Chapter 6

Aspects of the Cognitive Ethology of an Injury-Feigning Bird, the Piping Plover

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The Injury Feigning Plovers

The Plovers' Behaviors Toward Intruders

I shall concentrate on the piping plover *Charadrius melodus* and also include data from Wilson's plover *C. Wilsonia*, two shorebirds which typically nest on beaches or sand dunes of the eastern United States. Both parents incubate the eggs for about 4 weeks. At this point precocial young hatch; they can run freely and feed themselves on their first day. The young are able to fly in another 3 weeks.

The nest, eggs, young, and adult are all extremely well-camouflaged on the sand. The nest, like that of many birds that perform distraction displays, is simply a scrape on the ground sometimes lined with commonly found sand-colored shells. In some regions the nest may be further hidden because it is located among light grasses. Because the nest is easily accessible to predators, protection of the eggs depends on camouflage, preventing potential predators' knowledge of the nest's location, and keeping them out of the nest's vicinity.

In order for a plover to be conspicuous special behaviors or vocalizations are required. During incubation and before the young can fly, both parents of both species perform distraction displays to intruders which move along the ground. (See review of various species' behavior in Gochfeld, 1984.)

There are several different kinds of distraction behaviors. The bird, especially piping plovers, may peep loudly while walking and keeping apace or ahead of the intruder. The plover may also fly conspicuously and slowly exposing its underside and bright wing stripes as it circles within about 30 meters and returns again to the vicinity of the predator. As it flies or walks at a distance from its young, it can be heard to vocalize a "peep" or "peep-lo." This is, in fact, often what first attracts the human's attention to the cryptically colored bird against the sandy beach. Sometimes the plover may engage in false brooding that is, sit down with feathers slightly fluffed, wriggling as it does so giving the appearance of sitting on a nest when, in fact, there are no eggs in that particular location. Or it may merely pace back and forth in the general vicinity of a human, seeming to eye the presumed predator as it does so.

On some approaches of an intruder, the bird may do a gradation of broken-wing displays (BWD), which may perhaps begin with a fanning tail and gradually increase

From C. Ristau (ed.), *Cognitive Ethology: The Minds of Other Animals* (Hillsdale, NJ: Lawrence Erlbaum Associates, 1991), 93–102, 118–120, 122–124.

the awkwardness of walk until it has one and then both wings widely arched, fluttering, and dragging. It may then vocalize loud raucous squawks as well. The broken-wing display is usually made while the bird is moving forward along the ground, although stationary displays are also made. The full display, as made by piping plovers, consists of outstretched widely arched wings that flutter and drag along the ground. The bird presents a convincing case for being injured, and the observer often trudges hundreds of meters after the bird only to see it suddenly fly away with agility. At that point one is far from the nest or young.

Note that the plover does not always make a broken-wing display (BWD) when its offspring are approached by a ground-moving object. In the course of my experiments conducted on Long Island, New York in 1983, parents gave broken-wing displays during approximately 40% of the close approaches to the nest. In other cases the plover left the nest cryptically with a silent low run. It may also silently hide in hollows with its tail towards the intruder making it very difficult to be seen.

Furthermore, a related species, the killdeer *C. vociferous*, only rarely performs broken-wing displays at the approach of grazing animals such as cattle, which do not eat eggs but may accidentally trample the nest. Instead, when cattle come quite close to the nest, the killdeer may lunge in a cow's face thereby startling it and causing it to veer away (Armstrong, 1947; Graul, 1975; Walker, 1955). A somewhat similar set of reactions to mammals occurs among southern lapwings in Africa (Walters, 1980). Cattle and horses were typically ignored until the animal approached within about 5 meters of the nest or young. At such times, the parent bird either lunged with a characteristic defensive posture, wings spread wide and held low, or else did a brief mild distraction display. In short, at least some species which perform broken wing displays exhibit flexibility in their use of the behavior.

But precisely what is it that the bird is doing? Is this a stereotyped reflex, a fixed action pattern (FAP), or possibly a disorganized "hysterical" behavior as some have termed it? (Skutch, 1976, p. 403).

Does the bird have to do it? Can it control initiation or stopping of the BWD? Can the behavior be construed as intentional? What is evidence for the existence of an intention? Finally, can we answer any of these questions in a satisfying way?

It will be important to distinguish between "intentional" meaning "on purpose" and the philosophical use of the term to mean "aboutness"—a mark of the mental. I shall discuss both meanings.

What Are Some Possible Hypotheses About the Plover's Behavior?

Note that the following hypotheses are not mutually exclusive; it is quite possible that some combination may finally prove to be the most satisfactory.

Reflexive or Fixed Action Pattern Response The bird's behavior is a reflex or an FAP which occurs when the parent bird is in a certain hormonal condition and is in the presence of an intruder and the plover's nest or young. A reflex is a simple stimulus-response connection in which a specific input is inevitably followed with little or no intervening processing by a unitary output. For example, the human knee-jerk response or the eye-blink response to a puff of air are reflexes. Complex behaviors are considered to be constructed by a chain of reflexes. In contrast, a fixed action pattern, a concept developed by the ethologists Lorenz and Tinbergen, is described in a recent textbook as follows:

> The distinguishing characteristics of the behavior are the innate and stereotyped coordination and patterning of several muscle movements which, when released, proceed to completion without requiring further sensory input. In terms of its almost total independence of feedback, the fixed-action pattern represents an extreme class of prewired behavioral performances which have come to be known as "motor programs." (Gould, 1982, p. 37)

For either a reflex or an FAP, there are several possibilities about the direction in which the plover makes a broken-wing display. In all cases, given the complexity of the motor acts involved, an FAP seems a more reasonable construct than does a reflexive interpretation. The possible directions are the following:

1. The BWD is made in random directions. This hypothesis predicts that the displaying bird should be just as likely to display toward as away from the nest or young.
2. The displaying bird merely goes away from the nest or young.
3. The displaying bird merely goes away from the intruder.
4. The displaying bird moves away from both the nest or young and the intruder. This hypothesis requires that the plover must know the location and movements or trajectories of the young and the intruders in order to respond appropriately. That is no small feat. (And it is difficult to conceive of as reflexive or an FAP.)

Conflict Behavior Earlier investigators often interpreted the broken-wing display to be the result of conflicting motivations. The displaying bird's behavior was thought to be "convulsive," "deliriously excited," and "its behavior patterns were more or less disorganized" (Skutch, 1976, p. 403). If the bird's behavior were indeed so disorganized, one would predict random directions of display or at least inconsistent leading away from the nest or young.

Approach/Withdrawal Tendencies This point of view, espoused by students of Schneirla (1972), is similar to the conflict hypothesis but emphasizes more orderly behaviors by the bird than those predicted by a simple conflict hypothesis. It is hypothesized that the bird would make a broken-wing display at the point of conflict. Not one of the many possible predicted behaviors suffices to account for the complexity of the observed behaviors.

Pre-programmed Sequence of Behavior According to this hypothesis, the bird behaves according to a programmed sequence of behavior in which stimuli such as direction of movement of the intruder, size of intruder, nearness to nest, and so forth determine the response of the parent bird. At least for the piping and Wilson's plovers, the variability observed in their behavior does not lend itself to an interpretation of a rigidly programmed sequence of behavior. If we allow for great flexibility in that programming, we are including the possibility of learning (see Learning), and if we allow reprogramming, we might well be talking about purposeful behaviors. Recognize, however, no program yet exists that adequately accounts for the behavior of a whole animal in the real world, so the kind of "super" program that could include descriptions of intentional behavior is not plausibly included as part of the hypothesis of pre-programmed behavior.

Learning Plovers might be able to learn about various aspects of a situation. This might include the ability to distinguish potential predators from those that are not. We have investigated that possibility in work discussed in Ristau (1986). Except for a simple reflexive interpretation of the plover's behavior and the conflict hypothesis, none of the other hypotheses necessarily preclude the possibility of learning.

An explanation of all the complexities of the parent bird's behavior in terms of operant conditioning is not viable if only because the infrequent interactions with predators are not likely to provide the extensive learning history required. A plover may, however, over one or more breeding seasons learn to improve its strategy for effective use of a BWD.

Intentional or Purposeful Behavior The plover wants to lead the intruder away from the nest or young. It behaves so as to achieve this objective, which might include using the broken-wing display. I do not mean to imply that every plover has independently thought of or learned to make a BWD. The BWD is exhibited throughout the species and is undoubtedly an evolved genetically transmitted behavior. (There is no direct evidence for this assertion for no studies have been made of the ontogeny of the BWD.) However, strategies for its effective use may well be learned both directly and by observation. The fact that a behavior or some aspect of it is learned or genetically prewired does not preclude the possibility of conscious thinking associated with it (see Griffin, 1984, 1985). The hypothesis of purposeful behavior requires that the plover must know the location and movements of young and intruders. In the next section, this hypothesis is discussed more fully.

Evidence Needed to Evaluate the Hypothesis: The Plover Wants to Lead the Intruder Away from Nest/Young

Based on the previous discussion concerning descriptive characteristics of intentional behavior, I propose the following observable behaviors as suggestive evidence in support of the following hypothesis: The plover wants to lead the intruder away from nest/young. I can make no claim that these are necessary and sufficient conditions for intentional behavior. I have not succeeded where centuries of philosophical thought have failed, that is, in proposing unassailable connections between observable behaviors and accompanying mental states. In evaluating the hypothesis, I will concentrate on broken-wing displays because they are very conspicuous and easily observed; other behaviors may also distract a predator.

1. The direction in which a bird moves during BWDs made in different encounters between intruders, nest or young, and parents should usually be appropriate or adequate to accomplish the objective of leading the intruder away. However, one should not expect that the parent bird will always move in a correct direction; in fact completely accurate performance might well be suspect. Neither is it required that the displaying bird move in an optimal direction.
2. The displaying birds should monitor the intruder to determine the intruder's attention, location, and behavior, particularly whether it is following the displaying bird.
3. Once the intruder's behavior is monitored, the displaying bird, if necessary, should modify its own behavior in a variety of ways in response to the intruder's behavior so as to achieve the goal of leading an intruder away. For

instance, if the intruder is not paying attention to the displaying bird, as indicated either by eye gaze or failure to follow, the plover should try to gain the intruder's attention by loud vocalizing or by flying or walking into the visual field of the intruder. As one example, the displaying bird could reapproach the intruder to try again from a closer distance to attract the intruder's attention. If the intruder stops following, the bird could increase the intensity of its display or stop displaying and change its behavior.

4. The bird should exhibit appropriate flexibility of behaviors in other circumstances. For example, it should not make BWDs before eggs are laid or after young can fly safely away. If we encounter a parent away from nest or young (e.g., feeding on its favorite mud flat), it should not make BWDs. If predators destroy the eggs or the eggs hatch and the young leave the nest, parents should no longer make BWDs leading away from the nest site. Flexibility could extend to other aspects of the bird's behavior, for example, the ability to learn which intruders are potentially dangerous and which are not.

Methods

The data being reported were gathered in the breeding season of 1982 on piping plovers and Wilson's plovers on a barrier island off the coast of Virginia. In that work, human intruders approached the nest or young, walked in the area of offspring, stopping at the nest and at other locations, and either followed or did not follow the displaying adult. Directions of the intruder's initial approach and changes in movements were varied so as to make the intruder's behavior unpredictable to the birds. Observations of the birds' behavior and of the location and direction of movement of the birds, chicks, and intruder were recorded by means of audio dictations and often videotape as well. Directions were given in compass points such as northeast or north northeast, which was the most precise specification of direction used. One observer was frequently located in a portable blind, while the other also functioned as an intruder. Sometimes both observers were the intruders.

Results

The reported data are drawn only from interactions in which the locations and directions of intruder, displaying birds, and nest or all chicks could be determined. The data derive from 19 different experimental sessions and from 10 birds which were members of 4 different pairs of piping plovers and 2 different pairs of Wilson's plovers. Data are combined for sessions with one and two intruders and for the stages of incubation and unfledged young. In 45 instances of broken-wing displays, the data were sufficiently detailed for analysis.

Evidence that the Plovers Make Broken-Wing Displays in a Direction "Appropriate" to Lead Intruders Away from the Nest or Young

Definitions of "Appropriate Direction" The first question I asked was whether the bird was displaying in a direction so as to cause an intruder to move toward or away from the offspring. In 44 out of 45 cases (98%), the bird's direction of display would have caused an intruder who followed it (i.e., went to the locations of the displaying bird) to get further from the young at the end of the period of injury-simulating display than at the beginning. One can also use a more stringent definition of the intruder

moving away from eggs or young. Would the intruder ever, in the course of following the displaying bird, pass closer to the offspring? By those requirements, in 39 of the 45 cases (87%), the most direct path by which an intruder could have followed the displaying bird would never bring it closer to the nest or young. These data indicate that the birds' direction of display is adequate to get an intruder further from offspring.

Where in the Intruder's Visual Field does the Bird Make Broken-Wing Displays? If the bird is displaying in order to attract the intruder's attention, one would expect the bird to be selective about where it displays; it should display where the intruder will see it. With respect to location, 44 of the 45 BWDs were made in front of the intruder rather than behind, that is, within a 180 degree arc of the intruder's visual field. The one possible exception occurred when an intruder was searching for young (very near them) and moving in a somewhat unpredictable fashion. The parent made a BWD to the side of the intruder, directed away from the young, and headed opposite to the general trend of the intruder's movement toward the chicks. In this situation, because the intruder was moving in a zigzag fashion, she was likely to turn so that sometimes the BWD would be within her visual field, and sometimes it would not.

These data do not determine which intruder characteristics the bird was responding to because, in most cases, the intruder was moving so that direction of movement, eye gaze, and facial and body orientation could be cues for the bird. When the intruder was stationary, it is conceivable the bird opted to display with respect to remembered direction of intruder movement rather than simply direction of eye gaze.

Positioning by the Bird Before Making a BWD Another question examined in detail was the location of the bird when it began its broken-wing displays. If this behavior is a reflex that is elicited whenever an intruder approaches closely enough, one might expect the display to occur wherever the bird is located. However, the bird always moves before displaying. Sometimes the bird moves by flying, which is an easily and accurately observable form of locomotion. One can argue that by flying to a location rather than walking, a slower form of locomotion, it is probably important to the plover to get to that location rapidly. In all 13 cases of flying, the bird's new position was closer to the intruder than was its position before flight. One would not expect such positioning if, as some have suggested, the bird were attempting to get away from the intruder.

Furthermore, in 11 of those 13 cases, not only was the bird closer to the intruder, but it was closer to the front of the intruder than it had been, that is, more directly in the center of the intruder's visual field and/or the path of the moving intruder.

Evidence that Birds Making a BWD Monitor the Intruder's Behavior To engage in these various behaviors strongly suggests the birds are monitoring the intruders. Are they? How can one determine what a plover is monitoring? Plovers have eyes that are placed laterally with both frontal and side (temporal) foveas so they can see can see over a wide field. It would be difficult to specify exactly what they are attending to within that field. They cannot, however, see behind them. Observations, photographs, and videotapes show that as a plover is making a broken-wing display while moving away from an intruder, it often turns its head sharply back over its shoulder its eye toward the intruder. The change in head/eye orientation strongly suggests monitoring of the intruder.

Modification of Displays in Response to Changing Intruder Behavior Further indications of intentionality are provided by the behaviors of plovers when intruders do not follow the displaying bird. Detailed information is available in 36 of the 45 total cases of broken-wing displays. In five instances the intruder followed the displaying bird and in all five cases the bird continued its display and did not stop to move closer to the intruder. Because five is a small number of cases, I looked through the data in 1983, 1984, and 1985 and found 12 additional cases (with adequate data) when the intruder followed the displaying bird; the bird did not reapproach the intruder in any of these cases.

In 31 cases of the original data set, the intruder did not follow the displaying bird or ceased to follow it. It seems sensible to expect that a bird that was not sensitive to the intruder's response to its display would simply continue what it was doing, that is, making a BWD. However, the bird did not typically do this. In 17 of these 31 instances (55%) when the intruder did not follow the display, the bird stopped its display and reapproached the intruder by either flying or walking closer. In nine instances (29%), the bird either continued to make a BWD or increased the intensity of the display, for example, by flapping its wings more vigorously or vocalizing raucously while displaying. Of the remaining five cases, after displaying, (a) the bird flew to the location of the young (three instances), (b) flew away (one instance), or (c) in one other case did not reapproach or fly.

Summary

In summary, the use of intense distraction displays, at least by the plovers in this study, indicates that they usually perform the displays in a direction that would cause an intruder following them to get further away from the threatened nest or young. Furthermore, the birds monitor the intruder's approach and modify their behavior in response to changes in intruder locomotion. I interpreted the data as providing at least suggestive evidence for the purposive nature (or first order intentional analysis) of the birds' behavior. I don't mean to claim that it is the very flexible, fully cognitive, fully conscious, purposeful behavior we humans sometimes have. (Of course, conscious intention is almost impossible to demonstrate in a totally unequivocal fashion even in other human beings, but these data are the beginnings.)

To those who are discomforted by attempts to study "consciousness" in animals, recognize that even taking the stance of purposeful or intentional behavior without ever implying consciousness is a fruitful enterprise. The stance led me to design experiments that I had not otherwise thought to do, that no one else had done, and that revealed complexities in the behavior of the piping plover's distraction behavior not heretofore appreciated. I invite readers to adopt the stance of intentional behavior and to help delineate the levels and kinds of knowledge and purposiveness an organism might have.

Discussion

The Benefits of Limited Anthropomorphism and of using an Intentional Stance

One may question why we should describe the way animals behave in terms of an intentional stance, that is, with respect to goals or beliefs and desires as philosophers use the terms. J. Bennett (in Ristau 1991) has discussed this issue by focusing on the

explanatory value of beliefs and desires and other mental states in understanding behavior. He, in fact, extends the ideas developed by Grice (1967), Dennett (1978, 1983, 1987) and Bennett (1976) to emphasize the importance of grounding the beliefs, desires, and behavior in the environment. When a simple, "triggered" stimulus-motor response description of behavior does not suffice, Bennett argues that an explanation may be needed in terms of a class of situations which are characterized by the organism's having certain beliefs and desires which make possible a variety of behaviors to achieve the goal.

Some, such as Burghardt (in Ristau 1991), consider an intentional stance a possibly useful heuristic device in suggesting experiments to be done and emphasizes that it should be considered just one of many possible approaches; he underscores the need for empirical data. I couldn't possibly disagree. Of course other approaches should be followed and, of course, every scientist needs empirical data. Yoerg and Kamil (in Ristau 1991) go a step further and state that anything that helps provoke a scientist to design experiments is OK—in that limited way. Thus, any sort of event might be the seed for a reasonable experiment, but the method of conjuring up an experiment should not be confused with the appropriate interpretation of the experiment or with a useful theoretical approach. For example, they suggest one may wish to imagine how an organism might feel or think when one makes field observations or designs an experiment, but that is not evidence that the organism actually feels that way. Their statements are also very sensible, but there are several other issues to be considered in conjunction with them.

Among these issues we should examine why it should be fruitful to be anthropomorphic in at least a limited way or to use an intentional stance when designing experiments or interpreting observational data. Why do these approaches work? Griffin and others propose that the approach of anthropomorphism works because animals may indeed have mental states including mental experiences. He uses several arguments to support his claim; most relevant here is the continuity of nature and of evolution. It is highly unlikely given all the continuities between humans and other organisms that humans alone should be aware or conscious, and have thoughts, purposes, beliefs, and desires. It is more likely that creatures other than humans should have a mind. The anthropomorphism, of course, should be limited. Another organism is not a human; it lives in different circumstances and sometimes has quite different sensory apparati. (See also Burghardt's ideas about critical anthropomorphism in Ristau 1991.)

Why should an intentional stance be particularly useful? Recall that, in Dennett's view, an intentional stance need not imply consciousness. The stance can be applied to a thermostat, a chess-playing computer program, a plover, or a human (a snake too?—see Burghardt in Ristau 1991) Other philosophers, for example, Searle (1980), distinguish between the derived intentionality of a thermostat or a computer program (intentionality derived from its designer) and the intrinsic intentionality of a human and perhaps a plover. A human actually does want a vacation or a dinner, whereas it is simply a useful strategy to deal with a chess-playing computer program to say it wants to bring its queen out early.

An intentional stance, at least the first level, can include a purposive interpretation of behavior (e.g., my studies in which I suggested that the plover wants to lead the intruder away from its nest). Because I took that stance, predictions about the plover's behaviors were made and experiments were designed to test the predictions.

Many ethologists who may not wish to deal with questions of animal mentality might opt to describe the plovers' injury feigning in terms of its function; the behavior functions to lead an intruder away from the nest. It has evolved to have that function. As proposed by the ethologist Tinbergen (1969), the function of a behavior is one of the four kinds of explanations of behavior scientists seek to answer. (The other three "whys" of behavior are evolution, ontogeny, and proximate mechanism —the last typically phrased in terms of physiological information; note the absence of any mentalistic explanation.) The concept of "proper function" (Millikan, 1984, 1986) of a behavior or a morphological structure, as developed by Millikan is related to this ethological formulation. (Millikan's ideas are described in Beer in Ristau 1991.)

It appears to me that a purposive or functional interpretation of behavior is useful because we may have struck upon an organizational principle of organisms. This is a most important point that I wish to emphasize. At an extreme level, the blowfly, upon encountering a sucrose solution with the chemoreceptors on its feet, extends it proboscis and imbibes the solution. We may say of the blowfly that its goal or the function of its behavior was to drink the sugar. At other extremes, there are the cases of the plover leading an intruder away from its nest or the human wanting dinner. For the blowfly, or some other organism, if you prefer, the proboscis extension and drinking behavior is probably under little if any voluntary control whereas there is extensive voluntary control, at least at the human end, for how to go about getting dinner. The degree of flexibility is a most important characteristic of the behaviors that are described as purposeful, and they may vary in interesting ways ontogenetically and across species. The description of the blowfly's behavior may be made in terms of the stimulus-response triggers as discussed by Bennett (in Ristau 1991) whereas that of the plover and the human appear to be better described by goals (desires) to be accomplished by a variety of behaviors.

Methodology

How then should one undertake studies using a limited or critical anthropomorphic approach or an intentional stance?

1. Empirical data are essential. Discussions of the possible mind states of animals without reference to their sensory and cognitive capabilities will be limited. It would be most useful to gather data so as to be descriptive of the organisms' behavior even to scientists uninterested in a mentalistic approach.
2. A hypothesis or stance and alternative interpretations must be specified as clearly as possible. Hypotheses must be falsifiable. Evidence must include not only data in support of a (mentalistic) hypothesis, but data which disconfirm simpler alternative interpretations. Precisely how the empirical data disconfirm alternative explanations must be carefully delineated.
3. In applying an intentional stance one should look for gaps in intentionality; that is, deviations from the expected behavior of a fully rational creature which, indeed, even we humans are not. One should look for errors and limitations of abilities in order to specify them more precisely.
4. Comparative studies are most useful. In this way, one can accumulate evidence about the different kinds of abilities. In particular, the degree of flexibility exhibited by different species may reveal differences along the continuum from rigidly programmed control of behavior to more voluntary control (Ristau,

1988). If we consider a potentially purposive behavior, the flexibility could be observed in terms of the breadth of stimuli to which the organism is responsive in achieving its goal; the situations or contexts in which the behavior can occur; and the ability to overcome obstacles in achieving the goal, particularly with respect to the variety and novelty of responses utilized.

Are Piping Plovers Intentionalist Creatures?

This is a tough question to answer. Remember that the philosophical meaning of intentional does not mean on purpose, although purposeful behavior and "wants it to be the case that" are among various intentional idioms. For a plover to be intentional it must be shown to have mind states. An intentional creature will have beliefs and knowledge, and it will act in accordance with them. Its behavior, such as a broken-wing display, will not simply appear, like a reflex or fixed action pattern, only in the presence of certain very specific stimulu. An intentionalist plover would be aware of its goal, and alters its behavior in ways appropriate to achieve its goal. There may be other and better ways of stating all this. I am simply exploring the possible application of an intentional stance to an animal's behavior—in this case, the piping plover.

It is for the previously mentioned reasons that I examined the ability of the piping plovers to attempt to continue to attract an intruder's attention and to cause the intruder to follow it away from nest/young as part of a body of evidence needed to indicate that the plover had a goal achievable by a variety of means. (Other behavioral flexibilites are discussed in Ristau, 1986). The plover is sensitive to many aspects of its environment including the attention paid by the intruder to its general nest area (defining attention in terms of direction of intruder's eye gaze). To begin to investigate the plover's knowledge/beliefs about its environment, the safe-dangerous experiments were conducted, which showed that a piping plover could learn to discriminate between two persons. These experiments are only a beginning in the exploration of whether and to what extent plovers are intentional creatures. The results so far suggest that they are. It will be important and most interesting to explore the limits of their abilities as well. They most assuredly are not the intentional creatures humans are, they are most likely far more limited than chimpanzees, and yet are probably interestingly different from snakes and blowflies. Whether critical aspects of the differences can be most profitably examined using an intentional stance to guide us remains an unanswered question.

Continuing the Dialogue

Most important is to continue the dialogue between scientists with different viewpoints and to establish more interaction with philosophers of science and of mind with whom we share concerns over similar issues. Using an intentional analysis, for example, is but one possible approach to the study of the animal and human minds. It is unlikely that any present viewpoint or theoretical orientation is totally correct. It behooves us to be open-minded, to learn from each other, and to explore.

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