968, p. 31)*

Charles Darwin is usually credited with being the first scientist to give serious attention to the study of animal emotions. In his books *On the Origin of Species* (1859), *The Descent of Man and Selection in Relation to Sex* (1871), and *The Expression of the Emotions in Man and Animals* (1872), Darwin argued that there is continuity between humans and other animals in their emotional (and cognitive) lives; that there are transitional stages among species, not large gaps; and that the differences among many animals are differences in degree rather than in kind.

Darwin applied the comparative method to the study of emotional expression. He used six methods to study emotional expression: observations of infants; observations of the insane, whom he judged to be less capable of hiding their emotions than other adults; judgments of facial expressions created by electrical stimulation of facial muscles; analyses of paintings and sculptures; cross-cultural comparisons of expressions and gestures, especially of people distant from Europeans; and observations of animal expressions, especially those of domestic dogs.

A broad evolutionary and comparative approach to the study of emotions will help researchers learn more about the taxonomic distribution of emotions. For example, reptiles, such as iguanas, maximize sensory pleasure (Cabanac 1999, 2000, Burghardt 2000). Cabanac (1999) found that iguanas prefer to stay warm rather than venture out into the cold to get food, whereas amphibians such as frogs do not show such behavior. Neither do fish. Iguanas experience what is called "emotional fever" (a rise in body temperature) and tachycardia (increased heart rate), physiological responses that are associated with pleasure in other vertebrates, including humans. Cabanac postulated that the first mental event to emerge into consciousness was the ability of an individual to experience the sensations of pleasure and displeasure. Cabanac's research suggests that reptiles experience basic emotional states, and that the ability to have an emotional life emerged between amphibians and early reptiles. His findings are consistent with some of MacLean's (1970) theory of the triune brain.

Joy, happiness, and play

Examples of animal emotions are abundant in popular and scientific literature (Masson and McCarthy 1995, Panksepp 1998, Bekoff 2000). Social play is an excellent example of a behavior in which many animals partake, and one that they seem to enjoy immensely. Individuals become immersed in the activity, and there seems to be no goal other than to play. As Groos (1898) pointed out, animals at play appear to feel incredible freedom.

Animals seek play out relentlessly and when a potential partner does not respond to a play invitation they often turn to another individual (Bekoff 1972, Fagen 1981, Bekoff and Byers 1998). Specific play signals also are used to initiate and to maintain play (Bekoff 1977, 1995, Allen and Bekoff 1997). If all potential partners refuse their invitation, individual animals will play with objects or chase their own tails. The play mood is also contagious; just seeing animals playing can stimulate play in others. Consider my field notes of two dogs playing.

> *Jethro runs towards Zeke, stops immediately in front of him, crouches or bows on his forelimbs, wags his tail, barks, and immediately lunges at him, bites his scruff and shakes his head rapidly from side-to-side, works his way around to his backside and mounts him, jumps off, does a rapid bow, lunges at his side and slams him with his hips, leaps up and bites him neck, and runs away. Zeke takes wild pursuit of Jethro and leaps on his back and bites his muzzle and then his scruff, and shakes his head rapidly from side-to-side. They then wrestle with one another and part, only for a few minutes. Jethro walks slowly over to Zeke, extends his paw toward Zeke's head, and nips at his ears. Zeke gets up and jumps on Jethro's back, bites him, and grasps him around his waist. They then fall to the ground and wrestle with their mouths. Then they chase one another and roll over and play.*

I once observed a young elk in Rocky Mountain National Park, Colorado, running across a snow field, jumping in the air and twisting his body while in flight, stopping, catching his breath and doing it again and again. There was plenty of grassy terrain around but he chose the snow field. Buffaloes will also follow one another and playfully run onto and slide across ice, excitedly bellowing "Gwaaa" as they do so (Canfield et al. 1998).

It seems more difficult to deny that these animals were having fun and enjoying themselves than to accept that they enjoyed what they were doing. Neurobiological data support inferences based on behavioral observations. Studies of the chemistry of play support the idea that play is enjoyable. Siviy (1998; see Panksepp 1998 for extensive summaries) has shown that dopamine (and perhaps serotonin and norepinephrine) is important in the regulation of play, and that large regions of the brain are active during play. Rats show an increase in dopamine activity when anticipating the opportunity to play (Siviy 1998). Panksepp (1998) has also found a close association between opiates and play and claims that rats enjoy being playfully tickled.

Neurobiological data are essential for learning more about whether play truly is a subjectively pleasurable activity for animals as it seems to be for humans. Siviy's and Panksepp's findings suggest that it is. In light of these neurobiological ("hard") data concerning possible neurochemical bases for various moods, in this case joy and pleasure, skeptics who claim that animals do not feel emotions might be more likely to accept the idea that enjoyment could be a motivator for play behavior.

Grief

> *Never shall I forget watching as, three days after Flo's death, Flint climbed slowly into a tall tree near the stream. He walked along one of the branches, then stopped and stood motionless, staring down at an empty nest. After about two minutes he turned away and, with the movements of an old man, climbed down, walked a few steps, then lay, wide eyes staring ahead. The nest was one which he and Flo had shared a short while before Flo died...in the presence of his big brother [Figan], [Flint] had seemed to shake off a little of his depression. But then he suddenly left the group and raced back to the place where Flo had died and there sank into ever deeper depression...Flint became increasingly lethargic, refused food and, with his immune system thus weakened, fell sick. The last time I saw him alive, he was hollow-eyed, gaunt and utterly depressed, huddled in the vegetation close to where Flo had died...the last short journey he made, pausing to rest every few feet, was to the very place where Flo's body had lain. There he stayed for several hours, sometimes staring and staring into the water. He struggled on a little further, then curled up—and never moved again. (Goodall 1990, pp. 196–197)*

Many animals display grief at the loss or absence of a close friend or loved one. One vivid description of the expression of grief is offered above—Goodall (1990) observing Flint, an eight and one-half-year old chimpanzee, withdraw from his group, stop feeding, and finally die after his mother, Flo, died. The Nobel laureate Konrad Lorenz observed grief in geese that was similar to grief in young children. He provided the following account of goose grief: "A greylag goose that has lost its partner shows all the symptoms that John Bowlby has described in young human children in his famous book *Infant Grief*...the eyes sink deep into their sockets, and the individual has an overall drooping experience, literally letting the head hang...." (Lorenz 1991, p. 251).

Other examples of grief are offered in Bekoff (2000). Sea lion mothers, watching their babies being eaten by killer whales, squeal eerily and wail pitifully, lamenting their loss. Dolphins also have been observed struggling to save a dead infant. Elephants have been observed to stand guard over a stillborn baby for days with their head and ears hanging down, quiet and moving slowly as if they are depressed. Orphan elephants who have seen their mothers being killed often wake up screaming. Poole (1998) claims that grief and depression in orphan elephants is a real phenomenon. McConnery (quoted in McRae 2000, p. 86) notes of traumatized orphaned gorillas: "The light in their eyes simply goes out, and they die." Comparative research in neurobiology, endocrinology, and behavior is needed to learn more about the subjective nature of animal grief.

Romantic love

Courtship and mating are two activities in which many animals regularly engage. Many animals seem to fall in love with one another just as humans do. Heinrich (1999) is of the opinion that ravens fall in love. He writes (Heinrich 1999, p. 341): "Since ravens have long-term mates, I suspect that they fall in love like us, simply because some internal reward is required to maintain a long-term pair bond." In many species, romantic love slowly develops between potential mates. It is as if partners need to prove their worth to the other before they consummate their relationship.

Würsig (2000) has described courtship in southern right whales off Peninsula Valdis, Argentina. While courting, Aphro (female) and Butch (male) continuously touched flippers, began a slow caressing motion with them, rolled towards each other, briefly locked both sets of flippers as in a hug, and then rolled back up, lying side-by-side. They then swam off, side-by-side, touching, surfacing, and diving in unison. Würsig followed Butch and Aphro for about an hour, during which they continued their tight travel. Würsig believes that Aphro and Butch became powerfully attracted to each other, and had at least a feeling of "after-glow" as they swam off. He asks, could this not be leviathan love?

Many things have passed for love in humans, yet we do not deny its existence, nor are we hesitant to say that humans are capable of falling in love. It is unlikely that romantic love (or any emotion) first appeared in humans with no evolutionary precursors in animals. Indeed, there are common brain systems and homologous chemicals underlying love that are shared among humans and animals (Panksepp 1998). The presence of these neural pathways suggests that if humans can feel romantic love, then at least some other animals also experience this emotion.

Embarrassment

Some animals seem to feel embarrassment; that is, they hope to cover up some event and the accompanying feeling. Goodall (2000) observed what could be called embarrassment in chimpanzees. When Fifi's oldest child, Freud, was five and a half years old, his uncle, Fifi's brother Figan, was the alpha male of the chimpanzee community. Freud always followed Figan; he hero-worshipped the big male. Once, as Fifi groomed Figan, Freud climbed up the thin stem of a wild plantain. When he reached the leafy crown, he began swaying wildly back and forth. Had he been a human child, we would have said he was showing off. Suddenly the stem broke and Freud tumbled into the long grass. He was not hurt. He landed close to Goodall, and as his head emerged from the grass, she saw him look over at Figan—had he noticed? If he had, he paid no attention but went on grooming. Freud very quietly climbed another tree and began to feed.

Hauser (2000b) observed what could be labeled embarrassment in a male rhesus monkey. After copulating, the male strutted away and accidentally fell into a ditch. He stood up and quickly looked around. After sensing that no other monkeys saw him tumble, he marched off, back high, head and tail up, as if nothing had happened. Once again, comparative research in neurobiology, endocrinology, and behavior is needed to learn more about the subjective nature of embarrassment.

Studying animal emotions

The best way to learn about the emotional lives of animals is to spend considerable time carefully studying them—conducting comparative and evolutionary ethological, neurobiological, and endocrinological research—and to resist critics' claims that anthropomorphism has no place in these efforts. To claim that one cannot understand elephants, dolphins, or other animals because we are not "one of them" leaves us nowhere. It is important to try to learn how animals live in their own worlds, to understand their perspectives (Allen and Bekoff 1997, Hughes 1999). Animals evolved in specific and unique situations and it discounts their lives if we only try to understand them from our own perspective. To be sure, gaining this kind of knowledge is difficult, but it is not impossible. Perhaps so little headway has been made in the study of animal emotions because of a fear of being "nonscientific." In response to my invitation to contribute an essay to my forthcoming book on animal emotions (Bekoff 2000), one colleague wrote: "I'm not sure what I can produce, but it certainly won't be scientific. And I'm just not sure what I can say. I've not studied animals in natural circumstances and, though interested in emotions, I've 'noticed' few. Let me think about this." On the other hand, many other scientists were very eager to contribute. They believed that they could be scientific and at the same time use other types of data to learn about animal emotions; that is, that it is permissible for scientists to write about matters of the heart (although at least one prominent biologist has had trouble publishing such material; Heinrich 1999, p. 322).

Biocentric anthropomorphism and anecdote: Expanding science with care

> *...we are obliged to acknowledge that* all psychic interpretation of animal behavior must be on the analogy of human experience....*Whether we will or no, we must be anthropomorphic in the notions we form of what takes place in the mind of an animal. (Washburn 1909, p. 13)*

The way human beings describe and explain the behavior of other animals is limited by the language they use to talk about things in general. By engaging in anthropomorphism—using human terms to explain animals' emotions or feelings—humans make other animals' worlds accessible to themselves (Allen and Bekoff 1997, Bekoff and Allen 1997, Crist 1999). But this is not to say that other animals are happy or sad in the same ways in which humans (or even other conspecifics) are happy or sad. Of course, I cannot be absolutely certain that Jethro, my companion dog, is happy, sad, angry, upset, or in love, but these words serve to explain what he might be feeling. However, merely referring acontextually to the firing of different neurons or to the activity of different muscles in the absence of behavioral information and context is insufficiently informative. Using anthropomorphic language does not have to discount the animal's point of view. Anthropomorphism allows other animals' behavior and emotions to be accessible to us. Thus, I maintain that we can be *biocentrically anthropomorphic* and do rigorous science.

To make the use of anthropomorphism and anecdote more acceptable to those who feel uncomfortable describing animals with such words as happy, sad, depressed, or jealous, or those who do not think that mere stories about animals truly provide much useful information, Burghardt (1991) suggested the notion of "critical anthropomorphism," in which various sources of information are used to generate ideas that may be useful in future research. These sources include natural history, individuals' perceptions, intuitions, feelings, careful descriptions of behavior, identifying with the animal, optimization models, and previous studies. Timberlake (1999) suggested a new term, "theomorphism," to lead us away from the pitfalls of anthropomorphism. Theomorphism is animal-centered and "is based on convergent information from behavior, physiology, and the results of experimental manipulations" (Timberlake 1999, p. 256). Theomorphism is essentially "critical anthropomorphism" and does not help us overcome the ultimate necessity for using human terms to explain animal behavior and emotions.

Burghardt and others feel comfortable expanding science carefully to gain a better understanding of other animals. However, Burghardt and other scientists who openly support the usefulness of anthropomorphism are not alone (see Crist 1999). Some scientists, as Rollin (1989) points out, feel very comfortable attributing human emotions to, for example, the companion animals with whom they share their homes. These researchers tell stories of how happy Fido (a dog) is when they arrive at home, how sad Fido looks when they leave him at home or take away a chew bone, how Fido misses his buddies, or how smart Fido is for figuring out how to get around an obstacle. Yet, when the same scientists enter their laboratories, dogs (and other animals) become objects, and talking about their emotional lives or how intelligent they are is taboo.

One answer to the question of why dogs (and other animals) are viewed differently "at work" and "at home" is that "at work," dogs are subjected to a wide variety of treatments that would be difficult to administer to one's companion. This is supported by recent research. Based on a series of interviews with practicing scientists, Phillips (1994, p. 119) reported that many of them construct a "distinct category of animal, the 'laboratory animal,' that contrasts with namable animals (e.g., pets) across every salient dimension...the cat or dog in the laboratory is perceived by researchers as ontologically different from the pet dog or cat at home."

The importance of pluralistic interdisciplinary research: "Hard" science meets "soft" science

A broad and motivated assault on the study of animal emotions will require that researchers in various fields—ethology, neurobiology, endocrinology, psychology, and philosophy—coordinate their efforts. No one discipline will be able to answer all of the important questions that still need to be dealt with in the study of animal emotions. Laboratory-bound scientists, field researchers, and philosophers must share data and ideas. Indeed, a few biologists have entered into serious dialogue with philosophers and some philosophers have engaged in field work (Allen and Bekoff 1997). As a result of these collaborations, each has experienced the others' views and the bases for the sorts of arguments that are offered concerning animal emotions and cognitive abilities. Interdisciplinary research is the rule rather than the exception in numerous scientific disciplines, and there is no reason to believe that these sorts of efforts will not help us learn considerably more about the emotional lives of animals.

Future research must focus on a broad array of taxa, and not only give attention to those animals with whom we are familiar (e.g., companion animals) or those with whom we are closely related (nonhuman primates), animals to whom many of us freely attribute secondary emotions and a wide variety of moods. Much information can be collected on the companion animals with whom we are so familiar, primarily because we are so familiar with them (Sheldrake 1995, 1999). Species differences in the expression of emotions and perhaps what they feel like also need to be taken into account. Even if joy and grief in dogs are not the same as joy and grief in chimpanzees, elephants, or humans, this does not mean that there is no such thing as dog joy, dog grief, chimpanzee joy, or elephant grief. Even wild animals and their domesticated relatives may differ in the nature of their emotional lives.

Many people believe that experimental research in such areas as neurobiology constitutes more reliable work and generates more useful ("hard") data than, say, ethological studies in which animals are "merely" observed. However, research that reduces and minimizes animal behavior and animal emotions to neural firings, muscle movements, and hormonal effects will not likely lead us significantly closer to an understanding of animal emotions. Concluding that we will know most if not all that we can ever learn about animal emotions when we have figured out the neural circuitry or hormonal bases of specific emotions will produce incomplete and perhaps misleading views concerning the true nature of animal and human emotions.

All research involves leaps of faith from available data to the conclusions we draw when trying to understand the complexities of animal emotions, and each has its benefits and shortcomings. Often, studies of the behavior of captive animals and neurobiological research is so controlled as to produce spurious results concerning social behavior and emotions because animals are being studied in artificial and impoverished social and physical environments. The experiments themselves might put individuals in thoroughly unnatural situations. Indeed, some researchers have discovered that many laboratory animals are so stressed from living in captivity that data on emotions and other aspects of behavioral physiology are tainted from the start (Poole 1997).

Field work also can be problematic. It can be too uncontrolled to allow for reliable conclusions to be drawn. It is difficult to follow known individuals, and much of what they do cannot be seen. However, it is possible to fit free-ranging animals with devices that can transmit information on individual identity, heart rate, body temperature, and eye movements as the animals go about their daily activities. This information is helping researchers to learn more about the close relationship between animals' emotional lives and the behavioral and physiological factors that are correlated with these emotions.

It is essential that researchers have direct experience with the animals being studied. There are no substitutes for ethological studies. Although neurobiological data (including brain imaging) are very useful for understanding the underlying mechanisms of the behavior patterns from which inferences about emotions are made, behavior is primary; neural systems subserve behavior (Allen and Bekoff 1997). In the absence of detailed information on behavior, especially the behavior of wild animals living in the environments in which they have evolved or in which they now reside, any theory of animal emotions will be incomplete. Without detailed information on behavior, and a deep appreciation of the complexities and nuances of the myriad ways in which animals express what they feel, we will never come to terms with the challenges that are presented to us.

Sharing the burden of proof

In the future, skeptics should be required to mount serious defense of their position and share the burden of proof with those who accept that many animals do indeed experience myriad emotions. No longer will it be acceptable to claim that "yes, chimpanzees or ravens *seem* to love one another" or that "elephants *seem* to feel grief" and then present innumerable reasons—"we can never *really* know that animals feel emotions"—why this cannot be so. Explanations about the existence of animal emotions often have as good a foundation as many other explanations that we readily accept (e.g., claims about evolution that cannot be rigorously verified). I and others readily accept that in some instances the emotions we attribute to animals (and humans) might not be realistic pictures of their inner lives (as expressed in overt behavior and perhaps supported by neurobiological data), but that in other cases they might well be.

There is also the problem of reconciling "common sense" with data from ethological, neurobiological, and endocrinological research and philosophical arguments. Many branches of science use anecdotes to develop research projects that produce "data" (the plural of anecdote is data). Allowing stories of animal emotions to motivate research that begins with the premise that many other animals *do* have rich emotional lives will help us learn more about them. We truly can ask such questions as do animals love one another, do they mourn the loss of friends and loved ones, do they resent others, or can they be embarrassed (Bekoff 2000).

Meeting the devil

Panksepp (1998) provides a useful thought experiment at the end of his encyclopedic survey of emotions. Imagine that you are faced with making a devil's choice concerning the existence of animal emotions. You must answer correctly the question of whether or not other mammals have internally experienced emotional feelings. If you give the wrong answer you will follow the devil home. In other words, the stakes are high. Panksepp asks how many scientists would deny under these circumstances that at least some animals have feelings. Likely, few.

The challenging future

> *To affirm, for example, that scallops 'are conscious of nothing', that they get out of the way of potential*

> *predators without experiencing them as such and when they fail to do so, get eaten alive without (quite possibly) experiencing pain'...is to leap the bounds of rigorous scholarship into a maze of unwarranted assumptions, mistaking human ignorance for human knowledge. (Sheets-Johnstone 1998, p. 291)*

Clearly, there is much disagreement about the emotional lives of other animals. The following questions can be used to set the stage for learning more about the evolution and expression of animal emotions: Our moods move us, so why not other animals? Emotions help us to manage and regulate our relationships with others, so why not for other animals? Emotions are important for humans to adapt to specific circumstances, so why not for other animals? Emotions are an integral part of human life, so why not for other animals?

Current research suggests that no one single theory of emotions can explain all of the psychological phenomena that are called "emotions." Panksepp claims (1998, p. 7), "To understand the basic emotional operating systems of the brain, we have to begin relating incomplete sets of neurological facts to poorly understood psychological phenomena that emerge from many interacting brain activities." There is no doubt that there is continuity between the neurobehavioral systems that underlie human and nonhuman emotions, that the differences between human and animals emotions are, in many instances, differences in degree rather than differences in kind.

By remaining open to the idea that many animals have rich emotional lives, even if we are wrong in some cases, little truly is lost. By closing the door on the possibility that many animals have rich emotional lives, even if they are very different from our own or from those of animals with whom we are most familiar, we will lose great opportunities to learn about the lives of animals with whom we share this wondrous planet.

The future holds many challenges and perhaps surprises for those who want to learn more about animal emotions. The rigorous study of animal emotions will require harnessing the best possible resources. These resources include researchers in various scientific disciplines who provide "hard data" and anecdotes (Bekoff 2000), other scholars who study animals, nonacademics who observe animals and tell stories, and the animals themselves. There is ample room for hard and soft science in the study of animal emotions. There are many worlds beyond human experience. There are no substitutes for listening to, and having direct experiences with, other animals.

Acknowledgments

I thank Colin Allen for comments on an ancestral draft of this essay and Jane Goodall for discussing many of these issues with me. Bernard Rollin, Donald Griffin, Rebecca Chasan, Janice Moore, Steve Siviy, and an anonymous referee provided numerous helpful comments for which I am deeply grateful.

References cited

Allen C, Bekoff M. 1997. Species of Mind: The Philosophy and Biology of Cognitive Ethology. Cambridge (MA): MIT Press.

Archer J. 1999. The Nature of Grief: The Evolution and Psychology of Reactions to Loss. New York: Routledge.

Bekoff M. 1972 The development of social interaction, play, and metacommunication in mammals: An ethological perspective. Quarterly Review of Biology 47: 412–434.

______. 1977. Social communication in canids: Evidence for the evolution of a stereotyped mammalian display. Science 197: 1097–1099.

______. 1995. Play signals as punctuation: The structure of social play in canids. Behaviour 132: 419–429.

______, ed. 2000. The Smile of a Dolphin: Remarkable Accounts of Animal Emotions. New York: Random House/Discovery Books.

Bekoff M, Allen C. 1997. Cognitive ethology: Slayers, skeptics, and proponents. Pages 313–334 in Mitchell RW, Thompson N, Miles L, eds. Anthropomorphism, Anecdote, and Animals: The Emperor's New Clothes? Albany (NY): SUNY Press.

Bekoff M, Byers JA. eds. 1998. Animal Play: Evolutionary, Comparative, and Ecological Approaches. New York: Cambridge University Press.

Burghardt GM. 1991. Cognitive ethology and critical anthropomorphism: A snake with two heads and hognose snakes that play dead. Pages 53–90 in Ristau CA, ed. Cognitive Ethology: The Minds of Other Animals—Essays in Honor of Donald R. Griffin. Hillsdale (NJ): Lawrence Earlbaum Associates.

______. 1997a. Would Darwin weep? Review of Masson and McCarthy's When Elephants Weep: The Emotional Lives of Animals. Contemporary Psychology 42: 21–23.

______. 1997b. Amending Tinbergen: A fifth aim for ethology. Pages 254–276 in Mitchell RW, Thompson N, Miles L, eds. Anthropomorphism, Anecdote, and Animals: The Emperor's New Clothes? Albany (NY): SUNY Press.

______. 2000. Staying close. Pages 163–165 in Bekoff M, ed. The Smile of a Dolphin: Remarkable Accounts of Animal Emotions. New York: Random House/Discovery Books.

Cabanac M. 1999. Emotion and phylogeny. Journal of Consciousness Studies 6: 176–190.

______. 2000. In a fever. Pages 194–197 in Bekoff M, ed. The Smile of a Dolphin: Remarkable Accounts of Animal Emotions. New York: Random House/Discovery Books.

Canfield J, Hansen MV, Becker M, Kline C. 1998. Chicken Soup for the Pet Lover's Soul. Deerfield (FL): Health Communications.

Coates P. 1998. Nature: Western Attitudes Since Ancient Times. Berkeley (CA): University of California Press.

Crist E. 1999. Images of Animals: Anthropomorphism and Animal Mind. Philadelphia (PA): Temple University Press.

Darwin C. 1859 On the Origin of Species By Means of Natural Selection. London: Murray.

______. 1871. The Descent of Man and Selection in Relation to Sex. Reprint, New York: Random House, 1936.

______. 1872. The Expression of the Emotions in Man and Animals, 3rd ed. Reprint, New York: Oxford University Press, 1998.

Damasio A. 1994. Descartes' Error: Emotion, Reason, and the Human Brain. New York: Avon.

______. 1999a. How the brain creates the mind. Scientific American 281: 112–117.

______. 1999b. The Feeling of What Happens: Body and Emotion in the Making of Consciousness. New York: Harcourt Brace.

Dick PK. 1968. Do Androids Dream of Electric Sheep? Reprint, New York: Ballantine Books, 1996.

Dror OE. 1999. The affect of experiment: The turn to emotions in Anglo-American physiology, 1900–1940. Isis 90: 205–237.

Ekman P. 1998. Introduction to C Darwin's The Expression of the Emotions in Man and Animals, Third edition. New York: Oxford University Press.

Fagen RM. 1981. Animal Play Behavior. New York: Oxford University Press.

Fraser D. 1996. Review of Masson and McCarthy's When Elephants Weep: The Emotional Lives of Animals. Animal Behaviour 51: 1190–1193.
Goodall J. 1990. Through a Window. Boston: Houghton-Mifflin.
______. 2000. Pride goeth before a fall. Pages 166–167 in Bekoff M, ed. The Smile of a Dolphin: Remarkable Accounts of Animal Emotions. New York: Random House/Discovery Books.
Groos K. 1898. The Play of Animals. London: D. Appleton.
Griffiths P. 1997. What Emotions Really Are: The Problem of Psychological Categories. Chicago (IL): University of Chicago Press.
Hauser M. 2000a. Wild Minds. New York: Henry Holt.
______. 2000b. If monkeys could blush. Pages 200–201 in Bekoff M, ed. The Smile of a Dolphin: Remarkable Accounts of Animal Emotions. New York: Random House/Discovery Books.
Heinrich B. 1999. Mind of the Raven: Investigations and Adventures with Wolf-Birds. New York: Cliff Street Books.
Hughes H. 1999. Sensory Exotica: A World Beyond Human Experience. Cambridge (MA): MIT Press.
Jamieson D, Bekoff M. 1993. On aims and methods of cognitive ethology. Philosophy of Science Association 2: 110–124
LeDoux J. 1996. The Emotional Brain: The Mysterious Underpinnings of Emotional Life. New York: Touchstone.
Lorenz KZ. 1991. Here I Am—Where Are You? New York: Harcourt Brace Jovanovich.
MacLean P. 1970. The Triune Brain in Evolution: Role in Paleocerebral Functions. New York: Plenum Press.
Masson J, McCarthy S. 1995. When Elephants Weep: The Emotional Lives of Animals. New York: Delacorte Press.
McRae M. 2000. Central Africa's orphaned gorillas: Will they survive the wild? National Geographic 197 (2): 84–97.
Panksepp J. 1998. Affective Neuroscience. New York: Oxford University Press.
Phillips MT. 1994. Proper names and the social construction of biography: The negative case of laboratory animals. Qualitative Sociology 17: 119–142.
Poole J. 1996. Coming of Age With Elephants: A Memoir. New York: Hyperion.
______. 1998. An exploration of a commonality between ourselves and elephants. Etica & Animali (9/98): 85–110.
Poole TB. 1997. Happy animals make good science. Laboratory Animals 31: 116–124.
Rollin B. 1989. The Unheeded Cry: Animal Consciousness, Animal Pain, and Science. New York: Oxford University Press.
______. 1990. How the animals lost their minds: Animal mentation and scientific ideology. Pages 375–393 in Bekoff M, Jamieson D, eds. Interpretation and Explanation in the Study of Animal Behavior: Vol. I, Interpretation, Intentionality, and Communication. Boulder (CO): Westview Press.
Sheets-Johnstone M. 1998. Consciousness: A natural history. Journal of Consciousness Studies 5: 260–294.
Sheldrake R. 1995. Seven Experiments that Could Change the World. New York: Riverhead Books.
______. 1999. Dogs that Know When Their Owners are Coming Home—and Other Unexplained Powers of Animals. New York: Crown.
Siviy S. 1998. Neurobiological substrates of play behavior: Glimpses into the structure and function of mammalian playfulness. Pages 221–242 in Bekoff M, Byers JA, eds. Animal Play: Evolutionary, Comparative, and Ecological Perspectives. New York: Cambridge University Press.
Skutch A. 1996. The Minds of Birds. College Station (TX): Texas A&M University Press.
Timberlake W. 1999. Biological behaviorism. Pages 243–284 in O'Donohue W, Kitchener R, eds. Handbook of Behaviorism. New York: Academic Press.
Tinbergen N. 1951. The Study of Instinct. Reprint, New York: Oxford University Press, 1989.
______. 1963 On aims and methods of ethology. Zeitschrift für Tierpsychologie 20: 410–433.
Washburn MF. 1909. The Animal mind: A Text-book of Comparative Psychology. London: Macmillan.
Williams GC. 1992. Natural Selection: Domains, Levels, and Challenges. New York: Oxford University Press.
______. 1997. The Pony Fish's Glow. New York: Basic Books.
Würsig B. 2000. Leviathan love. Pages 62–65 in Bekoff M, ed. The Smile of a Dolphin: Remarkable Accounts of Animal Emotions. New York: Random House/Discovery Books.