Animal Mind and the Argument From Design

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The argument from design has played an important role in the history of philosophy and biology. Paley, the 19th-century theologian, was struck by the bodily complexity and adaptive fit of animals to their environments; he used the argument from design to prove the existence of God. Darwin, however, provided the natural evolutionary mechanisms that eliminated the need for positing a divine creator to explain the structure of animals; he was thus able to treat the historical problem of organic evolution by providing a historical solution. Today, some students of behavior are similarly struck by the complexity of animals' actions and their adaptive fit to the environment. Like Paley, they use the argument from design, but to prove the existence of a conscious designer inside the head of the animal—the mind. This mentalistic approach suffers from many of the philosophical and empirical problems that plagued similar efforts in the past.

Natural historical problems require natural historical solutions. Although this observation is obviously true, what is not always obvious is which problems qualify as historical. For example, the early, static conceptions of animal life as ordered and unchanging gradations along a unilinear scale were misguided because the dynamic, historical nature of life was not yet recognized (Lovejoy, 1936). The proponents of this Great Chain of Being were certainly awestruck by the majesty of God's creation; yet, when one approaches a historical problem from an ahistorical perspective, one may gain a sense of wonder but lose a path to understanding.

In this article, we consider the question of animal mind; specifically, can there be a natural science of animal mind, awareness, and consciousness? Although this question is being raised today as if it were new, in fact it is quite old. Furthermore, the philosophical foundation of today's animal mind movement, we suggest, bears a strong resemblance to the argument from design espoused by Plato, Aristotle, Newton, and others as a proof of the existence and nature of God. The weaknesses of the argument from design as a proof of God have been well-known for years; interestingly, some current accounts of animal mind seem to suffer from the same weaknesses.

But, before we delve into the matter, a few caveats are in order. Our critique of the animal mind movement does not encompass all aspects of contemporary cognitive psychology. The success and impact of the so-called "cognitive revolution" of the past 30 years, compared with earlier failed attempts to investigate mental processes, were due in large part to the careful anchoring of cognitive constructs to measurable and manipulable behaviors; its success and impact were also due to a decidedly mechanistic approach to cognition, particularly the effort to understand cognitive processes with the aid of computer algorithms and mathematical models. Moreover, the extension of the cognitive revolution to the animal world has helped give rise to the field of comparative cognition (for a recent review, see Wasserman, 1993); this field is a branch of experimental psychology that is dedicated to the scientific study of learning, memory, conceptualization, and other cognitive processes in animals through cautious objective inferences based on what Romanes (1883/1977) rather colorfully called behavioral "ambassadors" (p. 1).

However, a new and arguably more daring field has arisen in parallel with comparative cognition. This rival field—called cognitive ethology by its founder D. R. Griffin (1976)—has as its declared goal "to learn as much as possible about the likelihood that nonhuman animals have mental experiences, and insofar as these do occur, what they entail and how they affect the animals' behavior, welfare, and biological fitness" (Griffin, 1978, p. 528; see Ristau, 1991, for recent essays and analyses of the field of cognitive ethology). We submit that it is this very goal of investigating animal consciousness that, although grand and romantic, falls far outside the scope of a scientific psychology that has struggled for the better part of the past century to eschew such tantalizing, but ultimately unsubstantiable, analyses of subjective mental experience.

Natural Theology and the Argument From Design

To better understand the uses made of the argument from design by more modern thinkers, we first review the argument's historical and philosophical foundations. We begin this review with David Hume who, in his *Dialogues Concerning Natural Religion* (1776/1985), dealt the argument a serious, if not mortal wound.

Hume (1776/1985) presented his *Dialogues* as a conversation among three imaginary protagonists: De-

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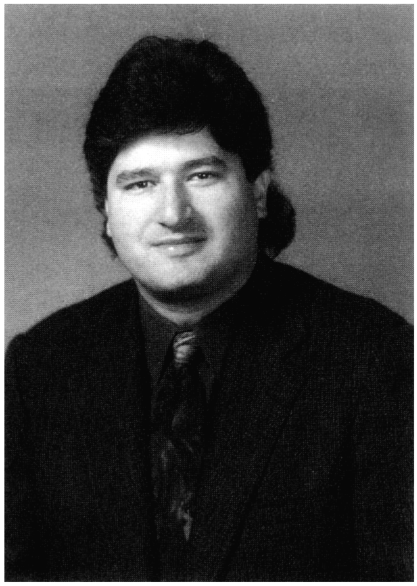

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mea, the rigidly orthodox believer; Philo, the skeptic; and Cleanthes, the believing philosopher. Cleanthes presents and supports the argument from design by first noting the remarkable complexity of nature. But nature's complexity is not random or chaotic, as shown by the "curious adapting of means to ends, throughout all nature" (p. 15). These ends, Cleanthes observes, resemble the products "of human design, thought, wisdom, and intelligence" (p. 15). By noting that the products of nature, like those of human design, are complex and purposeful,

> we are led to infer, by all the rules of analogy, that the causes also resemble, and that the Author of Nature is somewhat similar to the mind of man, though possessed of much larger faculties, proportioned to the grandeur of the work which he has executed. By this argument a posteriori, and by this argument alone, do we prove at once the existence of a Deity and his similarity to human mind and intelligence. (p. 15)

Later, Cleanthes poses the same arguments with an anatomical bent, and Hume, through the voice of Cleanthes, shows how easily and forcefully such arguments present themselves:

> Consider, anatomize the eye: survey its structure and contrivance, and tell me, from your own feeling, if the idea of a contriver does not immediately flow upon you with a force like that of sensation. . . . Who can behold the male and female of each species, the correspondence of their parts and instincts, their passions and whole course of life before and after generation, but must be sensible that the propagation of the species is intended by nature? . . . To what degree, therefore, of blind dogmatism must one have attained to reject such natural and such convincing arguments? (Hume, 1776/1985, p. 25)

Thus, we can outline the following steps along the way to Cleanthes's full argument from design: First, Cleanthes is in awe of the complexity that he sees in Nature and the functionality of its many parts. Second, Cleanthes cannot understand how such complexity and functionality could have arisen without the imposition of order from an external designer, that is, God. In other words, he is unknowingly facing a historical problem, but he cannot imagine a historical answer. Finally, he resorts to familiarity and analogical reasoning to prove the existence of a designer.

Philo's skeptical response to Cleanthes's argument from design is straightforward. First, he notes that the world, although composed of intricate and interdependent parts, is imperfect: "Rains are necessary to nourish all the plants and animals of the earth: But how often are they defective? how often excessive?" (Hume, 1776/1985, p. 73). Second, denying worldly perfection allows Philo to critically infer that nature's imperfections imply an imperfect creative process, thus precluding the participation of a divine (and hence perfect) creator. Finally, Philo further undermines Cleanthes's position by ridiculing the analogical and anthropomorphic aspects of Cleanthes's argument. He asks of Cleanthes, "why not become a perfect anthropomorphite? Why not assert the deity or deities to be corporeal, and to have eyes, a nose, mouth, ears, etc.?" (p. 37).

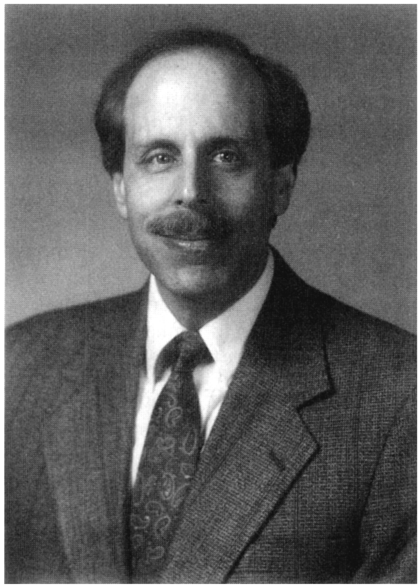
Like Cleanthes, Philo too lacks a mechanism by which to explain the complexity and functionality of nature, although he is willing to entertain the possibility of "a blind nature" (Hume, 1776/1985, p. 74). Without a clear mechanism, but also profoundly antagonistic to Cleanthes's arguments, Philo prefers the certain ignorance of the skeptic to the uncertain knowledge of the believer.

We view many of Hume's concerns as pertinent to the recent debate over animal mind. Specifically, we propose that the confounding of mind and design are central to the revitalization of mentalism within animal psychology. Indeed, in Hume's (1776/1985) *Dialogues*, Philo explicitly expresses this very confounding: "And if we are not contented with calling the first supreme cause a GOD or DEITY, but desire to vary the expression, what can we call him but MIND or THOUGHT, to which he is justly supposed to bear a considerable resemblance?" (p. 80).

Should the reader doubt that theorists ever make such explicit mental ascriptions to living beings, consider the following provocative comments by von Uexküll (1934/1957), the prominent ethologist who, before Griffin, was best known for his speculations about the private experiential worlds of animals:

> According to the behaviorists, man's own sensations and will are mere appearance, to be considered, if at all, only as disturbing static. But we who hold that our sense organs serve our perceptions, and our motor organs our actions, see in animals as well not only the mechanical structure, but also the operator, who is built into their organs, as we are built into our bodies. We no longer regard animals as mere machines, but as subjects whose essential activity consists of perceiving and acting. (p. 6)

> The biologist . . . takes into account each individual as a subject, living in a world of its own, of which it is the center. It cannot, therefore, be compared to a machine, but only to the engineer who operates the machine. (p. 8)



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Before proceeding to the key question of animal mind, we briefly examine the argument from design as it relates to two other scientific debates. First, the argument from design provided Darwin with a useful counterpoint against which he presented his evolutionary theories of the origins of animal complexity and adaptive fit. Second, and more controversially, the argument from design has also permeated current thinking about the role of genes in development. We hope that these discussions will further prepare the reader for our later remarks.

Evolution and the Argument From Design

A quarter century after Hume (1776/1985) wrote his *Dialogues*, William Paley (1802/1851) wrote his *Natural Theology: Or, Evidences of the Existence and Attributes of the Deity, Collected From the Appearances of Nature.* This work was the attempt of a prominent theologian and natural historian to make sense of the order that he perceived in nature. As is clear from his book's title, Paley hoped to provide a philosophical argument for the existence of God; he set out to do so, as did Cleanthes, by underscoring the complexity and purposeful design of organisms.

Paley's (1802/1851) argument draws on common experience and analogical reasoning to prove God's existence. First, Paley asks the reader to imagine coming across a stone on the ground and to imagine being asked about its origin. Given its simple nature, Paley argues, one would no doubt conclude that the stone had a simple origin. But, suppose one came across a watch instead. Would one still imagine a simple origin for such a complex device? The inference, he argues, is inevitable

> that the watch must have had a maker: that there must have existed, at some time, and at some place or other, an artificer or artificers, who formed it for the purpose which we find it actually to answer; who comprehended its construction, and designed its use. (Dawkins, 1986, p. 4)

Organisms, Paley (1802/1851) observed, are even more complex than watches. Thus, his biological argument is simple and direct: Organisms are too complex and too fit for the lives they lead to have been created by anything less than God. Like Cleanthes, Paley was impressed by complexity and adaptive fit; but, lacking a mechanism for explaining these features of animals, he was led to accept the same design argument that Cleanthes put forth in the *Dialogues*. In fact, the similarities between the arguments of Paley and Cleanthes are striking and underscore how common and prevalent are the basic tenets of the argument from design.

Evolutionary explanations were simplistic and unconvincing when Paley (1802/1851) wrote his *Natural Theology*. Darwin would not be born for 7 more years and he would not publish *On The Origin of Species* (1859) for 50 years after that. Of course, Paley and Darwin each shared an appreciation of the complexity of animal life, and each was duly impressed by the adaptive fit of animals to their modes of life. But, whereas Paley used analogical argument to prove the existence of a grand designer, Darwin was able to envision a natural mechanism that provides order to life through a "blind, unconscious, automatic process" (Dawkins, 1986, p. 5). Thus, at the heart of Darwin's approach was an appreciation of the historical forces that have shaped the structure and behavior of organisms (Ghiselin, 1969).

Development and the Argument From Design

Like evolution, development is a historical process, although it occurs over a far shorter time frame. Also similar to evolution, development comprises a series of complex and intricate processes. Unlike the processes of evolution, however, human development can be observed during a single lifetime, as a fetus becomes a neonate which then grows into a fully formed adult.

Despite abundant opportunities to observe the developmental process, the argument from design has nevertheless profoundly affected the conceptualization of development. Specifically, when confronted with the complex processes by which undifferentiated tissue becomes a functioning organism, many thinkers have turned to the genes in much the same way that Paley turned to God; in other words, the genes become the designer. Oyama (1985) described the allure of this perspective:

> It is a short step from the statement that we are as we are, and think as we do, because of our essential nature as biological creatures to a variant of the argument from design: our nature is created by a genetic plan, which was in turn created by natural selection. (p. 10)

The genes-as-designer idea of development comes cloaked in a number of different metaphorical guises (Nijhout, 1990). The architectural metaphor contributes the notion that genes provide a developmental blueprint, whereas the computer metaphor contributes the notion that genes provide a developmental program. These metaphors each presuppose a preexisting architect or programmer who plans and guides the course of development. Such ideas, however, fail at even the most superficial levels of scrutiny. In fact,

> if pressed, any student of life processes will admit that the species-typical genotype guarantees the species-typical phenotype only if the environment maintains its typical parameters as well. This is so obvious as to merit nothing but an impatient sniff: unquestionably the genes require the proper supporting conditions to do their work, but when those conditions are present, the genotype supplies the fundamental pattern of the organism. (Oyama, 1985, p. 14)

The central issue is, of course, one of control: "In a system in which every component, and past history, all have to come together at the right time and in the right proportions, it is difficult to assign control to any one variable, even though one may have a disproportionate effect" (Nijhout, 1990, p. 442).

Both Oyama and Nijhout conceived of development as a self-organizing process by which the organism is constructed dynamically through the interaction of many parts. If one merely observes snapshots of the beginning and end of the developmental process—the fertilized egg and the fully formed adult—and ignores the processes that connect the two endpoints, one is easily led to accept the same static and ahistorical conceptualizations that have misled so many others. And yet, some individuals find such conceptualizations comforting:

> The only reasons for supposing the existence of a program for development are first, that we would have designed such a system that way, and second, that it is discomforting to deal with the notion that development is largely self-organizing. (Nijhout, 1990, p. 443)

Animal Mind and the Argument From Design

In Hume's (1776/1985) *Dialogues*, the skeptic Philo disparagingly calls Cleanthes an anthropomorphite, by which he means that Cleanthes attributes human characteristics to the deity. More commonly today, this term refers to those who attribute human characteristics to animals. During the end of the 19th century and the beginning of the 20th century, the early comparative psychologists engaged in this second kind of anthropomorphism: Scientists (e.g., Romanes, 1883/1977) collected and disseminated scores of tales of amazing feats that they believed illustrated the almost human intelligence of animals. These tales, or anecdotes, formed an essential and substantial part of the database from which these early scholars hoped to begin building a science of animal behavior (for more on Romanes's use of the anecdote, see Wasserman, 1984).

Of course, the accumulation of astounding anecdotes failed to move psychology much closer toward an understanding of animal behavior. But the anecdotalists did serve to raise the ire of those who sought to develop a more objective science of psychology. Edward Thorndike (1898) was particularly irritated by the uncritical acceptance of stories attesting to the remarkable behaviors of animals. He wrote, with some passion, about the limited abilities of people to accurately and objectively describe the behaviors of animals:

> Human folk are as a matter of fact eager to find intelligence in animals. . . . Besides commonly misstating what facts they report, they report only such facts as show the animal at his best. Dogs get lost hundreds of times and no one ever notices it or sends an account to a scientific magazine. But let one find his way from Brooklyn to Yonkers and the fact immediately becomes a circulating anecdote. (p. 4)

The result of Thorndike's (1898) attack on the anecdotal method and his (and Pavlov's) invention of experimental methods to study animal learning has been that, for most of this century, the anecdote has been banned from mainstream scientific discourse. Today, however, the tide is turning. The arguments of philosophers and students of animal behavior alike are setting a different tone in the behavioral sciences. For instance, the philosopher Daniel Dennett (1983) tried to undo Thorndike's objections to anecdotal evidence with a single statement: "It is the novel bits of behavior, the acts that couldn't plausibly be accounted for in terms of prior conditioning or training or habit, that speak eloquently of intelligence" (p. 348).

In addition to the anecdote, mentalistic explanations stressing an animal's conscious intentions, desires, and feelings are also staging a comeback. Many students of animal behavior again feel free to describe and discuss the minds of their subjects. Among the ranks of the new animal mentalists are philosophers, anthropologists, and zoologists who, perhaps unaware of psychology's historical experience with mentalistic analyses of behavior, proclaim confidently that "there can be no methodological objection to a psychology that is mentalistic" (Sober, 1983, p. 113). However, as many of these self-professed cognitive ethologists kick off what Dennett (1983, p. 343) called the "weighted overshoes" of behaviorism, it is instructive to note how the argument from design permeates the foundations of this modern movement.

For example, the biologist Donald Griffin (1984) has, perhaps more so than anyone else, sought to redirect attention to the mental lives of animals. He asked, "Just what is it about some kinds of behavior that leads us to feel that it is accompanied by conscious thinking?" (p. 50). His answer was clear and, by now, familiar: complexity and adaptability.

> Complexity is often taken as evidence that some behavior is guided by conscious thinking. But complexity is a slippery issue. (p. 50)

> One very important attribute of animal behavior that seems intuitively to suggest conscious thinking is its adaptability to changing circumstances. . . . If an animal manages to obtain food by a complex series of actions that it has never performed before, intentional thinking seems more plausible than rigid automatism. (p. 51)

Thus it seems likely that a widely applicable, if not all-inclusive, criterion of conscious awareness in animals is versatile adaptability of behavior to changing circumstances and challenges. (p. 53)

Although Griffin (1984) claimed to place great weight on adaptation to changing circumstances as one of his criteria for ascribing conscious thought to animals, he is actually far less demanding. As an illustration of the kinds of behaviors that he finds amenable to mentalistic explanation, Griffin described the intricate behaviors of the assassin bug, which has

camouflaged itself chemically and tactilely by gluing bits of a termite nest all over its body. In this way it is able to capture a termite at the opening of the nest without alarming the soldier termites. After sucking out the termite's semifluid organs, the assassin bug jiggles the empty exoskeleton in front of the nest opening in order to attract another termite worker. . . . When a second termite worker seizes the first, it is then captured and consumed itself . . . and the process may be repeated continuously many times by the same assassin bug. The extraordinary complexity and coordination of these actions strongly suggest conscious thought, even though the assassin bug's central nervous system is very small. (p. 51)

Note that Griffin (1984) appears not to have been interested in the stimuli that actually influence the behavior; he also did not mention how rigid the behavior is under changing circumstances; nor did he provide any evidence that the behaviors constituting the complete act were "never performed before." In short, Griffin appears to have been little bothered by our having really no idea of how the assassin bug's behavior developed in either the evolutionary or individual time frames. In the end, it is the "extraordinary complexity and coordination" of the assassin bug's behavior that sways him toward an explanation in terms of conscious thought, not the "versatile adaptability to changing circumstances" that he states as a central criterion for conscious thought.

Moreover, Griffin (1984) sometimes tried to have it both ways. When a behavior is complex and adaptive, he ascribed intelligence and conscious thought to the organism. When the behavior is hurtful, he considered the act to be automatic, but he refrained from calling the organism stupid:

When a moth flies again and again at a bright light or burns itself in an open flame, it is difficult to imagine that the moth is thinking, although one can suppose that it is acting on some thoughtful or misguided scheme. . . . But to explain the moth flying into the flame as thoughtful but misguided seems far less plausible than the usual interpretation that such insects automatically fly toward a bright light, which leads them to their death in the special situation where the brightest light is an open flame. (p. 51)

Thus, Griffin's (1984) writings imply a qualitative difference between the mental activities of moths and assassin bugs. Although he is reasonably awestruck by the "complexity and coordination" of the assassin bug's behavior, ascribing this behavior to conscious thought is, we propose, quite premature when not a single direct experiment has been performed.

Griffin's (1984) description of purposeful behavior is little different from Paley's (1802/1851) description of purposeful design. Both Griffin and Paley were impressed by complexity and intrigued by adaptability, and both resorted to ahistorical perspectives in pursuit of their preferred conclusions. Paley explained the construction of organisms by claiming that God was the designer; Griffin, like von Uexküll (1934/1957) before him, explained the intricacy of animal behavior by positing a conscious mindful designer inside the head of the organism. However, neither answer is experimentally verifiable or observable. Why then do Griffin and his followers find explanations of behavior in mentalistic terms so satisfying?

Oddly, some mentalists claim that explaining behavior in terms of conscious beliefs and desires is more parsimonious than "an abstemiously behavioristic story of unimaginable complexity" (Dennett, 1983, p. 347). This claim is, we suggest, an example of the nomological fallacy: that naming something is tantamount to explaining it. But, leaving aside whether alternative frameworks exist for exploring and explaining such behaviors as those of the assassin bug, how can a mentalistic explanation of behavior really be acceptable? How might one objectively prove or disprove the existence or causal efficacy of a belief or a desire? Animal mentalists are evidently confusing linguistic brevity with conceptual elegance.

One example of how misleading a mentalistic approach can be is provided by Dennett's (1983) discussion of food choice in birds and bats. First, he asks the reader to consider

the role of intentional characterizations in evolutionary biology. If one is to explain the evolution of complex behavioral capabilities or cognitive talents by natural selection, one must note that it is the intentionally characterized capacity (e.g., the capacity to acquire a belief or a desire to perform an intentional action) that has survival value, however it happens to be realized as a result of mutation.

Then, Dennett (1991) elaborated

If a particular noxious insect makes its appearance in an environment, the birds and bats with a survival advantage will be those that come to believe this insect is not good to eat. In view of the vast differences in neural structure, genetic background and perceptual capacity between birds and bats, it is highly unlikely that this useful trait they may come to share has a common description at any level more concrete or less abstract than intentional system theory. (p. 641)

Dennett's (1991) argument is that because birds and bats are so different structurally and behaviorally from one another (*Aves* and *Mammalia* are, after all, different phylogenetic classes), the only explanation for their similar eating habits is a higher order one involving their beliefs about what is good to eat. Is it not true, then, that the same argument should be made regarding the fact that these two very different kinds of animals both fly? Must we also suggest that birds and bats are only able to fly because they believe they can do so?

Animal Mindlessness

Dennett's (1983) argument that it is "the novel bits of behavior . . . that speak eloquently of intelligence" commits a basic statistical error; specifically, although he assumes that novel behavior provides evidence of intelligence, he does not consider the fact that novel behavior can just as well provide evidence of stupidity. In other words, if animal intelligence exhibits a normal distribution throughout a population of animals, then it is unwise to consider and emphasize only one tail of the distribution—the tail that represents high intelligence.

The anecdotalist or mentalist might reply that the experimental psychologist's focus on reliable and lawful behavior is too narrow to disclose and comprehend true intelligence. But is intelligence just a judgment call? Are there behaviors that should rightly count against the depth of animal intelligence?

In Humes's (1776/1985) *Dialogues*, one of Philo's strategies to refute the argument from design, quoted above, was to show how imperfect much of nature truly is. Certainly, he argues, if God were perfect and the universe were created in his image, then the world too would be perfect. That the world is not perfect supports the skeptical position. Philo could not go beyond skepticism, however, because he (i.e., Hume) knew very little about the history and structure of the world. Likewise, Philo could not provide a sensible explanation for the imperfections of animals because these explanations would not arrive until the next century.

Perfect processes do not produce imperfect products. This simple insight, seminal to Philo's attack on Cleanthes's argument from design, was also central to Darwin's evolutionary insights. Thus, although Darwin recognized that animals and plants are exquisitely adapted to their environments, he also saw that the process of adaptation entails serendipity and contrivance, not deliberate design. Stephen J. Gould (1980) described Darwin's insight and approach as exemplified in Darwin's 1862 treatise, *On the Various Contrivances by Which Orchids Are Fertilized by Insects*. Using the same basic argument put forth by Philo, Gould wrote,

> Orchids manufacture their intricate devices from the common components of ordinary flowers, parts usually fitted for very different functions. If God had designed a beautiful machine to reflect his wisdom and power, surely he would not have used a collection of parts generally fashioned for other purposes. Orchids were not made by an ideal engineer; they are jury-rigged from a limited set of available components. (p. 20)

Gould then continued,

> Our textbooks like to illustrate evolution with examples of optimal design—nearly perfect mimicry of a dead leaf by a butterfly or of a poisonous species by a palatable relative. But ideal design is a lousy argument for evolution, for it mimics the postulated action of an omnipotent creator. *Odd arrangements and funny solutions are the proof of evolution—paths that a sensible God would never tread but that a natural process, constrained by history, follows perforce* [italics added]. (pp. 20–21)

Just as new students of evolution are usually taught about the optimal structural design of animals and how this design helps them to survive, so too are new students of animal behavior taught about the optimal responses of these creatures. Indeed, in their natural settings, the fit of animals to their environments is extraordinary. No doubt this evident fit contributes to the high regard that field biologists have for the intelligence of their subjects; it may even help to explain the prevalence of mentalists within this group of investigators. In the laboratory setting, however, the quirky and irrational behaviors of animals readily emerge, contributing to a far less romantic and sentimental view of animal cognition among these researchers. What are some illustrations of such quirky and irrational behaviors and what sense can be made of them?

Consider first an animal's direct approach to and contact with signals of appetitive events. In nature, signs and significates ordinarily reside in one and the same place (Eibl-Eibesfeldt, 1975). A kernel of grain is both a sign of nutrition and the nutrient itself. Without careful experimental analysis, naturalists might observe a pigeon's pecks at seeds, for example, and conclude that the complex sensorimotor coordination of these precisely targeted responses must surely be the result of a mindful beast behaving with the clear intention of replenishing its depleted food stores. How wrong they would be!

Several dozen laboratory studies have decisively disclosed that pigeons (and many other vertebrate animals) quite mechanically approach and contact localized signals for food (and other appetitive events), even when these directed "sign-tracking" responses are maladaptive to the well-being of the experimental subjects (see Hearst & Jenkins, 1974, and Wasserman, 1981b, for reviews and analyses of this large research literature). If the signal for food is a briefly lighted key, then the pigeon will approach and peck it with great alacrity, not only when pecks are without any scheduled consequence, but when they actually lead to the omission of scheduled feedings. Furthermore, when the signal for food is located several feet from the food tray, pigeons will wastefully expend great energy racing toward and pecking the lighted key, activities that take the birds so far from the food tray that the brief periods of its operation (from two to four seconds) are often too short for the pigeons to make the return run from the key to the activated food tray.

Films of the pigeon's pathetically irrational shuttling from the response key to the food tray occasionally elicit laughter from audiences. Lectures detailing the full scope of the pigeon's inability to cope with these seemingly diabolically contrived laboratory situations often lead students to conclude that pigeons are simply "stupid." In addition, some ethologists have trenchantly opined that the only stupid creatures at work in such projects are the experimental psychologists who conducted the misguided investigations, because all behaviors sustained outside of natural conditions are necessarily "perversions" without real biological significance.

But, remember Gould's (1980) wise words: Historical constraints are bound to produce "odd" and "funny" solutions. Here, the oddity and funniness of the pigeon's sign-tracking behaviors result from the misfiring in unnatural situations of a process that has been shaped by millennia of evolutionary selection, as well as a lifetime of individual experience, to suit natural conditions. It is precisely that misfiring when sign and significate are unnaturally separated from one another in the laboratory that most incisively and dramatically elucidates the mechanical and mindless process that works so well when, in nature, sign and significate are the same object.

Animals not only move physically toward or away from environmental stimuli, but their behavior also determines whether and when these stimuli occur. A familiar place for demonstrating and investigating this other kind of so-called "goal-directed" action is in conditioning chambers bearing the names of their famous constructors. In Thorndike's original puzzle box as well as in Skinner's newer, improved version, animals from pigeons to rats to cats to monkeys have learned to perform behaviors whose scheduled consequences have involved the presentation of appetitive events or the omission of aversive ones. As in the case of sign tracking, the purpose of these instrumental or operant responses is, at first blush, so obvious that experimental analysis seems to be superfluous: The contingency between response occurrence and event presentation or omission is directly understood by the animal, which does just what the contingency requires to bring about the desired state of affairs. We are, of course, often warned that appearances can be deceiving; they are especially so in this case.

The first sign of trouble for a purposive interpretation of operant conditioning was Skinner's (1948) classic report of "superstition" in the pigeon. Without any contingency between response and consequence, six out of his eight experimentally naive pigeons came to respond with stereotypic and idiosyncratic behaviors when food was automatically dispensed every 15 seconds. What could explain such wastefully silly behaviors by the hungry pigeons?

Skinner (1948) did briefly entertain a mentalistic interpretation: The pigeons had mistakenly believed that they had to perform these perverse rituals to receive food. However, he preferred a simpler and more mechanistic account: Events that behavior theorists call "reinforcers" had mindlessly strengthened the behaviors that they followed. The mere temporal conjunction of a response and a reinforcer may raise the likelihood of that class of behavior to a level at which future conjunctions become higher still, thereby leading by positive feedback to frequent and persistent responding despite there being no real contingency between response and reinforcer (for subsequent accounts of superstitious behavior, see Staddon & Simmelhag, 1971; Timberlake & Lucas, 1985; Wasserman, 1973).

Although the details of their behavior theories differed, both Skinner and Thorndike agreed with one another that operant conditioning is a strikingly mindless affair. Thorndike (1911) wrote about his cats' learning to escape from the puzzle box:

> The process involved in the learning was evidently a process of selection. The animal is confronted by a state of affairs or, as we may call it, a "situation." He reacts in the way that he is moved by his innate nature or previous training to do, by a number of acts. These acts include the particular act that is appropriate and he succeeds. In later trials the impulse to this one act is more and more stamped in. . . . The profitless acts are stamped out. . . . So the animal finally performs in that situation only the fitting act. . . . Here we have the simplest and at the same time the most widespread sort of intellect or learning in the world. There is no reasoning, no process of inference or comparison; there is no thinking about things, no putting two and two together; there are no ideas—the animal does not think of the box or of the food or of the act he is to perform. (pp. 283–284)

A more recent, but no less nettlesome problem for a purposive interpretation of operant conditioning was Thomas's (1981) study of the effect of temporal contiguity on lever pressing in rats. In the experiment, one food delivery was scheduled every 20 seconds. Food came at the end of a 20-second interval if no lever presses were emitted; the first lever press within a 20-second interval immediately delivered the one feeding that was scheduled for that interval. Lever pressing thus advanced the time of food delivery and made food delivery temporally contiguous with lever pressing. However, lever pressing had no economic consequence for the rat; it received 1 feeding per 20-second interval and 180 feedings per one-hour session regardless of whether it made this response. Despite this patently purposeless schedule, Thomas's six rats increased their lever pressing from nearly 0 responses per minute in the 1st session to between 22 and 36 responses per minute by the 30th session.

Even more damaging to a purposive interpretation were the results of a second experiment in which the reinforcement schedule was similar to the first: Food delivery came at the end of a 20-second interval if no lever presses occurred, and food immediately followed the first lever press within a 20-second interval. However, a response within one 20-second interval omitted the food delivery that was scheduled for the next 20-second interval. Thus, there was a clear negative contingency between responding and reinforcement; as the rat's rate of response rose, the rate of reinforcement would actually fall from 3.0 to 1.5 feedings per minute. This negative contingency notwithstanding, the lever pressing of all of Thomas's six new experimental subjects increased from 0 responses per minute in the 1st session to between 6 and 32 responses per minute by the 30th session.

The clear conclusion from Thomas's critical results is completely consistent with Thorndike's (1911) and Skinner's (1948) analyses of reinforcement: For operant conditioning to take place, it is sufficient that a reinforcer follow a response. Temporal contiguity may then blindly and purposelessly increase the incidence of operant behavior (for more recent and elaborate interpretations of operant conditioning, see Colwill, 1993; Dickinson & Balleine, 1994; Rachlin, 1992).

In nature as well as in most investigations conducted in the laboratories of experimental psychologists, animals have to do things to bring about certain states of affairs. Rats may not only have to press a lever to receive a tasty tidbit of food, but they may also have to push aside a stone to unearth a delectable root lying beneath it. In each of these and countless other cases, responses are not only necessary to accomplish ends, but they are soon followed by those ends. The proximate mechanism of reinforcement—namely, temporal contiguity—holds in these familiar cases in which logic and purpose should encourage operant responding as well as in those unusual cases in which logic and purpose fail to account for the emergence of operant responding. Clearly, the natural contingencies of reinforcement that have shaped this behavioral mechanism were quite unlike those that Skinner and Thomas contrived in their laboratories; yet, it is precisely because of their unnaturalness that these contrived contingencies are so important in illuminating the effective ingredient of reinforcement.

Incisive investigations into the processes of animal behavior have not been the exclusive domain of experimental psychologists. Ethologists too have provided valuable insights into the mechanisms and functions of behavior. For instance, in their study of the egg-rolling behavior of the graylag goose, Lorenz and Tinbergen (1938) showed that this bird will reach out to a distant egg and roll it back into the nest. Had they ended their study with this simple observation, perhaps a mentalist would have used the graylag goose as an example of an animal that intends to maintain all of its eggs within the nest and who purposefully reaches out to wayward eggs and gathers them back using a gentle but effective scooping motion, thus avoiding damage to its precious cargo. But Lorenz and Tinbergen did not stop there. Rather, they carefully manipulated the situation, for example, by removing the egg just after the goose had begun its gathering motion. The goose did not respond rationally and cease the needless act; instead, it continued its "egg-rolling" behavior in the absence of the egg!

Other behaviors are even more extraordinary in their seeming purposelessness. Eibl-Eibesfeldt (1975) described one well-known behavior of the digger wasp as follows:

> The digger wasp (*Ammophila*) opens and inspects the cavity it has dug before it deposits caterpillars in it to serve as food for its larva. It arrives with the caterpillar, drops it near the entrance, enters the cavity, inspects it, reappears head first, and pulls the caterpillar inside. (p. 252)

The digger wasp's behavior is surely no less remarkable than that of the assassin bug described by Griffin (1984). Perhaps an animal mentalist would even describe the wasp's behavior in the following way: First, the digger wasp digs a cavity and then leaves it to capture its prey. After a successful hunt, the wasp returns with its victim to the original cavity and deposits it as food in anticipation of the future needs of its offspring. However, before depositing the caterpillar, the wasp first inspects the cavity to ensure that it is still safe and, after convincing itself of that fact, it retrieves the prey and deposits it as planned. Remarkable indeed, but very misleading.

A far different sense of the cognitive capabilities of the digger wasp is gained when the situation is unnaturally manipulated by the experimentalist. Eibl-Eibesfeldt (1975) continued,

> If one removes the caterpillar to a place some distance from the nest while the wasp inspects the cavity, it will search for it until it has found the caterpillar, bring it back to the entrance, and the entire sequence of dropping, inspecting, and so on is repeated. This can be repeated 30 to 40 times, at which time the wasp will finally carry the caterpillar directly into the cavity without prior dropping and inspection. . . . The animal can adapt to the new situation only with great difficulty; its behavior follows a quite rigid program. Normally no disruptions occur, so the wasp achieves its goals quite readily. (p. 252)

Although many more examples of "irrational" behaviors could be provided, they would all make the same point: Just as nature's "odd arrangements and funny solutions are the proof of evolution," so the odd and funny actions of animals are the proof of irrational and mechanical processes underlying behavior. Behavior is constructed through a historical process; but, if researchers fail to search for the factors that influence it, they will be forced, like the animal mentalists, to treat behavior ahistorically and simply posit a conscious engineer in the machine. Yet, if one wishes to explain complex behaviors like that of the assassin bug in terms of conscious intention and desire, must one not also explain the behaviors of the compulsive digger wasp, the hallucinatory graylag goose, and the profligate pigeon and rat in those same terms as well?

Animal Mind and Human Consciousness

Many behavior theorists (e.g., Skinner, 1977, 1985) have argued that ascribing human qualities to God or to animals is a form of prescientific thought. It is not surprising then that, as the science of animal behavior emerged in the late 19th century, the issue of animal mind centered around the anthropomorphic question, "Do animals, like humans, exhibit conscious awareness?" For Romanes (1883/1977), analogy and common sense suggested the answer. He concluded that "the activities of organisms other than our own, when analogous to those activities of our own which we know to be accompanied by certain mental states, are in them accompanied by analogous mental states" (p. 6).

And take Yerkes's (1905) account of ant behavior, about which he asked if we may not

> reasonably believe . . . that the ant with its complex organization, however different from ours, its highly developed and complexly differentiated nervous system, its manifold forms of sensory discrimination, its docility, and its extremely varied social life, possesses a form of consciousness which is comparable in complexity of aspect and change with the human? (p. 149)

Washburn (1926) answered this question with an emphatic yes; she even went so far as to promote introspection and anthropomorphism as key elements of her methodology for studying mental states in animals:

> Since an inner world of experience exists, we may legitimately try to investigate it. For this purpose we possess a method, which is called introspection. We can . . . observe what goes on in our own consciousness when we receive certain stimuli and make certain movements. Further, we can by the use of the same kind of inference from one case to another similar case . . . infer that when a being whose structure resembles ours receives the same stimulus that affects us and moves in the same way as a result, he has an inner experience which resembles our own. (p. 21)

Such attempts to provide a mentalistic methodology for studying animal consciousness have been resisted for many years. This resistance was fortified by writers like the early behaviorist Jennings (1905/1976), who argued that "objective evidence cannot give a demonstration either of the existence or of the nonexistence of consciousness, for consciousness is precisely that which cannot be perceived objectively" (pp. 335–336). Recently, however, that resistance has broken down as a new generation of researchers, inspired by Griffin's mentalistic speculations and bolstered by Dennett's philosophical arguments, has asked such once taboo questions as, "Do animals attribute mental states to others?"

So, in a bold and provocative report that has received considerable publicity, Povinelli, Nelson, and Boysen (1990; see also Povinelli, 1993) attempted to unveil unprecedented attributional processes in chimpanzees (*Pan troglodytes*). This experiment used a discrimination learning paradigm in conjunction with a final transfer test to produce responding on the part of the animals that, the authors proposed, could most parsimoniously be explained by the chimpanzees' attribution of mind to other animals.

The excitement and novelty of such projects clearly depend on the degree to which simpler and better substantiated explanations can effectively be dismissed (for related examples, see Cheney & Seyfarth, 1985; Karakashian, Gyger, & Marler, 1988). Povinelli et al. (1990) suggested that a contingency-based account of their data, although possible, was not likely given the claimed immediacy with which the chimpanzees learned the transfer task. In a recent review of that project, however, Heyes (1993) argued that the essential data that could have documented the immediacy of discrimination transfer had not been provided in the original report. Povinelli (1994) responded to Heyes by reporting those data; unfortunately, they showed that the chimpanzees had not in fact exhibited immediate transfer, thus undermining the argument that contingency-based learning was an unlikely explanation for the results.

The outcome of this (or any other) experiment does not, of course, mean that chimpanzees do not make mental attributions—indeed, such a notion cannot be disproved. But the Povinelli–Heyes exchange does illustrate the value of retaining healthy skepticism as increasingly complex cognitive processes are attributed to animals by their human experimenters. In fact, a forthcoming report (Gagliardi, Kirkpatrick-Steger, Thomas, Allen, & Blumberg, in press) suggests that even human adults—whose abilities to make attributions of mental states to others are rarely questioned—often do not exhibit behaviors that accord with such a purported ability when they were given a task similar to that used by Povinelli and his colleagues.

The assumption that humans behave with the causal mediation of consciousness is one that is very difficult to dismiss because it appears to be substantiated by all people on a daily basis; its substantiation comes not from analogy, but from direct personal experience. Nonetheless, the notion that consciousness does not play a causal role in behavior has many current supporters (e.g., Harnad, 1982). The historical roots of this idea—that consciousness may be a by-product of the activity of the brain rather than a causal factor in behavior—goes back at least as far as the writings of T. H. Huxley, as quoted by William James (1890/1983):

> The consciousness of brutes would appear to be related to the mechanism of their body simply as a collateral product of its working, and to be as completely without any power of modifying that working, as the steam-whistle which accompanies the work of a locomotive engine is without influence upon its machinery. Their volition, if they have any, is an emotion indicative of physical changes, not a cause of such changes. (p. 135)

Huxley's conception of consciousness, called *epiphenomenalism*, was historically supplanted by James's functionalism; however, it has nevertheless remained a viable alternative to other conceptualizations of the nature of the human mind.

Although some may find it absurd to question the nature and importance of human consciousness, one must not overlook the numerous instances of one's own inability to identify correctly the environmental influences that control behavior (e.g., Nisbett & Wilson, 1977). Humans, like animals, often display mindlessness.

As one particularly clear example, researchers were able to induce stuttering in a normal, nonstuttering participant using a negative reinforcement paradigm (Goldiamond, 1965). While reading from a text, the participant received continual electric shock. When the participant exhibited a nonfluency (i.e., when he stuttered), the shock was turned off. Within a short period of time, the participant was stuttering at such a high rate that he was no longer receiving shock. Moreover, when the participant was tested again two days later, his stuttering rate was so high that he was only shocked twice. The participant's explanation of his own behavior is most surprising and enlightening. He

> repeatedly attributed his nonfluencies to his anxiety and his anxiety to his nonfluencies. . . . He was finally asked if a shock might have been contributory. "Oh no," he said. "On the first day, you had a short somewhere, and your equipment leaked so badly that I meant to tell you about it. You had it fixed by the second session. Shocks had nothing to do with my stuttering.

I stuttered worse today [during the second session], but there were no shocks at all today," which was almost true, but it was [his] behavior that produced this condition of no shock. So much for [his] explanation of his own behavior. (Goldiamond, 1965, pp. 111–113)

These and increasing numbers of other experimental examples (e.g., Hefferline, Keenan, & Harford, 1958; Svartdal, 1991) highlight the inadequacies of human self-awareness. Although people may think they understand their own behavior and its causes, all too often they do not. Thus, researchers must exercise extreme caution not to assume too much about human consciousness as they go about assessing the minds of nonhuman animals. Humans may be very much like animals—but not in the way that mentalists would like people to believe.

Concluding Comments

Perhaps because of the prominence of behaviorism in experimental psychology during most of the 20th century, many current critics are all too eager to believe that this approach has outlived its usefulness. Some (e.g., Allen & Hauser, 1991) have prematurely announced the demise of behaviorism. Others (e.g., Griffin, 1992) have characterized behaviorists as cold, unfeeling, and dogmatic purveyors of scientifically correct thinking.

In fact, behaviorism has had to adapt to many challenges, even from those within its own ranks. For instance, Breland and Breland (1961) were among the first investigators to force behaviorists to acknowledge the important interrelation between acquired and inherited actions (also see Skinner, 1966). Similarly, some of the notable achievements of contemporary cognitive psychology have inspired many of today's behaviorists to examine the cognitive capabilities of animals through highly advanced behavioral techniques (Hulse, Fowler, & Honig, 1978; Wasserman, 1993). Nevertheless, the careful anchoring of inferred cognitive processes (e.g., memory, timing, attention, conceptualization, etc.) to observable and manipulable events, the postulation of an extremely limited number of such objectively defined and operationalized processes, and the scrupulous avoidance of untestable mentalistic mechanisms are all essential to the further development of a scientific psychology of animal cognition (Honig, 1978; Pribram, 1978; Wasserman, 1981a, 1982, 1983). The mentalistic framework of the cognitive ethologists would appear to be too fundamentally flawed to advance that science (Michel, 1991; Yoerg & Kamil, 1991).

"Anthropomorphizing works," declared Cheney and Seyfarth (1990, p. 303) about their studies of vervet monkey behavior. "Attributing motives and strategies to animals is often the best way for an observer to predict what an individual is likely to do next" (p. 303). Although many researchers view this brand of "mock" anthropomorphism as a natural and effective heuristic, it is also clear that this form of anthropomorphism can all too easily lead one down the proverbial primrose path toward a form of "explicit" anthropomorphism (Burghardt, 1985; Kennedy, 1992). In contrast to mock anthropomorphism, where one may use the notion of a mental state as a guide for evaluating a behavior's function, explicit anthropomorphism elevates the mental state to the level of a causal mechanism for explaining behavior. It is the willingness to take that last interpretive step, from mock to explicit anthropomorphism, that characterizes the mentalist.

Today there appear to be growing numbers of researchers of animal behavior who are ready and eager to take that perilous step; they do so with the firm conviction that new experimental approaches are overcoming the once powerful antimentalistic arguments of behaviorists and their allies. It is our experience, however, that many of these bold conclusions about conscious mental processes in animals are rash and will not withstand close scrutiny (e.g., Gagliardi et al., in press; Wasserman & Astley, 1994). The search for new paradigms to examine the possible private mental life of animals will no doubt continue; we hope and trust that there will always be hard-headed critics around to point out the shortcomings of each new effort (see the target article by Lubinski & Thompson, 1993, and its several follow-up commentaries for a recent endeavor to elucidate private events in pigeons).

We close by noting that—if we may be allowed this one mentalistic reference—there is a strong sense of déjà vu to the current debate between animal mentalists and those espousing a more objective analysis of animal behavior and cognition. Indeed, most of the essential arguments for and against mentalism and behaviorism were well-rehearsed during the opening decades of the 20th century. Of course, like all sciences, psychology can be expected to revisit seminal issues over succeeding generations. But psychology has proved to be especially susceptible to radical shifts in its intellectual foundations, perhaps because of its relative youth as an independent discipline and the humbling complexity of its subject matter. One eminent psychologist observed that

> psychology has ever been the playground of philosophers, ignorant of its empirical findings but confirmed in their belief in the unassailability of their introspections and determined that psychology must be made the stepping stone to a knowledge of reality and value. . . . It is only by divorcing itself from metaphysics and values and adopting the phenomenological method of science that psychology can escape the teleological and mystical obscurantism in which it is now involved. (Lashley, 1923, p. 347)

Those words, so appropriate today, were written over 70 years ago by the neuropsychologist Karl Lashley. Is it not time to profit from extensive experience with animal mentalism and again resume the less fashionable but more achievable quest for natural laws of animal behavior and cognition?

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