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The Human Side of Animal Behavior

Kennon A. Lattal
West Virginia University

An important element of behavioral research with nonhuman animals is that insights are drawn from it about human behavior, what is called here the human side of animal behavior. This article examines the origins of comparing human behavior to that of other animals, the ways in which such comparisons are described, and considerations that arise in evaluating the validity of those comparisons. The rationale for such an approach originated in the reductionism of experimental physiology and the understanding of the commonalities of all life forms promulgated by Darwinian evolutionary biology. Added more recently were such observations as the relative simplicity of animal behavior, tempered by the constraints placed on resulting comparisons by the absence of verbal behavior in animals. The construction of comparisons of human behavior to that of animals may be framed on the basis of Skinner's (1957) distinction between the metaphorical and generic forms of the extended tact. Both ordinary and systematic comparisons of animal and human behavior are congruent with Skinner's extended tact framework. The most general consideration in evaluating comparisons of animal and human behavior is that a functional basis for the claimed similarity be established. Systematic analysis and convergent evidence also may contribute to acceptability of these comparisons. In the final analysis, however, conclusions about the human side of animal behavior are nondeductively derived and often are assessed based on their heuristic and pragmatic value. Such conclusions represent a valuable contribution to understanding the human animal and in developing practical solutions to problems of human behavior to which much of psychology is dedicated.

Key words: animal behavior, human behavior, extension, metaphor, model, analogue, simulation, extrapolation, generalization, evaluation

Harlow's clinging monkeys, Skinner's superstitious pigeons, Brady's executive monkeys, and Seligman's helpless dogs are among the most well-known images in psychology (Brady, Porter, Conrad, & Mason, 1958; Harlow, 1958; Seligman, 1974; Skinner, 1948). Each has been suggested to portray familiar human behavior in nonhuman animals (hereafter described as animals), purporting to reveal the human side of animal behavior. Only about 7% of the pages of journals published by the American Psychological Association have dealt with animal behavior (N. Miller, 1985). Despite this small percentage, the impact of such work on the understanding of human behavior has been substantial. This research has helped to shape both broad conceptual frameworks for understanding and interpreting human behavior (e.g., Skinner, 1953) and specific research areas and problems of human behavior (e.g., Branch & Hackenberg, 1998; Domjan, 1987; Epstein, 1986; Keehn, 1986; Maser & Seligman, 1977; N. Miller, 1985). Such work, however, is not without controversy. Even though the contributions have been numerous, critics have noted shortcomings and limitations of basing a science of human behavior in large or small part on insights about an understanding of behavioral mechanisms derived from animal research (e.g., Chomsky, 1959; Gardner, 1985; Lowe, 1983; Schwartz, Schuldenfrei, & Lacey, 1978).

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Address correspondence to the author, Department of Psychology, West Virginia University, Morgantown, West Virginia 26506-6040 (E-mail: klattal@wvu.edu).

A linchpin in both responding to critics and further developing connections, both broad and specific, between human and animal behavior is a better understanding of the processes or methods by which the two are compared. Despite their pivotal role, such processes have been assumed more often than discussed, and even less seldom assessed. This review therefore examines the process of relating human behavior to that of other animals. Three questions are important in the process, and each is considered in turn: How did the practice of relating human and animal behavior originate, and how does it continue to be justified? How have similarities between human and animal behavior been established? And how are such asserted similarities evaluated?

ORIGINS AND RATIONALES FOR RELATING HUMAN AND ANIMAL BEHAVIOR

Origins

Historical precedents often set in place practices early in the development of a discipline that determine the further development and practices of the discipline. Such is the case with psychology and the study of animals. It therefore is to those earlier events that I first turn in considering how psychology and, later, behavior analysis developed the practice of relating animal and human behavior.

Using *systematic* observations of and research on animals to draw conclusions about human behavior began with 19th-century physiology, when, for example, the French physiologist Bernard observed that "without [the] comparative study of animals, practical medicine can never acquire scientific character" (1865/1957, p. 126). The close relations among medicine, physiology, and early experimental psychology, and particularly the emphasis on a reductionistic approach to studying human functioning in physiology and medicine, contributed to the development of animal experimentation in psychology. In 1895, Meyer, a psychiatrist who had used white rats while a medical pathologist, suggested the rat's utility as a subject to Kline. Kline became the first psychologist to use them, around 1897, in laboratory demonstrations for a comparative psychology class at Clark University. Kline's colleague, Small, built the first maze for rats and conducted the first experiments in psychology using them as subjects (Boakes, 1984; see Small, 1900). In the context of the present discussion, it is ironic that Small's maze was modeled, and named, after one built for the amusement of aristocratic humans at Hampton Court Palace in England.

Concurrent with advances in nervous system physiology that bore on the understanding of behavior, Darwinian evolutionary theory and 19th-century naturalism led to theoretical interest in animal mind and intelligence (Boakes, 1984). This interest in turn followed two general paths. One led to modern ethology, with its emphasis on the study of animal behavior in natural settings. The other led to comparative psychology, which began with the comparative study of mind and its evolution, as exemplified by Thorndike's (1898) seminal work on animal intelligence. This latter path infused both the traditions of rigorous objective description and experimental analysis into the psychological study of animal behavior.

Among other things, problems of making nontrivial behavioral comparisons across species and the more general difficulty of defining intelligence, in either human or animal, ultimately gave rise to a new science of animal and human behavior that focused on learning. Watson, who used rats as the subjects for his dissertation and who subsequently worked extensively in comparative psychology, called learning the "great problem in all human psychology." To this he added, "and any facts we can gather about the way the animal learns will be helpful to us" (1910, p. 351). He went on to observe

that "man gets his first steps [in learning a new skill] in exactly the same way as does the animal" (p. 352) and "it is not a difficult matter to show that there is a practical import to the study [of animal psychology]" (p. 353).

Even though Watson's career subsequently shifted, the new psychology of learning, based largely on the study of animals, had gained a strong foothold in American psychology. The interest in learning as a central problem of psychology culminated in the so-called grand learning theories of the 1930s, the work of Tolman, Hull, Guthrie, and Skinner. Each of these theorists articulated and refined the notion that animal and human learning were made of similar stuff. Tolman (1938), for example, reflected this optimism about the new psychology of learning when he observed that,

> Everything important in psychology (except perhaps such matters as the building up of a superego, that is, everything save such matters as involve society and words) can be investigated in essence through the continued experimental and theoretical analysis of the determiners of rat behavior at a choice point in a maze. Herein I believe I agree with Professor Hull and also with Professor Thorndike. (p. 34)

Rationales

Contemporary observers of relating animal and human behavior include many authors of recent psychology of learning textbooks. These authors justify the use of animals at least in part because of its importance to developing behavior principles that are general across many species. The direct relevance of animal experimentation to human behavior is either implicit or explicit in many such textbooks, iterating Skinner's (1953) observation that "We study the behavior of animals because it is simpler. . . . Conditions may be better controlled" (p. 38; cf. Catania, 1992; Lieberman, 1990; Mazur, 1986; Schwartz, 1989). "Simpler" is rarely defined precisely. Among its implied meanings are that fewer or more easily specified variables are involved in the control of animal behavior in comparison to multiply determined human behavior, that variables are more easily controlled in studying animal as opposed to human behavior, or that the processes involved in animal behavior are somehow more basic.

Other reasons for studying animals also are given. Domjan and Burkhard (1986) added that genetic factors can be controlled in animal studies of learning (although in practice they are not often considered). Another justification sometimes given is that a wider range of problems and variables can be investigated with animals than with humans because of the different code of ethics for experimentation with animal as opposed to human subjects (Domjan & Burkhard, 1986). Others have suggested that using animals eliminates expectancy effects on the part of the subject (Mazur, 1986; Zajonc, 1969), an observation that relates to the absence of language in animals.

This absence is at the core of a large body of objections to relating human and animal behavior. Some psychologists reacted positively to the absence of language. Zajonc (1969), for example, suggested that this absence forced the use of nonverbal measures of behavior. The norm among many other psychologists, however, ranges from reasoned caution to wariness in relating the behavior of nonverbal animals to that of verbal humans:

> Through his language responses the individual has become an integral part of a system of conditions which extend his environment virtually without limit as to space and time. An animal on the other hand can react only to the immediate environmental conditions during its life and only within the spatial range of its own sense organs. (Weiss, 1929, pp. 169–170)

> A price is always paid for the convenience of a given approach to a problem. The price to be paid for over much experimentation with animals is to neglect the fact that human subjects are brighter, are able to use language—*and probably learn differently because of these advances over lower animals.* (Hilgard, 1948, p. 329)

> The unavailability of language as a medium of cognition for animals dictates that models of animal cognition will differ in many important re-

spects from their human counterparts. (Roitblat, Bever, & Terrace, 1984, p. 9)

Such cautionary observations certainly are warranted. On the other hand, there also is danger in overstating the differences in terms of the absence of verbal behavior in other animals at the expense of overlooking or dismissing valid similarities. For example, in experimental work, differences between animal and human behavior on basic tasks, such as reinforcement schedules, have been cited in support of a discontinuity between animals and humans based at least in part on language (e.g., Lowe, 1983). In response, however, others, such as Perone, Galizio, and Baron (1988), have suggested caution in too quickly concluding discontinuities between human behavior and that of other animals. They suggest, for example, how procedural differences between studies of reinforcement-schedule performance of animal and human subjects may account for at least some aspects of performance differences and thereby identify the source of some of the purported discontinuities (cf. Joyce & Chase, 1990; LeFrancois, Chase, & Joyce, 1988). Zajonc's (1969) observation that "the existence of such discontinuities is today more a matter of opinion and conjecture than established fact" (p. 3) remains relevant in such discussions. Language certainly adds a layer of complexity that warrants continued analysis, but, as Sidman (1960, p. 55) has noted, behavioral differences between species are easy to find, but the similarities that are found are often more responsible for advancing the science. It is to the analysis of those similarities that we now turn.

EXTENDING CONCEPTS AND PRINCIPLES

Relating animal and human behavior involves extending concepts and principles developed in one set of circumstances to another. As part of his analysis of verbal behavior, Skinner (1957) proposed the extended tact as a process whereby verbal practices—for example, concepts, principles, or labels—are brought under the control of new circumstances. Such extended tacts occur when, after a verbal response has been reinforced in the presence of one stimulus, "a novel stimulus possessing one [common feature with the original stimulus] . . . evoke[s] a [similar verbal] response" (p. 91). Two types of extended tacts identified by Skinner are generic and metaphorical. Generic extension is akin to stimulus generalization in that a new stimulus is sufficiently similar to one previously correlated with reinforcement that the new stimulus now controls a similar verbal response to that reinforced in the presence of the old stimulus. It also resonates to Sidman's (1960) analysis of systematic replication in that the conditions under which a phenomenon first are observed are extended by varying the dimensions of the original situation. Metaphorical extension "takes place because of the control exercised by properties of the stimulus, which though present at reinforcement, do not enter into the contingency respected by the verbal community" (Skinner, 1957, p. 92).

These two types of extension may be used to describe how animal and human behavior have been related to one another. Such extension, in addition, may be identified as ordinary, that is, based on casual, informal observation and conceptually "loose" description, or systematic. The latter are based on a conceptual framework that typically is grounded in naturalistic and experiment-based observations.

ORDINARY COMPARISONS OF HUMAN AND ANIMAL BEHAVIOR

Comparisons of human behavior and that of other animals in everyday experience frequently begin with an observation of animal behavior that then is identified with processes or features usually associated with humans. Such ordinary comparisons are anthropo-

morphic or metaphorical, and they are the most elementary examples of attempts to relate animal and human behavior.

Anthropomorphism

Is the cat embarrassed? Is the bird sad? Anthropomorphic statements are statements of assumed literal similarities or isomorphisms between animal and human behavior. Affirmative answers to the two questions above suggest literal similarities: The cat *is* embarrassed and the bird *is* sad. These assertions are based on the extension of nominal human characteristics to another species, the process that Skinner (1957) labeled *generic extension*: Whatever aspects of behavior that control the use of these terms to describe human behavior are assumed to control their use in the animal case. Of course, not all statements of similarities between animal and human behavior are anthropomorphic. For example, saying that a dog and a human are both hungry, tired, or asleep may be literal similarities and not anthropomorphic comparisons.

Generic extensions that are anthropomorphic are subject to many criticisms (see Kennedy, 1992). One of the oldest is Morgan's (1894): "In no case may we interpret an action as the outcome of the exercise of a higher psychical faculty, if it can be interpreted as the outcome of the exercise of one which stands lower on the psychological scale" (p. 53). Another is that many of the characteristics attributed anthropomorphically to animals are ambiguous in the human behavior from which they derive. For example, even such psychological mainstays as *anxiety* are defined in many different ways in the scientific literature, making descriptions of animal behavior in such terms even more confusing. One might define *embarrassment* as "a social emotion that seems to require a knowledge of how one appears to others." Presumably, such knowledge is lacking in the cat, thereby adding surplus meaning to the term as applied to animal behavior. The broader question here is whether such a definition of even human embarrassment is viable. Does it require self-knowledge? Is embarrassment an emotion or is it behavior in context? How is "knowledge of one's appearance" determined?

Despite the compelling logic of Morgan's (1894) canon and other criticisms of anthropomorphism by behavioral scientists, anthropomorphic descriptions of animal behavior have influential contemporary practitioners and defenders (e.g., Griffin, 1984), just as they have historical ones (Romanes, 1882; see also Baenninger, 1994, Heyes, 1987, and Kennedy, 1992, for further thoughtful commentaries on anthropomorphism in contemporary ethology and comparative psychology).

Metaphor

Consider the following two responses: "The dog is jealous" and "The dog behaves like it is jealous." In the context of the preceding discussion, the first statement is anthropomorphic if it is presented as literally true. If, on the other hand, the first response means what the second response says, then it is a metaphor. The second statement is a simile, which is included here as a form of metaphor (cf. Skinner, 1957). Davidson (1984) noted that "a simile tells us what a metaphor merely nudges us into noting. . . . The figurative meaning of a metaphor is the literal meaning of a simile" (p. 253). In the functional sense of applying or extending a concept to a new context and for ease of description, in line with previous suggestions by Skinner (1957) and Goodman (1968; cited in Davidson, p. 255), metaphor and simile are considered together here. In either the metaphor or the simile version of the above description of what is described as jealousy in the dog, there is control of a verbal response by stimulus properties that more typically control such responses in the presence of human behavior; hence, they fit Skinner's anal-

ysis of metaphorical extension. Such extension also is synergistic in that the nature of the original concept changes when the metaphor is extended. Thus, by asserting that the dog is jealous, the very definition of jealousy, however imprecise in the first place, is changed to include this new usage. As Skinner (1957, p. 93) also noted, once reinforced, a metaphorical verbal response ceases to be a metaphor.

Metaphorical extension can facilitate the emergence of new concepts from old ones (Catania, 1992; Schon, 1963). Catania observed that "much of technical vocabulary evolved metaphorically from concrete, everyday sources" (p. 273). Zuriff (1985) went even further, noting that "far from being pejorative, the adjectives 'metaphorical' and 'analogical' are at the very core of the best scientific thought" (pp. 221–222). Some of the most familiar concepts in psychology are based on metaphor, from Freud's likening the unconscious to an iceberg and James's stream of consciousness to the reliance of information-processing theory on the metaphor of the computer. Even the concept of reinforcement originated in metaphor.

The loose stimulus control of metaphorical extension also makes such extension valuable in everyday language and literature. It allows an economy of expression such that a wealth of connotations can be summarized in a single word or phrase. This summary of connotations that metaphor allows in language and literature also is manifest in extending scientific concepts, as noted in the preceding paragraph. Such metaphorical extension in science, however, is a double-edged sword, and perhaps this is why Skinner (1957) contended that metaphorical extension "is one of the great differences between science and literature" (p. 99). The very flexibility that allows extension also allows ambiguity and surplus meaning in scientific vocabulary, with resulting confused definitions of terms such as anxiety and jealousy as described above (see also Mandler & Kessen, 1959).

SYSTEMATIC COMPARISONS OF HUMAN AND ANIMAL BEHAVIOR

In contrast to anthropomorphic and casual metaphorical comparisons of animal and human behavior, in many instances the relations asserted between the behavior of humans and other animals are based on more formal and systematic observations of the sort that occur in the context of experimental analysis. In addition, such comparisons have a conceptual base, which most commonly is the psychology of learning (cf. Domjan, 1987). Rather than the goal of simple description that characterizes anthropomorphic and casually metaphorical comparisons of animal and human behavior, the goal of systematic comparisons is the prediction, if not control, of behavior (cf. Epstein, 1986).

Grosch and Neuringer (1981) observed that systematic relations between animal and human behavior may be established through processes of either analogical or extrapolative reasoning. These are but two other terms for, respectively, metaphorical and generic extension (Skinner, 1957; see also Zuriff, 1985, pp. 220–222). Even though in the literature of experimental psychology systematically relating animal and human behavior is described in a number of different ways, these different descriptions reflect comparisons made through the use of either metaphorical or generic extension. Table 1 provides examples of investigations based on these two methods of extension, along with the descriptions of the comparisons used or implied by the investigator. It is proposed that all of the nominal types of comparisons in Table 1 can be categorized into two groups. In the first are those involving metaphorical extension; it includes those labeled analogues, simulations, and models. In the second are those involving generic extension; it includes those

TABLE 1

Examples of classes of human behavior or concepts typically associated with human behavior that have been studied with animals and the descriptions assigned to such comparisons by authors or implied by the authors

Human behavior under study	How described?	Authors
Freedom	Extrapolation	Catania (1983)
Self-control	Extrapolation	Catania (1983)
Verbal behavior	Extrapolation	Catania (1983)
Insight	Simulation	Epstein (1986)
Self-awareness	Simulation	Epstein (1986)
Symbolic communication	Simulation	Epstein (1986)
Tool use	Simulation	Epstein (1986)
Use of memoranda	Simulation	Epstein (1986)
Alcoholism	Model, homologue	Falk and Tang (1980)
Depression	Extrapolation	Ferster (1966)
Self-control	Model, analogue	Grosch and Neuringer (1981)
Love	Extrapolation	Harlow (1958)
Gambling	Analogue	Kendall (1987)
Cultural transmission	Extrapolation	Lefebvre and Giraldeau (1994)
Communication of private states	Model	Lubinski and Thompson (1987)
Phobia	Model	Mineka (1987)
Anorexia	Model	Pierce and Epling (1994)
Self-control	Extrapolation	Rachlin and Green (1972)
Depression	Model	Seligman (1974)
Superstition	Extrapolation	Skinner (1948)

labeled extrapolations and homologues.

Comparisons Based on Metaphorical Extension

Metaphorical extensions involve what might in ordinary language be called novel descriptions of behavioral processes of animals. In the case of comparing animal and human behavior, such extensions typically begin with an observation of human behavior that in turn leads to an attempt to construct aspects of the behavior in the animal laboratory. As a result, a property of the stimulus (in this case the behavior of the animal) controls verbal behavior, normally or typically associated with human behavior, that does not "enter into the contingency respected by the verbal community" (Skinner, 1957, p. 92) with respect to the behavior of animals. Thus, a label like *self-control,* typically controlled by aspects of human behavior, comes to be used to describe the behavior of animals under certain conditions.

Such constructions are described variously as models, analogues, or simulations. The use of different labels to describe these constructions raises the important question of whether these labels imply a distinct method for comparing human and animal behavior. Analogues and models are both incomplete depictions or representations of the putative phenomenon under study, but they are incomplete in different ways. An analogue has an "as if" character along the lines of a simile. By contrast, a model attempts to represent only some of the features—the essential ones—of the phenomenon being modeled. Models and analogues are regarded as logically distinct in formal theory construction. In such constructions, the sequence of development begins with metaphor, then moves to analogues, and finally to more precisely or formally constructed models (e.g., Pribram, 1980). The relations among metaphor, analogue, and model in comparisons of human behavior to that of animals, however, are

not so precise. The labels of analogue and model frequently are used interchangeably. Grosch and Neuringer (1981), for example, noted that their "experiment explores an animal *model* of self control" and in the next paragraph state that their "experiments used the . . . '*analogue*' approach" (p. 3). Mace (1994) observed that "animal *models* [of behavior disorders] have been used by behavioral researchers with promising results. . . . For example, learned helplessness provides an experimental account and *analogue* to depression" (pp. 544–545). Falk and Tang (1980) similarly described how homologues might serve as models. Epstein (1986) equated models and simulations by noting that "Some *simulations* mimic phenomena in relatively arbitrary ways. At one extreme are *models*" (p. 132). The same procedure that Epstein discussed as a *simulation* of social communication, Lubinski and Thompson (1987) identified as a *model* of that process. (Italics have been added in each of the quotations.)

The term *model* often is used to describe animal studies of symptoms associated with behavior pathology of humans (e.g., Keehn, 1986), perhaps because of the connections of clinical psychology with psychiatry and psychiatry in turn with general medicine. In the latter, animal research on physiological and disease processes is commonly labeled as a model of the disease under study. The term therefore may be attractive to describe in animal–human behavior comparisons because of the status of its association with animal models of disease and physiological functions. *Model* also is associated with relatively precise quantitative descriptions of behavior. The precision of the comparison to human behavior through an animal model, however, is no greater than what is described as an animal analogue or a simulation.

Thus, in that *model, analogue,* and *simulation* are used more or less interchangeably, there is no basis for asserting one is different from, let alone more precise than, the others. In describing comparisons of human and animal behavior, these labels set the occasion for imprecision and conceptual confusion (cf. Hineline, 1980). This is not to imply that in other contexts the terms have the same use or meaning (cf. Kaplan, 1964/1998; Mandler & Kessen, 1959; Pribram, 1980), only that they have not been used in systematically different ways when applied to comparing animal and human behavior. The use of different labels is controlled by idiosyncratic and perhaps local scientific and social contingencies rather than systematic features of the comparison being made. The common feature of the three terms is their grounding in metaphorical extension, and this seems to be the more accurate description of the method of the comparisons.

Comparisons Based on Generic Extension

Generic extensions, as we have seen, involve the control of a verbal response by stimuli that are similar to ones previously associated with reinforcement. When these extensions are systematic, they have been labeled by investigators as *extrapolation, extension,* or *generalization.* In contrast to metaphorical extension, generic extension most often has begun with observations of a behavioral process in animals that then are extended to human behavior. An observation by Ferster (1966) illustrates the approach: "If the major feature of clinical depression is a reduced frequency of behavior under normal control by the environment, to apply a laboratory analysis of behavior we first need to determine how the basic behavioral processes might increase or decrease the frequency of behavior" (p. 346). Thus, the label, and process, of extinction, developed in the laboratory, is extended to human behavior in natural settings.

As with the different terms used to describe systematic metaphorical extensions, the different terms used to de-

scribe generic extensions do not connote different methods of making the comparisons. Each of the three therefore may be considered as an instance of a single method of comparison based on generic extension. The process involves establishing a behavioral principle, then analyzing naturally occurring human behavior into its component parts, and finally bringing the behavioral principle derived in the laboratory to bear on the components. Thus, a behavioral principle is extrapolated, extended, or generalized from the analysis of animal behavior to that of humans. The human behavior then is described as being restructured, reconceptualized, or synthesized (cf. Catania, 1983), in terms of the basic principles. Because the basic principles often first are formulated based on experiments involving animals, a similarity of behavioral process between the two is inferred.

Homologues and Generic Extension

In evolutionary biology, homologous structures are those with similar phylogenetic origin (e.g., the wing of a bird and the foreleg of a horse) despite different function (e.g., flying and walking). These may be contrasted to structures labeled analogues, which have similar functions despite different phylogenetic origins (e.g., the wings of a bee and those of a hummingbird) and are the result of parallel evolution (Lorenz, 1974). Applying these descriptions to comparisons of human behavior to that of other animals, behavior patterns that appear similar but are controlled by different behavioral processes may be said to be analogous. Behavior patterns that do not necessarily appear the same but are controlled by identical behavioral processes may be said to be homologous (cf. Lattal, 1998).

Thorndike (1898) appears to be the first psychologist to apply the label of homologue to the comparison of human and animal behavior when he posed as the central question of his monograph on animal intelligence that of whether "animal association is homologous with the association of human psychology" (p. 108). More recently, psychologists and behavior analysts also have described behavioral homologues (e.g., Falk & Tang, 1980). Concerning the possible similarity between rewarding oneself with a treat for completing a writing project and reinforcing the responses of animals with food, Malott (1993) observed,

> Getting a bite of food after loading it on your fork is *homologous* to your dog's getting a bite of food after rolling over. . . . Both are direct-acting contingencies of reinforcement. They serve the same function. . . . But your [rewarding yourself for writing the paper] is only analogous to your dog's getting a bite of food after rolling over. . . . The control your contingency exerts over your future writing is a rule-governed analog to reinforcement and requires language skills. Your dog's contingency is reinforcement and requires no language. . . . These two contingencies are only superficial analogs (not fundamentally related homologs). (pp. 9–10)

Homologues may be recast as instances of generic extension. Malott's (1993) first example illustrates the point. The common stimulus is "getting a bite of food after an action" and the verbal response controlled by both would be "reinforcement." The extensions described in Table 1 as analogues conform more closely to metaphorical extension than to the structural definition offered by Malott, illustrating again the ambiguity of the plethora of terms used in describing relations between human and animal behavior. This consideration of homologues completes the review of how relations between animal and human behavior have been constructed. We now turn to how such constructions might be evaluated.

EVALUATING ASSERTED RELATIONS BETWEEN ANIMAL AND HUMAN BEHAVIOR

Evaluating assertions of similarity between human behavior and that of other animals is not different in prin-

ciple from the assessment of assertions about other between-species similarities and differences or of how any laboratory study of behavior relates to behavior in nonlaboratory settings. Lorenz (1974) suggested that "no such thing as a false analogy exists: An analogy can be more or less detailed and hence more or less informative" (p. 230). A similar observation may be made for the metaphorical and generic extensions between animal and human behavior described above. The strength of asserted relations between animal and human behavior can rely on neither their falsifiability nor the impossible criterion of the two being isomorphic. Other dimensions must be considered when evaluating asserted relations between human and animal behavior.

Structure Versus Function

Probably the most universal consideration among behavior analysts is whether the claimed similarity between animal and human behavior focuses on structure or function. This is in part the distinction between analogues and homologues discussed above. Many comparisons of animal and human behavior, particularly anthropomorphic and metaphorical ones, are made on the basis of superficial similarity of appearance or topography of the behavior. The use of structure as a basis for comparison is not limited, however, to anthropomorphism and metaphor. Marks (1977), for example, made the ambiguous observation that "to be useful, models of psychopathology must bear strong resemblance to their natural counterparts" (p. 174). If a resemblance of topography or form is being suggested, the observation is contrary to the position of behavior analysts that structural similarity between animal and human behavior is neither necessary nor sufficient for valid, useful comparisons of the two. First, any similarity in appearance may be superficial. Second, a structural criterion would preclude the analysis of many characteristically human behavioral phenomena with animals. Third, employing a structural criterion for such comparisons is to commit what Bachrach (1965) labeled the analogue error, a point iterated somewhat differently by Malott (1993, discussed above). Two instances of behavior may appear similar in topography or form, but the controlling variables may be different. A lethargic dog can be created with ease, but to equate the dog's lethargy with human depression *on the basis of similar appearance* is to commit the analogue error. Psychological depression in humans and animals may share certain features, but these features are functional rather than necessarily similar in form. In a complementary manner, differently appearing behavior in humans and animals may be controlled by similar variables or behavioral processes. For example, the form of revenge in humans might involve planning and other forms of verbal behavior (e.g., Dumas' *The Count of Monte Cristo*). What we might study as revenge in rats or pigeons would likely have a different topography or appearance. Yet, the functional, controlling variables of both instances could be the same.

Systematic Nature of the Comparison

Generally speaking, behavior analysts favor systematic observations under controlled conditions over more informal or casual observations. Systematic observations most often result from laboratory experimentation, where the phenomenon's "defining properties and . . . range of applicability can be refined" (Catania, 1983, p. 59). Insightful and useful observations of the relations between animal and human behavior, however, also have come from systematic naturalistic observation of behavior in evolutionary context (e.g., Lorenz, 1974). The heuristic role of an informal anthropomorphic observation or a casual metaphor, however, cannot be dismissed categor-

ically. These latter observations are limited in both scope and precision, but they can serve as a first approximation to comparing human and animal behavior subsequently in more systematic ways.

Quantitative Dimensions

The assertion of similarities between animal and human behavior often is strengthened if the behavior involves multiple similarities. This is not necessary, however, for establishing similarity between human and animal behavior, but is only helpful. This multiple-similarities approach is sometimes described as the gathering of convergent evidence (e.g., Pierce & Epling, 1994). W. Miller, Rosellini, and Seligman (1977) suggested that similarities in symptoms, etiology, cure, and prevention might yield a good test of an animal model of depression: "As two phenomena converge on one or two of the criteria, investigators can then test the model by looking for similarities predicted along the other criteria" (p. 144). An example of a carefully constructed comparison in which numerous similarities between animal and human behavior were identified and thereafter confirmed experimentally is the work of Grosch and Neuringer (1981). They demonstrated that the controlling variables of self-control in pigeons paralleled similar variables in human self-control demonstrated in a series of experiments conducted by Mischel (e.g., 1974). Similarly, the question of points of similarity was the focus of discussion as to the value of a claimed simulation of communication by pigeons conducted by Epstein, Lanza, and Skinner (1980) (e.g., Savage-Rumbaugh, 1986).

What might be called levels of similarity is another dimension of a quantitative comparison. Consider anorexia nervosa, which has been addressed at three levels. First, it is a failure to eat. Second, it involves physiological changes that may be causative. Third, anorexia, in humans at least, entails environmental as well as simply physiological determinants. Animal studies involving the different levels may prove differentially useful in the treatment of this disorder. Simply creating circumstances under which an animal fails to eat (a structural approach) is not in itself useful in shedding light on human anorexia, because the animal's failure to eat, like the humans, may be a function of many variables. Identifying the physiological basis of anorexia in animals (e.g., Mrosovsky & Sherry, 1980) may be more useful, but it still does not address environmental determinants of the human disorder. Animal studies that focus on environmental determinants in concert with physiological variables, that is, those that involve multiple levels, may prove to be the most useful in developing treatment programs (e.g., Pierce & Epling, 1994).

Qualitative Dimensions

Even though a proposed relation between the behavior of humans and other animals may point to only a few specific similarities (or even one) between the species, it still can stimulate conceptual and experimental analysis of the possible similarities. Such qualitative similarities involve heuristic and pragmatic, rather than necessarily logic-driven, considerations in evaluating the animal–human behavioral comparisons. As Catania (1983) noted,

> The success of the [analogue] is . . . judged not only on the basis of the empirical results but also on the extent to which the refined understanding of the phenomenon has implications for the human non-laboratory situations from which the analog emerged. (p. 59)

This is the "useful working" criterion of pragmatism (James, 1955). Similarly, Zuriff (1985) observed that an extrapolation from one phenomenon to another may be regarded as a "brilliant insight and as a demonstration of the heuristic fertility of [the asserted similarity between two phenomena]," but he then went on to ask,

> What then distinguishes this case from the "tea leaves case" where the extrapolation is invalid? In both cases the scientist may be supposed to provide a defense of the derivation by pointing to specific alleged similarities between the [two] domains. . . . The difference is that in the one case others see the similarity and in the latter case they do not. (p. 221)

Most comparisons of animal–human behavior are, as Zuriff (1985) notes, "non-deductively derived" (p. 221), leaving the criteria for evaluating the relation rather open ended. Sidman (1960) put it this way: "Induction is a behavioral process, not a logical one . . . evaluation of generality is a matter of judgement" (59). Hebb and Thompson (1954) made a related point as follows:

> The animal experiment may clarify a human problem without "proving" anything. It may draw attention to facets of human behavior one has not noticed; it may point to a troublemaking but implicit assumption; it may suggest a new principle of behavior. (p. 533)

Other Considerations

Face validity: The matter of appearance. Given that structural similarity between human and animal behavior is neither a necessary nor a sufficient condition for useful comparison between animal and human behavior, what is the role for face validity? Is a similarity in topography or physical appearance between the animal and human behavior valuable in making these comparisons? Face validity has a negative effect if a claim of similarity is made on this basis alone, in the absence of functional similarities of the sort described previously. This is particularly so because of the potential for such face-valid comparisons to be used in applied settings with humans despite their questionable scientific worth.

Given a functional basis for the comparison, however, similarities in appearance may enhance the impact of the comparison, particularly when describing the work to nonscientists. The face validity of a phenomenon also likely contributes strongly to others "seeing" the asserted similarity. Indeed, some of the most successful comparisons of animal and human behavior include, in addition to functional similarities, at least superficial similarities in appearance (e.g., Harlow, 1958; Seligman, 1974).

Selection of a species. The two staple species of psychology laboratories, the rat and the pigeon, often have been used in animal investigations of human behavior. This frequently is for no more compelling reasons than availability and convenience. In other cases, particular species have been especially useful, either by design or serendipity. Mineka (1987), for example, used monkeys to develop an animal model of phobic behavior because of the strong, easily measured reaction that monkeys have to snakes. Perhaps the particular reactions of dogs to unavoidable shock, combined with humans' emotional reactions to dogs undergoing such procedures, led to a successful series of conclusions about human depression based on that work (Seligman, 1974). The animal species certainly is not an irrelevant consideration in drawing comparisons of animal and human behavior, but neither is it essential.

The use of species also relates to the face validity issue already discussed, in that some human-behavior-based labels for animal behavior are more likely to be accepted than others. Labels related to emotional or affective responses of humans such as love, fear, and depression have been used often, and with wide acceptance, in psychological studies of primates and canines. The juxtapositioning of other labels and species, such as the empathy of cows or the angst of earthworms, is more likely to evoke controversy and skepticism as to their utility and validity. Miles (1983) presented a useful analysis of the effects of different descriptions used in animal–human behavior comparisons.

Labeling animal behavior. The labels attached to laboratory-based animal behavior affect the understanding of human behavior in other ways as well. Most experimental results are

open to many different interpretations and conceptual frameworks. To discuss self-control rather than simple conformity to a quantitative model of choice behavior (Rachlin & Green, 1972), depression rather than transfer of learning (Seligman, 1974), or cultural transmission rather than learning through imitation (Lefebvre & Giraldeau, 1994) may attract a wider audience and facilitate the likelihood of the extension being acknowledged. One of the most widely cited experiments in psychology is Skinner's (1948) analysis of superstitious behavior in pigeons. Kellogg (1949) correctly noted the potential for mentalistic and anthropomorphic problems raised by Skinner's use of the superstition concept, yet had Skinner not described it thus, his work likely would not have achieved its current visibility. Furthermore, studies like Skinner's that do attempt to relate their findings to interesting behavioral processes in humans also stimulate conceptual development and research by suggesting relations between human behavior and different areas of investigation within behavior analysis. As noted previously, the impact is particularly convincing when the verbal label is supported by a careful, thorough experimental analysis.

Labeling animal behavior in terms of putative human counterparts, even when questionable on some grounds, also can have the positive effect of forcing the question of definition of the human concept under study. Following a clever conceptual analysis and demonstration, Epstein (1986) labeled an instance of a pigeon pecking at a spot on its breast visible only via a mirror an example of self-concept, because a similar form of behavior had been so labeled in humans by some investigators. Although Epstein's use of the self-concept label in this instance may be controversial, his work offers a challenge to those who use such labels to more precisely define their concepts.

The functions of research with animals. Basic research with animals related to the study of the learning and physiological substrates of behavior also contributes to the understanding of human behavior. All behavioral research with animals, however, cannot, and should not, be justified or assessed in terms of direct and immediate relevance to the understanding of human behavior. Animal research in psychology and behavior analysis is of at least equal value in the development of theory and in the understanding of *animal* behavior. Nor, of course, can the study of animals supplant the study of humans.

CONCLUSION

Achieving generality by extending observations across variables, settings, and species is an important function of science (Sidman, 1960). The long-standing practice in psychology of studying animal behavior to further the understanding of human behavior exemplifies this function. Recent calls for the expansion of such practices underline its continuing significance for both the science and practice of behavior analysis (e.g., Lattal & Doepke, 2001; Mace, 1994). Across a range of substantive behavioral problems and processes, a common denominator is the method by which human behavior and that of other animals are related. Despite a sometimes confusing variety of labels describing such methods, the processes exemplify extended tacts, specifically those that Skinner (1957) described as metaphorical or generic extension. The significance of such extensions is affected by the methods with which they are accomplished, with a strong bias for systematic, controlled observations over ordinary or casual ones and functional over structural comparisons. Conclusions about the human side of animal behavior are nondeductively derived and often are assessed based on their heuristic and pragmatic value. These conclusions are valuable in understanding the human animal and in developing practical solutions to problems of human behavior

to which much of psychology is dedicated.

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