2 Crotalomorphism: A Metaphor for Understanding Anthropomorphism by Omission

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The Story of Country Blue

When foreign students come to study at the University of Tennessee, the Center for International Education at the university presents them with a story, paraphrased as follows, to help them understand and deal with their new culture.

People from a country called Blue normally wear blue clothes, blue hats, and blue sunglasses. Houses are blue and so are the cars and streets. Country Blue borders country Yellow where people wear yellow clothes, yellow hats, and yellow sunglasses. Houses as well as cars and street are yellow in country Yellow. These two countries are internally peaceful, but have conflicts with each other. They view the customs and policies of the other country as bizarre and evil. One day, a diplomat from Blue decided to visit Yellow, learn about their customs and traditions, and write an extensive article to his fellow Blue citizens explaining how people in Yellow view the world. He was convinced that they were not evil, they just saw the world in a different way. Therefore, the Blue diplomat put on yellow clothes, a yellow hat, and yellow sunglasses. After three months living in Yellow, the Blue diplomat returned to his country and reported that the citizens in Yellow were not bad, bizarre, or stupid. His article claimed that in country Yellow life was actually very nice and Green!

This tale characterizes someone trying to understand another culture who neglected to consider a basic limitation: his own colored glasses. These he did not, or perhaps could not, remove. In an even more profound way, our human glasses are ingrained in us, and are very hard to remove (if possible at all). Nevertheless, if we are aware of having biased spectacles, we can attempt to address their effects upon us. In order to understand the cognitive accomplishments of a bee or beetle, squid, or chimpanzee, we need to evaluate how they perceive *their* world. In doing so, technology can assist us, but we need to constantly remind ourselves that we are using our human senses and human-based technology, and are processing the information with a human brain.

Like the Poor, Anthropomorphism Will Always Be with Us

Anthropomorphism is defined as the attribution of human properties to nonhuman entities. Such entities can be supernatural (gods) or animate or inanimate nature. The problem with anthropomorphism is that it often leads to the attribution to nonhumans of properties that they do not possess. It is but an extension of the problems facing anyone trying to understand another human culture, as in the Blue/Yellow example, or actually, the experiences of any person other than yourself. The problems inherent in using overt behavior to infer what other people or animals experience was recognized by Romanes and the early comparative psychologists (Burghardt 1985a), but they sought ways of surmounting the problem. After several decades, however, psychologists and ethologists came to regard anthropomorphism as a serious error that must be avoided at any cost. When Griffin's writings, *as a scientist* (Griffin 1978) seemed to be encouraging unfettered and untestable speculation about consciousness and awareness in nonhuman animals, the critical reaction was swift. It reached its zenith in the book by Kennedy (1992), who, nevertheless admitted that the tendency to be anthropomorphic seems endemic to human beings and can never be eliminated.

Some recent attempts look more closely at what anthropomorphism really is and how it operates. Lockwood (1989) argued that not all anthropomorphic attributions were equal. For example, two kinds of anthropomorphism (allegorical and personification) are restricted to nonscientific writing and therefore are not a problem in science. Two others, which Lockwood called "superficial" and "explanatory," have potentially harmful consequences in science, and these were the main culprits for Kennedy. Lockwood also identified a fifth kind of

anthropomorphism, applied, which he considered a legitimate strategy that had been used by authorities such as Darwin: the use of the personal perspective to convey what it is like to be another living being.

Anthropomorphism can be further demystified by showing that it is a legitimate and perhaps particularly creative way to do science if it is used to develop hypotheses that can be tested in a rigorous manner (Burghardt 1985a). Critical anthropomorphism was introduced as a way of using various sources of information, including "natural history, our perceptions, intuitions, feelings, careful behavior descriptions, identifying with the animal, optimization models, previous studies and so forth in order to generate ideas that may prove useful in gaining understanding and the ability to predict outcomes of planned (experimental) and unplanned interventions" (Burghardt 1991, p. 73).

Critical anthropomorphism was deliberately modeled after a proposed solution to a centuries-old controversy in science and philosophy: the nature of the external world (Mandelbaum 1964). Here one important contrast is that between direct or "naive" realists who accept that the world is just as it appears to us, and variants of subjectivists, idealists, and solipsists who basically argue that nothing exists but our own minds (or as Edgar Allen Poe wrote, "All that we see or seem is but a dream within a dream").

More germane is the position of skeptics who do not deny the existence of an external world, but assert that our flawed senses show that we can never learn anything about it. Illusions serve the purpose of the latter nicely (see Gregory 2001). Mandelbaum's (1964) solution was to advocate a radical critical realism based on both relevant sensory and neural data and predictive inferences. Furthermore, a process called "transdiction" could be applied to ground "inferences to objects or events which not only have not yet been observed, but which in principle cannot be observed" (Mandelbaum 1964, p. 63). Just as in the study of perception critical realism is the most scientifically congenial approach, so in the realm of animal minds, critical anthropomorphism is required.

Recently, an edited book (Mitchell et al. 1997), a monograph (Crist 2000), and articles (e.g., Fisher 1990) have been devoted to reviewing and exploring the problems and perils of anthropomorphism and anecdotes in modern studies of animal behavior. Perhaps the default condition of the human mind is anthropomorphic and this condition functions in understanding and dealing with other people (Caporael and Heyes 1997) and animals, especially domesticated and economically valuable ones (Morgan 1894). Perhaps anthropomorphism is only harmful in science when it is unacknowledged, unrecognized, or used as the basis for accepting conclusions by circumventing the need to actually test them.

Anthropomorphism by Omission

Anthropomorphism by omission is the failure to consider that other animals have a different world than ours. We can, without realizing it, attribute human traits to other species by failing to consider that many animals perceive the world in a different manner than do we. Scientists may know this in theory, but if they do not deliberately acknowledge that different species have different perspectives and priorities than we do, they may draw anthropomorphic conclusions that are erroneous.

The idea of studying the private worlds of other animals was pioneered by Jacob von Uexküll (1909/1985), who attempted to bring the latest neural, physiological, and perceptual findings to bear in understanding the behavior of animals by considering both their inner world (Innenwelt) and how they perceived and responded to their environment (Umwelt). A major aspect of this approach was to evaluate differences among species in the salience of biologically relevant perceptual cues (Tinbergen

1951; Burghardt 1985b). The cognitive ethology movement as pioneered by Don Griffin in the mid-1970s explicitly focused on the ways that animals perceive, interpret, and experience the world (e.g., Griffin 1978; Allen and Bekoff 1997; and chapters in this volume). An important component of this approach, though often understated, is to consider the animal being studied as an active participant, with the researcher trying to put him or herself in the animal's situation. Timberlake and Delamater proposed that to understand the behavior of an animal, "Experimenters not only need to put themselves in the subject's shoes, they need to wear them—walk, watch, hear, touch, and act like the subject" (Timberlake and Delamater 1991, p. 39). The power of this concept is shown by the recent demonstration by David Carrier's lab that strapping humans in a weighted suit framed like a theropod carnivorous dinosaur gave plausible insights into the dinosaur's maneuverbility (Stokestad 2001). Even skeptics allow that "Carrier's creative approach to dino motion has given them things to consider" (Stokestad 2001, p. 1572). More recently, Bekoff (2000) has extended this view to advocate a biocentric anthropomorphism.

Although it is true that we will never fully appreciate how another animal experiences the world, by doing our best to accomplish this through applying critical anthropomorphism, including the full range of available scientific data, we will get closer to understanding the life of the animal. Conceptually the task is no different from that of trying to understand another person who may differ from us in age, gender, sensory and motor abilities, personality, temperament, language, health, profession, wealth, status, or a host of other variables. Nevertheless, although we can never obtain access to the full inner life and private experiences of another human being, some people seem to be more successful at generalizing to the situations of other people and are thus considered particularly insightful, empathic, or privy to human nature writ large (e.g., major novelists, playwrights, composers). Others can exploit their knowledge in political, social, and deceptive activities (Burghardt 1997). Partial knowledge is possible and useful even if full knowledge is unobtainable both in practice and in principle.

Our aim in this essay is to document the presence of anthropomorphism by omission and raise awareness about its presence and its detrimental influences on science. If this argument is convincing, then when we analyze the behavior of animals, we not only can but *must* deliberately put ourselves in the animal's shoes; not doing so is potentially and truly anthropomorphic. Thus we are extending the approach advocated by Timberlake and Delamater (1991) one step further. Omitting to put oneself in the animal's shoes often leads to default anthropomorphism or anthropomorphism by omission.

Crotalomorphism—More than a Metaphor?

Consider another story, but one involving the study of other species, species in which, unlike our tendencies with primates and domestic animals, anthropomorphism is not usually considered a serious threat to the work of trained scientists.

A researcher is studying the behavior of a very colorful lizard. When this lizard sees a person, it rapidly changes its color to match its background, just as octopuses are well known to do. The researcher concludes that the change in color is a cryptic response to avoid predation. Just at this time, however, a large female timber rattlesnake (*Crotalus horridus*) that is quietly observing the researcher from some nearby brush is suddenly spotted by the researcher, who is both startled and scared. Rattlesnakes, being pit vipers, can detect patterns of infrared radiation from mammals through the loreal pits situated between the eyes and nostrils. Therefore, when the snake perceives the researcher, she detects it as a very warm animal moving in a

much cooler background (not unlike the way the human sees the colorful lizard). When the startled researcher saw the rattlesnake, adrenaline kicked in and the flow of blood to the arms and legs was reduced, along with all other peripheral circulation; this is a normal response to stress. The researcher turned cooler and was therefore less visible to the infrared-detecting "eyes" of the snake. Our clever rattlesnake concludes that the person is trying to escape by matching the cooler background. The drop in peripheral temperature is a cryptic response to predators with heat-sensing organs.

This is an example of crotalomorphism by omission; for although there is evidence that predator stress can lower body temperature (Gabrielsen and Smith 1985), the snake's conclusion would probably be dismissed as erroneous by most human scientists. However, is the snake's conclusion different in any essential way from the conclusion of the human researcher studying lizards? Crotalomorphism illustrates the problem of interpreting the world solely by one species' standards. Together the snake and the scientist are playing out the same game as the people from country Blue and country Yellow!

We are convinced that unwitting anthropomorphism by omission is frequently present in several scientific fields related to animal cognition and we use examples from the literature, including our own work (Burghardt 1998), for we have not been immune ourselves.

A Few Case Histories

Foraging Tactics in Snakes

When a northern water snake (*Nerodia sipedon*) catches a fish, it typically lifts the fish out of the water and takes it to the shore, where it swallows it. Water snakes are generally viewed as not using any specialized technique, other than grab and hold, to subdue or kill their prey, since they lack venom and do not constrict. However, if an anaconda, a large and largely aquatic tropical species, catches a deer and drags it to water where the animal cannot breathe and its capacities to move are reduced, it is often concluded, reasonably we might add, that the anaconda is subduing the deer, not only by constriction, but also by bringing the deer to an environment where it cannot breathe or run.

However, a deer forced into water is no different than a fish carried to land. While recognizing that the deer is being deliberately subdued, we fail to see that the fish is being subdued as well. The former is much more evident to us because we would also be subdued if we were in the position of the deer and not in that of the fish. So, even without directly attributing human traits to the animals, we may fail to consider the traits in which they are different. The fact that most scientists might readily agree when this possibility is pointed out does not invalidate our observation that removing a fish from water is not readily viewed as a functional predatory tactic.

Warning Coloration

Aposematic coloration has been considered a means to warn predators of potential danger and has been the basis of much theoretical work. Yet there is often little consideration of how the presumed predators of aposematically patterned and colored animals actually identify prey, if they can even see the presumed warning cues, or what warning coloration looks like to different predators. This is particularly evident when the predators are invertebrates rather than vertebrates. Even with vertebrates, many may be effectively color blind. A few years ago we came close to making an error in interpreting the responses of garter snakes to warning colors (Terrick et al. 1995) since, although snakes have cones in the retina, the latest research finds that they have no ability to discriminate wavelength (Jacobs et al. 1992). The discrimination we found may have been due, as we noted, to contrast, not

wavelength. To other predators, color may be important and our study clearly began with this view.

Drawing conclusions about the aposematic coloration of a species without first asking whether it is aposematic for the species' predators is another example of anthropomorphism by omission. In fact, it would be less anthropomorphic if less research was devoted to studying aposematic coloration and more time researching aposematic scents, aposematic vocalizations, and aposematic textures.

Courtship in *Drosophila*

Another example of the problems of anthropomorphism by omission is seen in a study of the role of sound during the courtship of fruit flies (*Drosophila* spp.) carried out by Boake and Poulsen (1997). Males shake their wings vigorously during courtship, producing sounds, and it was hypothesized that such sounds were an essential part of courtship. An experiment was carried out with wing-clipped males that could not produce the sound. Such males were expected to have reduced mating success. To the authors' surprise, clipped males did better than the controls in one species! The authors then mention that a reviewer (R. Hoy) pointed out that the clipped males had lighter wings (stumps) and thus might vibrate them faster—hence vibration, more than sound, may be the important part of the stimulus. In the world of humans, the shaking of the wings of an insect can only be detected by the sound they make. Owing to the much larger body mass of the researchers, it escaped their attention that the movement of the wings could produce substantial vibratory stimuli for an insect, though not for them.

The Cat and the Mouse

In the field of cognitive ethology, anthropomorphism by omission has also taken its toll. Colin Beer (1997, p. 203) states that "the reach and complexity of connections attaching to ideas in the human case will usually *far exceed* [our italics] what is conceivable for any animal." This respectable and plausible claim is supported by Beer (1997, p. 203) by describing a cat crouching beside a hole down which it has just chased a mouse: "We should be inclined to say that the cat thought there was a mouse down the hole. But consider what thinking that would mean to us: it would mean that there was a furry mammal down the hole, a tetrapod vertebrate, a whiskered rodent, a warm-blooded cheese-eater, and a whole lot more that could not possibly occur to the cat. Only a *small part* [our italics] of the network within which mouseness is nested for us extends into the cat's world."

Beer apparently failed to consider that the world of the cat is different than ours, and that only a small part of that world is obvious to us. The odors left by a chased and stressed mouse might allow the cat to obtain information as to whether the mouse is fat or thin, young or old, male or female, sick or injured. Perhaps it is aware of, and even enjoys, listening to the pitter-patter of the mouse running down the hole or smelling the odors left behind. We can't even begin to imagine the number of things that the cat may be aware of in that moment, such as the taste of the last mouse it caught, the feeling of grabbing and biting a mouse, or the memory of a former encounter when a mouse bit him. Given the salience and importance of rodents to cats, their "thoughts" and private experiences about mice in this situation might be far richer and certainly quite different than ours.

Human and Nonhuman Language

In the literature dealing with comparative communication and language, the superiority of human language as a means of communication is contrasted with "less evolved," "simpler," or "less advanced" systems in other species (cf., Brickerton 1998; Allen and Saidel 1998; Ujhelyi 1996). In addition to the various criticisms that

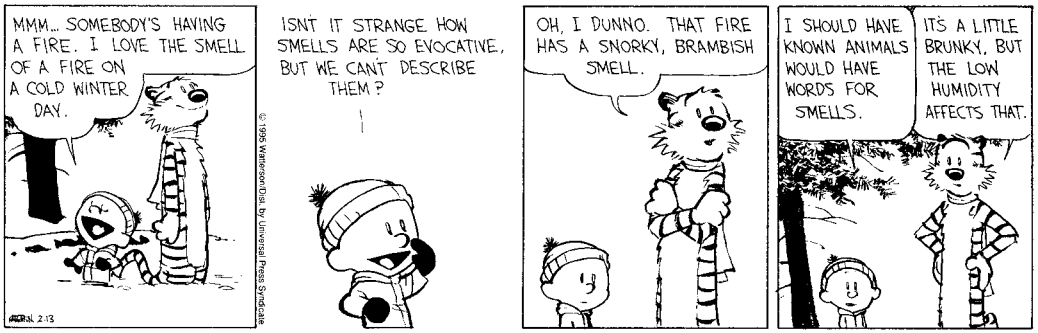

Figure 2.1
Calvin and Hobbes, by Bill Watterson. Reprinted by permission of Universal Press Syndicate.

can be made of such formulations (e.g., Allen and Saidel 1998), such statements also are prone to committing the error of anthropomorphism by omission, for they often fail to recognize that other species have different worlds than ours (figure 2.1). We often ignore the complex information contained in chemical cues and pheromones since we are so limited chemically.

As another example, consider honey bees studying communication between humans. To them, we would appear to perform rather poorly since we do not, and perhaps cannot, give our partners the location of the closest restaurant by dancing! Claiming that our language is superior risks not being aware of its limitations compared with communication in other species because we are biased in our understanding of it. We are not denying that human language might be, and probably is, generally more complex than other forms of communication in all other animals. Nevertheless, it is uncritically anthropomorphic to begin research on comparative language with this bias, which often goes unrecognized.

Zoos as Products of Anthropomorphism by Design

Zoo exhibits, even the most modern, are often shaped much more by the needs of the human visitors or human caretakers than the animals shown living in supposedly "natural" settings. Naturalistic exhibits reflect human concepts of nature, not necessarily those of the animals exhibited. Indeed, if the exhibit is too effective, the animals may not be readily spotted by visitors, and the exhibits will be changed for people, the paying customers, not for the resident animals. This has happened in gorilla exhibits (Burghardt 1996).

It has actually been argued that the best modern zoos are those that treat the zoo as a theatrical experience for the public, not one oriented to the lifestyle of the captive species (Polakowski 1989). This view seems to be pervasive in action if not in rhetoric in most zoos. An honest and explicit recognition of the anthropomorphic nature of modern zoos would be helpful. It is not enough to have eliminated tea parties for chimpanzees at zoos.

Conservation Planning

Decision makers often develop wildlife management plans that include various ecological benchmarks while ignoring the perceptual capabilities and life histories of the animals that are to be protected. The use of travel corridors to connect patches of habitat has been urged as a management measure to allow species to move between separated natural areas. Metapopula-

tion analysis has identified gene flow across relatively isolated populations as a central issue in conservation biology (Wiens 1996). The spatial scale involved is a critical issue. If the patches are too far apart, then the animals will not be able to find a patch by using their natural navigation method, and gene flow will be interrupted (Wiens 1996).

A well-documented example of how landscape modeling has neglected the perceptual world of animals and their private experiences involved the white-footed mouse, *Peromyscus leucopus* (Lima and Zollner 1996). Agricultural lands that allow some patches of natural vegetation are considered sufficient to allow gene flow from one population to the other. Zollner and Lima (1997) challenged this notion by testing the ability of mice to return to a forest patch from different distances. They found that animals released in agricultural lands would aim straight toward the forest when they were released at distances less than 20 m from it. However, mice released as close as 30 m from a forest orientated randomly, suggesting that these mice cannot discriminate a patch of forest at that distance. Hence the perceptive world of these mice (and not ours) must be considered when we formulate plans about the spatial layout of habitat patches for conservation.

Addressing the Pervasive

We have provided a few examples of anthropomorphism by omission that show that its presence can be detrimental to work in a variety of disciplines. It is not enough to avoid an anthropomorphic vocabulary and claim to be strictly objective. Anthropomorphism is like Satan in the Bible—it comes in many guises and can catch you unawares! Lockwood (1989) pointed out some of the guises. The most easily recognized are not the problem; the conceit that one is immune to them is more often the problem.

If anthropomorphism is a natural tendency of human beings, scientists are not immune; lurking unseen, it can compromise efforts in many areas. By using critical anthropomorphism and trying to wear the animals' "shoes," we can overcome part of our natural bias and obtain a more legitimate understanding of the life of other species and of nature (Rivas and Burghardt 2001). We encourage other researchers to put themselves in the position of their study animals, not only as a novel, complementary approach to their work, but as a required step in conducting good science. As the essays in this volume attest, issues of animal cognitive abilities are prime areas where anthropomorphism by omission may occur, but it is also those researchers working on animal cognitive behavior who are in the best position to discover what is necessary in order to avoid it.

Finally, the view of science embedded in our essay here is one being urged in various quarters. For example, in a recent technical article on the use of statistical inference to interpret data in experimental psychology, the following quotation appeared that puts our message in a broader context:

> The selection of hypotheses, their number, their location on the continuum of possible hypotheses, and their prior probabilities depend on the researchers' experience, their theoretical frame of mind, and the state of the field at the time of the study. (Kreuger 2001, p. 19)

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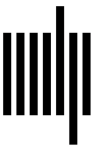

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