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Functions of Research in Radical Behaviorism for the Further Development of Behavior Analysis

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The experimental analysis of behavior began as an inductively oriented, empirically based scientific field. As the field grew, its distinctive system of science—radical behaviorism—grew with it. The continuing growth of the empirical base of the field has been accompanied by the growth of the literature on radical behaviorism and its implications. In this article the case is made that radical behaviorism is more than an abstract description of the assumptions and practices of the field; it is an active area of research within the field itself, and that such theoretical research is of great importance to the development of the field. Some of the characteristics of radical behaviorism are described in brief, along with the functions of organization, clarification, and extension of various aspects of behavior-analytic science. Research examples are given from the areas of work on the system itself, behavior-analytic theory, and implications of behavior analysis for issues and findings in other fields. The unique characteristics of radical behaviorism provide an integrative and generative scientific framework for the continuing development of behavior analysis.

Key words: radical behaviorism, behavior analysis, pragmatism, theory

In the early 1930s at Harvard University, B. F. Skinner carried out a series of carefully controlled and inductively oriented experiments on the behavior of individual laboratory rats (e.g., Skinner, 1938, 1956). These experiments served as the basis of the scientific field later called ''the experimental analysis of behavior.'' As the field developed over the years, a system of science developed with it.

Skinner's distinctive systematic views concerning a science of behavior, which he called ''radical behaviorism,'' were introduced in his 1945 paper ''The Operational Analysis of Psychological Terms,'' and a significant portion of his subsequent writings were dedicated to describing and extending those views (e.g., Skinner, 1953, 1957, 1964, 1969, 1974). A substantial literature of radical behaviorism has also developed, which includes a number of books (e.g., Baum, 2005; Chiesa, 1994; Leigland, 1992; Moore, 2008) and numerous articles. The purpose of this paper is to provide a brief overview of that scientific system and its place in the larger context of behavior analysis, and to propose that the system itself may be regarded as a source of scientific research that serves the development of behavior analysis as a comprehensive science of behavior.

This research would generally fall under the heading of the conceptual analysis of behavior, which, along with basic behavior analysis and applied behavior analysis, constitute the three general domains of research in the field (e.g., Moore, 2008). The fact that the conceptual analysis of behavior normally refers to nonempirical scientific work might imply to some behavior analysts that such work would not qualify as research at all. An excellent and widely accepted example of nonempirical scientific research is found in contemporary theoretical physics, where powerful quantitative methods have organized and extended previous empirical findings and suggested new directions in the interpretation and explanation of complex physical phenomena and have helped to formulate new empirical questions that await experimental test (e.g., Greene, 1999, 2004).

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The case to be made in this paper is that the field of behavior analysis has reached a stage of development in which a *nonempirical*, *conceptual*, or *theoretical* domain may be identified and defined explicitly. The domain may be described in terms of its sources, characteristics, areas of research, and the functions of such research in the larger field of behavior analysis.

This description should in no way, of course, be construed as an argument against empirical research. To the contrary, such scientific work is based on and is an extension of the empirical work of the field. In the case of behavior analysis, the work includes (but is not limited to) the organization of the empirical findings and the extension of the behavioral processes to complex psychological and behavioral phenomena, including the empirical findings in other fields with mentalistic explanatory practices.

As noted above, the general label for such work in behavior analysis has been the ''conceptual analysis of behavior.'' This label has been a useful general descriptor for much of this work, particularly as it contrasts with research in the experimental and applied analyses of behavior. However, a conceptual analysis of behavior could mean many things from any number of philosophical or scientific perspectives. A more specific set of descriptors may be useful to identify the source of the analysis. Identification of the theoretical, conceptual, or philosophical work of the field with radical behaviorism establishes and maintains a direct relation between such work and the field of behavior analysis.

What is radical behaviorism? The simplest answer is to say that it is the philosophy of the science of behavior analysis (e.g., Moore, 2008; Skinner, 1974). A somewhat more specialized answer is to say that it is the scientific system for this area of psychology, which is to say that it is the framework for conceptualizing such fundamental issues as the definition and specification of the subject matter of the field, the goals of the scientific analysis, the methods deemed appropriate to that analysis and those goals, and the explanatory practices involved. A third way of answering, and one more consistent with the field itself (e.g., Skinner, 1957), is to say that it describes a set of abstract and pervasive verbally governed behavioral practices of the scientific culture called behavior analysis.

These three answers describe radical behaviorism in systematic terms. This paper will make the case that a second kind of answer to the question is now appropriate. The specific purposes of this paper are (a) to make the case that radical behaviorism is more than a description of the systematic characteristics of behavior-analytic science; rather, it is an active area of research within that science; and (b) to show that theoretical research has characteristics as unique as the system itself, that it covers the full range of behavioral phenomena, and that it is of great importance to the future development of the field.

DESCRIBING THE DOMAINS OF BEHAVIOR ANALYSIS

Behavior analysis is a wide-ranging and diverse field, and the place of radical behaviorism in the larger field may also be examined by considering its place among the proposed subfields or domains (Moore, 2008) of behavior analysis. As noted previously, the most general and familiar of such proposals is the description of the field in terms of the basic, applied, and conceptual analyses of behavior. The latter domain provides a generic label for the nonempirical or theoretical interests of behavior analysis, but as a label it appears to imply a methodological rather than a systematic theme. Radical behaviorism identifies the systematic source

for theoretical work, and more specific distinctions have been suggested for the basic and applied domains as well.

For example, Moore (e.g., 2008) has proposed four professional areas for behavior analysis: the experimental analysis of behavior, applied behavior analysis, behavior-analytic service delivery, and radical behaviorism. As Moore notes, many behavior analysts work in more than one of these areas during the course of their careers.

A proposal is offered here that is similar to Moore's (2008) but emphasizes domains of behavior-analytic research. The proposed five domains of research are as follows: (a) the experimental analysis of behavior, the original basic-research area with laboratory-based experimental research with nonhumans and humans; (b) applied behavior analysis, applied science with many areas of application; (c) clinical behavior analysis, a specialized area of application but with a very broad domain, distinguished from applied behavior analysis on the basis of its historically separate professional and research identity and an emphasis on treatment strategies that depend most importantly on verbal behavior (e.g., Dougher, 1993; Dougher & Hayes, 2000; Kanter & Woods, 2009); (d) the functional analysis of verbal behavior, a specialized area of basic and applied research of central importance to human behavior (e.g., Skinner, 1957); and (e) radical behaviorism, with research relevant to or derived from the scientific system of behavior analysis, involving a broad range of abstract issues and applicable to particular topics of basic and applied research or practice, as well as issues relevant to the field as a whole, including relations between behavior analysis and other fields.

Of the three proposed descriptions of the subfields or domains of behavior analysis described above (the standard description, the proposal by Moore, 2008, and the present proposal), three points may be made. First, in all three descriptions the categories are clearly not mutually exclusive; there are many overlapping research and professional interests possible and which often occur in practice. Second, none of the three descriptions should be viewed as a replacement for any of the others, but may be viewed rather as alternative sets of descriptors that might be useful for different purposes (e.g., an overview of the field, a description of professional areas, a description of research interests by specialty, etc.). Finally, two of the classification schemes explicitly place radical behaviorism into the field as a distinctive area of interest for behavior analysis. Next, some of the varieties of behaviorism and some of the distinctive characteristics of radical behaviorism as a scientific system will be summarized for the purposes of providing (a) a brief overview to the larger behavior-analytic audience and (b) a context for the functions and examples of research in the domain of radical behaviorism.

BEHAVIORISM AND RADICAL BEHAVIORISM

The Behaviorisms

Space limitations prevent a complete review of the literature of the varieties of behaviorism. Accordingly, the overview that follows should be considered a minimal summary of some of the major developments and themes involved.

Briefly, Watson's proposal of 1913 to study behavior rather than consciousness was met with mixed reviews, but quickly gained popularity. Those that followed Watson in the late 1920s and early 1930s were dissatisfied with various aspects of his original (or classical) behaviorism, and worked to develop a newer version (neobehaviorism) that combined rigorous experimentation with constrained theorizing in a way that

was analogous to developments in the philosophy of science with the rise of logical positivism (e.g., Hergenhahn, 2005; Smith, 1986). From the 1930s to the 1950s, this mediational neobehaviorism held sway in American psychology, and many psychologists, under the leadership of such prominent researchers and theoreticians as Clark Hull (e.g., 1943) and Edward Tolman (e.g., Hergenhahn; Moore, 2008; Smith), were interested in formulating large-scale theories of learning, subject to rigorous testing through studying the behavior of rats in laboratory mazes.

By 1950, these learning theories had begun to generate more problems than solutions. A variety of internal problems with the theories combined with the realization that the theories were making little or no progress toward understanding complex human behavior. Furthermore, all the research and theorizing had produced few applications. However, out of the decline of the era of the grand theories of learning came a simpler, strategic version of mediational neobehaviorism, which has come to be called methodological behaviorism (e.g., Day, 1980, 1983; Hergenhahn, 2005; Moore, 2008).

Methodological behaviorism is the dominant scientific perspective of contemporary mainstream experimental psychology (Day, 1980, 1983; Leigland, 1997; Moore, 2008); it is what is taught as "the scientific method" in virtually all introductory or general psychology textbooks, and it is what is tested on the psychology content exam of the Graduate Records Examination. Methodological behaviorism can be summarized in terms of the following four characteristics: (a) the study of overt, publicly observable behavior; (b) the use of operational definitions, at least with respect to the independent and dependent variables of an experiment; (c) the development of inferential theory for the purposes of scientific explanation; and (d) the testing of theory through experimentation, usually with experimental designs with large numbers of subjects and parametric inferential statistical analysis. This systematic perspective describes the strategic methodological practices of such mainstream research areas as cognitive psychology, social psychology, developmental psychology, and others.

Radical Behaviorism

The term *radical behaviorism* will be taken to refer to the scientific system that developed out of Skinner's writings (e.g., Skinner, 1945, 1974, 1989b). To identify radical behaviorism as originating with Skinner's work is simply to make direct contact with the historical roots of the systematic perspective for the purposes of (a) clarification and critical examination and (b) exploration of the broader implications of the system and formulation of productive extensions that advance the science. What follows should be regarded as a summary only, an overview for the larger behavior-analytic audience, and viewed in the context of a substantial and growing literature of radical behaviorism (e.g., Baum, 2005; Baum & Heath, 1992; Catania & Hineline, 1996; Chiesa, 1994; Hineline, 1980, 1990, 1992; Lattal, 1992; Leigland, 1992, 1997, 1999; Malone & Cruchon, 2001; Moore, 1981, 1990, 1995, 2008; Smith, 1986; Todd & Morris, 1995).

Sources. Briefly, the conspicuous sources of radical behaviorism are commonly (but not exhaustively; see also Jacques Loeb via W. J. Crozier; e.g., Day, 1980; Hergenhahn, 2005) identified as Francis Bacon, Ernst Mach, and the functionalist and pragmatist traditions in American psychology and philosophy, respectively (e.g., Day, 1980, 1983). Bacon, a contemporary of Galileo, formulated and promoted a different view of science than the one that has traveled the famous path of the development of physics from Galileo to Newton

and beyond (e.g., Hergenhahn, 2005; Greene, 1999). Bacon viewed science as an inductive, empirically based exercise, with a skepticism toward preconceived theoretical notions, and with a conviction that the distinguishing characteristic of scientific knowledge was its usefulness. Mach's well-documented influence on Skinner may be seen in the behavior-analytic antipathy to metaphysics, and in an emphasis on economy of description in the explanation of natural phenomena (e.g., Marr, 1985; Moxley, 2005; Smith, 1995).

Perhaps the single most important source material for the understanding of radical behaviorism, however, and one that connects the influence of the other sources and is found throughout Skinner's writings from his doctoral dissertation to his final book, is pragmatism (e.g., Baum, 2005; Day, 1980, 1983; Hayes & Brownstein, 1986; Leigland, 1999; Moore, 2008; Moxley, 2005; Schneider, 1997; Zuriff, 1980). Pragmatism comprises a complex and varied philosophical literature (e.g., Murphy, 1990), yet several important pragmatic themes may be found throughout Skinner's systematic writings.

Behavior analysts are probably most familiar with pragmatic themes in Skinner's writings regarding *truth*, in which the term is interpreted in terms of effective action (e.g., Day, 1980; Hayes & Brownstein, 1986; Leigland, 1999; Moore, 2008). Another pragmatic theme that is found throughout Skinner's work is antirepresentationalism, a view that prominent pragmatist philosopher Richard Rorty (Murphy, 1990) has advocated as the most important characteristic of pragmatism. Basically, antirepresentationalism stands against the traditional and commonly held view that minds or languages have special properties or characteristics that allow them to more or less accurately represent reality, in and of itself. The alternative, pragmatist view is that nothing stands apart, nor can it stand apart, from human language, culture, and history. Saying that a particular vocabulary (e.g., a technical scientific vocabulary) more accurately represents "true reality" than another vocabulary may be restated to say that the former vocabulary is more useful or more effective under certain conditions (e.g., when prediction and control are required) than the latter vocabulary. Moreover, to say that it is more effective *because* it is true or real does not help, because there is no independent test of correspondence to "true reality" apart from effectiveness (e.g., Rorty, 1991).

Remarkably, Skinner made the same argument for the span of his entire career (Leigland, 1999), and it was part of his rejection, from his earliest professional years, of the traditional objective–subjective distinction (e.g., Day, 1980; Moore, 1995; Skinner, 1989a). As one general illustration of the point, an examination of *Verbal Behavior* (Skinner, 1957) reveals that Skinner's interpretation of verbal and nonverbal contingencies gives us no access to the world, to "true reality," in and of itself. All behavior, nonverbal and verbal, is tied up in a constantly changing historical web of interacting variables, and there is no way for any individual organism to "transcend" the interactions.

Similarities between radical behaviorism and pragmatism provide perspectives and verbal tools to be employed in exploring the implications of the scientific system and in communicating with those outside behavior analysis. One of the principal benefits of the pragmatist/radical behaviorist perspective is that it liberates behavior analysis from much of the traditional agenda of philosophy. As a scientific field, much of that agenda is not worth having, in the sense that much of it involves verbal entanglements that have little, if any, bearing on scientific issues. In following the pragmatic implications of radical behavior-

ism, behavior analysts may thus address a wide variety of traditional philosophical issues from a consistent and comprehensive scientific perspective without engaging the traditional assumptions and problems involved. Such issues may instead be engaged, interpreted, and reconfigured as complex verbal behavior (e.g., Baum, 2005; Chiesa, 1994; Leigland, 1992; Moore, 2008).

Some Characteristics of Radical Behaviorism

The differences between methodological behaviorism (encompassing virtually all of mainstream general experimental psychology, including cognitive psychology) and radical behaviorism (behavior analysis) may be highlighted by considering three general topics of central importance to all scientifically oriented behavioral and psychological systems. All three topics, of course, involve a variety of complex themes and problems that cannot be covered adequately in this article, but will be addressed only by way of overview.

Behavior. Virtually all experimental psychologists, despite various complaints about behaviorism from many quarters and the theoretical areas of interest, are behaviorists (e.g., Day, 1980; Hergenhahn, 2005; Moore, 2008). These psychologists practice methodological behaviorism, and can be said to do so, in part, because they regard the empirically defined subject matter of their field to be overt and publicly observable (and therefore verifiable and ''objective'') behavior.

Radical behaviorism takes a larger view of the phenomena included under the term *behavior*, and this is certainly part of what has confused and infuriated critics over the years. Although Skinner, in *The Behavior of Organisms* (1938), indicated that *behavior* ought to be taken to mean overt actions, it is clear from his writings beginning in 1945 that he was including all of the functional activities of the behaving organism under the term. His 1945 paper, ''The Operational Analysis of Psychological Terms,'' contained his first use of the term *radical behaviorism*, his first introduction to the functional analysis of verbal behavior, and his first treatment of the role of private events in a scientific analysis of verbal behavior.

An examination of his subsequent writings (e.g., Skinner, 1953, 1957, 1964, 1969, 1971, 1974) shows that the subject matter of his science, or the phenomena that could be collectively brought under the term *behavior*, included nonsocial and social and nonverbal and verbal actions and activities, whether public or private. Thus the origins of radical behaviorism show that Skinner had adopted the pragmatic view that a single observer may be able to discriminate the phenomena of nature sufficiently to apply scientific methods leading to effective action (Skinner, 1945).

A way to contrast the radical behaviorist view with the practice of methodological behaviorists is to say that the latter studies overt action and constructs (or ''infers'') hypothetical, internal, causal processes to provide explanation via conventional psychological theory. By including all of the public and private phenomena of the individual organism under the global term *behavior*, radical behaviorists have encompassed all of the traditional subject matter of ''mental life'' as behavioral phenomena to be explained rather than as concepts and terms to be used, through ''inference,'' in an attempt to explain overt action. From the behavior-analytic perspective, the interest is in the functional activities of the whole organism, whether public or private, in which the activities are analyzed and explained through their interactions with the natural world.

Explanation. Behavior analysts have a focal interest in the functional analysis of behavior. Such an analysis can be expressed informally, as

when it may be said that behavior analysts have an interest in the causes of behavior (e.g., Skinner, 1953, 1974). In this case the term *cause* may be interpreted in accordance with Skinner's consistently applied descriptive use of the term as an observed correlation between events (Leigland, 1998). A more complete expression would be that it is an analysis of the variables of which behavior (in the sense described previously) may be observed to be a function. The variables of interest are those available to natural science; that is, biological (observed rather than inferred; e.g., Skinner, 1938), historical, and contextual variables.

One way to summarize the principal difference in explanatory practices between methodological and radical behaviorism is to say that traditional psychological theory (the former) is in the business of explaining the environment–behavior interactions under study, and it does so by making inferences about presumed underlying processes that might serve a causal function. Behavior analysis, on the other hand, is in the business of explaining *behavior*, that is, the changes and dynamics of the functions of the behaving organism. Provisional explanation in this case is produced through the empirical linking of the behavioral phenomena to biological, historical, and contextual variables.

Methodology. The hallmark of behavior-analytic methodological practices is, of course, single-subject experimental research (e.g., Sidman, 1960; Skinner, 1956). Observational and descriptive studies also play a role, as do the practices of interpretation. Interpretation played an important role in Skinner's contributions, perhaps most prominently in *Verbal Behavior* (1957) but also in a broad array of concepts that were based on or derived from the experimental analysis of behavior, from operant seeing to the analysis of cultural contingencies (e.g., Skinner, 1953, 1964, 1971).

The primary methodological focus of the field, however, is revealed by the original name of the field, the experimental analysis of behavior. The general strategy may be summarized in terms of several distinctive characteristics. First, the focus is on the behavior of the individual organism under the controlled conditions of the laboratory. Second, direct records of behavior are collected over time in which there are direct manipulations of environment–behavior contingencies. Third, orderly changes in behavior may be related to the changes in contingencies, and this order is made visible through graphic and quantitative analysis (e.g., Johnston & Pennypacker, 1993; Lattal & Perone, 1998; Sidman, 1960; Skinner, 1938,1956). Recent years have seen an increase in the number of studies in behavioral journals that employ inferential statistics and group designs (for a recent discussion, see Vilardaga, Hayes, Levin, & Muto, 2009), and although the emphasis in these studies is still with the individual organism, the role of such methodological variations in the future of behavior-analytic research practices remains to be seen.

Functions. There are at least three ways in which research in radical behaviorism may further the development of behavior-analytic science (Leigland, 1997). First, it can serve to clarify the scientific practices of the field through critical examination and discussion. Second, some work in the area involves the organization of empirical findings into larger thematic units, or as a way of reviewing or revealing the coherence to be found in a large body of empirical research. Third, such research can extend the field into new areas by suggesting and evaluating new methodological variations, new areas of basic research, or new areas of application. Such functions are certainly not unique to the work in

this particular domain of behavior analysis, yet the contributions of research in radical behaviorism, based on its overarching systematic position, may serve these functions from the most abstract of perspectives and on the largest of scales. Some examples of such research are described in the following section.

EXAMPLES OF RESEARCH AREAS FOR RADICAL BEHAVIORISM

What follows is a small sample of research that may be described as representative of contributions from the area of radical behaviorism. That is to say, these are examples of theoretical work in the field of behavior analysis that may serve important functions for the development of the field. This work may also be described as examples of the conceptual analysis of behavior, but identifying the area as radical behaviorism has the benefit of making explicit the source of such research. That is, radical behaviorism, derived from, compatible with, and an extension of the empirical base of behavior analysis, is the source of the integration and coherent development of behavior analysis. It is this systematic perspective—rigorous, consistent, comprehensive, and useful—that provides the scientific framework for a complete science of behavior (e.g., Leigland, 1997; Moore, 2008; Skinner, 1953). More specifically, we could characterize research in radical behaviorism as thematic work in which the empirical and conceptual findings of behavior analysis are brought to bear on more general or abstract issues that affect the field. Many more examples might have been included; these were selected to illustrate a variety of research areas and contributions.

Issues of the Scientific System Itself

General treatments. As noted above, a number of general treatments of radical behaviorism have appeared over the years. These include books by Chiesa (1994), Baum (2005), Moore (2008), and a collection of the papers of Willard Day, the first person to explore and describe the distinctive characteristics of Skinner's scientific system (Leigland, 1992; for another variation on contemporary behaviorism, see Rachlin, 1994). These sources provide a relatively comprehensive description of radical behaviorism, including its unique and salient characteristics, historical roots, philosophical connections, and implications for a science of behavior. Although the sources differ in length, style, organization, and issues chosen for emphasis, they nevertheless present a remarkably consistent and coherent picture of the systematic perspective that defines the field of behavior analysis.

Among the themes addressed in these sources, to varying degrees of coverage, are (a) the historical context of the development of radical behaviorism and its ties to the writings of Skinner, (b) the strongly pragmatic characteristics of radical behaviorism as a scientific system, (c) the central importance of the functional analysis of verbal behavior, (d) the role of private events in a natural science, (e) scientific methodology and single-subject experimentation, and (f) the implications of radical behaviorism for the continued scientific development of behavior analysis. Although there are many different types of contributions to the literature of radical behaviorism, sources such as these provide the most comprehensive treatments of the scientific system and its implications.

Complete consensus rarely, if ever, occurs in any scientific field (including physics; e.g., Greene, 2004), however. One issue of disagreement in behavior analysis concerns the treatment of private events noted above. Rachlin (e.g., 1994; see also Baum, 2005) describes an alternative treatment that emphasizes the analy-

sis of "mental" phenomena without assuming behavioral functions of private events, but rather relies on overt activities and contingencies extended in time. The latter perspective may represent a minority view, but it nevertheless provides an excellent example of ongoing and dynamic critical analysis of the systematic characteristics of radical behaviorism.

Historical and systematic perspectives. Documenting, describing, and exploring relations among radical behaviorism and various historical themes and systematic perspectives began with the work of Willard Day. In 1969, two papers were published in the *Journal of the Experimental Analysis of Behavior* that revealed certain characteristics of Skinner's scientific system by showing similarities (and differences) between that system and a generic version of phenomenology on the one hand (Day, 1969b) and the "natural language" philosophy of the later writings of Ludwig Wittgenstein on the other (Day, 1969a). These papers both established Skinner's radical behaviorism as an organized and sophisticated scientific perspective and indicated certain directions for further systematic development and research.

During the years that followed, an increasing number of behavior analysts have made contributions in a variety of topics of systematic importance to the field. For example, the contributions of Hineline (e.g., 1980, 1990, 1992, 2001), Morris (e.g., 1982, 1992, 1997, 2009), and Moxley (e.g., 2001, 2002, 2005, 2007) have addressed a diverse set of historical and systematic themes. Other behavior analysts have pursued important connections to be found between radical behaviorism and contextualism (e.g., Hayes, Hayes, & Reese, 1988; Morris, 1993, 1997; Vilardaga et al., 2009) and pragmatism (e.g., Baum, 2005; Day, 1980, 1983; Leigland, 1999; Moore, 2008), among other themes.

Some of the functions of research on radical behaviorism involve the organization, description, and clarification of the scientific system in such a way that its historical context, assumptions, and characteristics may be made explicit and open to critical examination. The exploration of the scientific system and its implications has also revealed themes that establish and extend connections to the literatures of contextualism and philosophical pragmatism. Pursuing these connections through further research might serve to address explicitly some of the most common misconceptions that have followed Skinner's work and that have delayed a more widespread appreciation of behavior-analytic science. This work might also promote the establishment of alliances with those in other fields, such as philosophical pragmatism.

Behavior-Analytic Theory

Organization and communication. Despite what appears to be a persistent misperception of behavior analysis as a field that allows little, if any, theorizing (e.g., Hergenhahn, 2005), the distinctive varieties of behavior-analytic theory continue to develop in sophistication and scope. One function of such theoretical work is the organization of research literatures for critical review or for communication of lesser known research areas to domains within the behavior-analytic scientific community or to the field as a whole. An example of the former is Schlinger, Derenne, and Baron's (2008) comprehensive review of a half century of experimental research on pausing under ratio reinforcement schedules. Coming to a satisfactory understanding of this complex puzzle might illuminate a variety of basic and applied research issues. An example of the latter is Critchfield and Kollins' (2001) incisive and thorough review of the literature of temporal discounting, a research interest that spans such

fields as behavior analysis, cognitive psychology, and economics. The phenomenon is familiar to behavior analysts as the tendency for organisms to select more immediate smaller reinforcers at the expense of delayed larger reinforcers. Critchfield and Kollins' review was directed specifically at the audience of applied behavior analysts, but should be of interest to all behavior analysts as an especially challenging problem in cultural evolution (Chance, 2007).

Explanation. Another function of such theoretical work involves, of course, the explanation of behavior. The unique characteristics of the explanatory practices derived from radical behaviorism, for example, a pragmatic emphasis on the role of environment–behavior interactions, may be seen in many interesting and productive examples of contemporary behavior-analytic theory.

Three examples will be considered briefly. One example is Lowenkron's (e.g., 1998, 2006) elegant concept of joint control. Joint control is an inductive formulation based on practical issues that arose from a series of studies of conditional discrimination learning in children (e.g., Lowenkron, 1984, 1988). The concept has been used to account for appropriate selection responding under conditions of complex or delayed stimulus control, and involves (in the most generic example) the mediational effects of previously evoked self-echoic verbal behavior in combination with a topographically similar stimulus that becomes available under conditions of a search or at a later time. Joint control has been useful in the teaching and explanation of conditional discrimination and has been invoked in accounting for stimulus equivalence relations and related phenomena that involve complex conditional discrimination (e.g., Lowenkron, 2004; Lowenkron & Colvin, 1995; Palmer, 2006a; Wright, 2006).

A second example is McDowell's (e.g., 2004) computational theory of selection by consequences, which employs evolutionary principles of mutation, selection, and reproduction applied to a population of potential behaviors under contingencies of reinforcement. Simulation studies have shown that virtual organisms show steady-state behaviors similar to those of live organisms when analyzed in quantitative detail (e.g., McDowell, Caron, Kulubekova, & Berg, 2008).

A third example is Glenn's (e.g., 1988, 2004) conceptual work on cultural contingencies. Her work on metacontingencies, or contingencies of cultural selection, and related functional concepts constitute an important framework for the development of an understanding of cultural evolution in terms of behavioral variation and selection dynamics.

These three theoretical approaches have arisen in the field of behavior analysis and address the analysis of behavior in widely differing contexts and time scales, and issues of relevance to both basic science and application. The basis for the inclusion of these seemingly different research interests and theoretical perspectives as examples of research in radical behaviorism may be found in the system that ties them together. That is, in each of these examples, whether largely interpretive (at this point) or tied to large data sets, the theoretical work is tied to a set of interrelated, functionally defined, empirically based technical concepts. So far, the situation may appear to be a common one found in general experimental psychology, in which the explanatory practices of methodological behaviorism lead to theoretical terms of some sort that are said to be related to some sort of data set. But the relations among the behavior-analytic theoretical examples are far deeper than that; the set of empirically based concepts is a *common* set of functional relations. I suggest that

such coherence and range are unique among the psychological and behavioral sciences. These examples also illustrate a kind of scientific research; a kind of theoretical work that is distinctively pragmatic and behavior analytic.

Implications of Radical Behaviorism for Empirical and Theoretical Issues in Other Fields

As a comprehensive, coherent, and useful science of behavior, behavior analysis should have relevance to any and all questions and investigations of human behavior, from the behavior problems of children diagnosed with autism to the verbal behavior of physicists as they work mathematically and also speak in nontechnical terms about quantum mechanics. The potential for such applicability may be seen throughout Skinner's writings (e.g., 1953, 1957, 1969, 1971).

A brief sampling of radical behaviorist research that involves extensions to work in fields such as philosophy may include Day's early work on connections between radical behaviorism and pragmatism (1983) and phenomenology (1969b) as well as an interpretation of the ordinary-language concept of intention (1976; see also Neuman, 2007). Moore (2008) included a discussion of a variety of traditional issues in philosophy of mind from the perspective of radical behaviorism. Other areas of development include linguistics (e.g., Palmer, 2006b; Schoneberger, 2000, 2005), memory (e.g., Palmer, 1991; White & Wixted, 2010), and values (e.g., Leigland, 2005).

Many additional issues and questions await analysis by radical behaviorists. To offer one kind of example, prominent philosopher Daniel Dennett is well known both as a critic of Skinner (e.g., Dennett, 1978) and as a fierce advocate of natural science (e.g., Dennett, 1995). A more recent book by Dennett (2003), *Freedom Evolves*, is an examination of the concept of free will from a naturalized perspective. Skinner, of course, has examined the concept of freedom in a number of sources (e.g., Skinner 1953, 1971, 1974), also from a naturalized perspective. An interpretive analysis of the verbal behavior of both authors might be revealing in terms of differences and perhaps common ground. To address these relations may bring not just a naturalized philosophy but a natural science of behavior into the philosophical dialogue. More generally, by bringing behavior analysis and radical behaviorism to the task of naturalizing the traditional agenda of philosophy of mind, we also bring more complex verbal phenomena (in this case, those typically described with the language of the "mental"; e.g., Leigland, 1996) within the scope of a behavioral analysis.

One final example of a question in which the comprehensive scope of radical behaviorism is in need of extension and development in combination with all of the other domains of behavior analysis is the problem posed recently by Chance (2007). Surely the most important application of all, it addresses what Skinner once called "perhaps the most terrifying question in the history of the human species" (1982, p. 8); namely, we may know that certain things may happen in the future and that action is needed now, but why should the action occur?

The question concerns the role of behavioral science in the long-term viability of the human species, a question about which Skinner wrote a great deal, especially in his later years (e.g., Skinner, 1971). Recently, Chance (2007) has documented a change in Skinner's views during the last few years of his life, from a conviction that a science of behavior was the key to human survivability and development to a resignation that a science of behavior now shows how survivability and development may be beyond our reach.

It is difficult to imagine any problem that would be more complex and more important, yet Chance (2007) outlined a way to approach the larger problem through the identification of some of the contingencies that seem to challenge the successful problem-solving behavior necessary for survival (many of these challenges involve the phenomenon of temporal discounting; see Critchfield & Kollins, 2001). It may be, after all, another technical problem best suited for behavioral science and technology, and would obviously require the combined efforts of all the basic, applied, and conceptual areas available. It may also be the only viable way to address, if not answer (at least provisionally), the question of the future of the human species.

CONCLUSIONS

The purpose of this paper has been to recognize the central role of the systematic perspective of behavior analysis—radical behaviorism—as both a description of the field and its practices in its most abstract sense (a philosophy of science) and as an active area of research within that field. Examples of such theoretical research (e.g., work within the systematic assumptions and practices themselves, behavior-analytic theory, and extensions to problems and phenomena in other fields) serve several functions for behavior analysis; namely, the organization of the diverse empirical findings of the field, clarifications of the system and its practices, and the extension of the range of behavior analysis. This domain of behavior analysis may be called *radical behaviorism* because it names the common source of the conceptual analyses of behavior that occur within the field.

Yet all scientific fields, including physics (e.g., Greene, 2004), include a diversity of views even on some fundamental issues, and not all of the research and theory that occur in behavior analysis may be regarded as examples of radical behaviorism. Regarding the explanation of behavior, there have been calls by prominent researchers for behavior analysis to adopt the practices of general experimental psychology and methodological behaviorism, including the use of inferred hypothetical constructs as a necessary explanatory strategy (e.g., Staddon, 1993, 1997). The practices of methodological behaviorism, however, although enabling the collection of a great deal of empirical data, has also enabled theoretical chaos, in that researchers are free to invent new terms, models, and theoretical processes that bear no relation to any others in a given research area (e.g., Leigland, 1997; Marr, 1996; Moore, 2008; Skinner, 1950; Watkins, 1996). The most productive application of this type of research is to provide jobs for academics.

The source of the coherence and effectiveness of behavior analysis is radical behaviorism (where *source* may be interpreted to be the common assumptions and practices that are characteristic of the scientific culture; e.g., Skinner, 1957), although the foundation of the field as a whole is a function of the interplay between the empirical domains and the systematic and theoretical interests. In many areas of behavior-analytic research the theoretical work is very closely tied to the technical aspects of the experimental analysis, as noted recently in the example of equivalence relations cited by Sidman (2009):

> Those with a theoretical bent will also find much of interest in the data on equivalence relations. … But take care … do not go into theory construction under the illusion that you can escape from the technological constraints of rigorous experimentation. Failure to attend to the subtleties of experimental methodology will make one unable to evaluate rigorously the data that must inevitably be produced to test any theory. (p. 16)

Perhaps no better example of the close relations between theoretical and the empirical and technical aspects of research can be found than that of the molecular–molar controversy that surrounds the explanation of the complex behavioral effects found in nondiscriminated avoidance (e.g., Dinsmoor, 2001, and commentaries).

In a recent overview of the status and prospects of certain quantitative approaches in the experimental analysis of behavior, McDowell et al. (2008) suggested that a new phase of theoretical development might be at hand:

> Obviously, the development and verification of a reasonably comprehensive theory of behavior dynamics would be a boon to both behavior analysis and artificial intelligence, and is certainly worthy of a focused research effort. …
> Accordingly, it may be time in our discipline to welcome specialists in theoretical behavior analysis, just as there are specialists in theory in other fields, such as physics. This may seem a strange idea for a discipline founded on inductive experimentation. It goes without saying that this foundation has served our discipline well; the experimental analysis of behavior has generated a large body of data that establishes many important facts about behavior and the environmental variables that regulate it. But it may now be time to make a concerted effort to weave those facts into a coherent and reasonably comprehensive mathematical mechanics of adaptive behavior that can be widely accepted, and hence can take its place among the established theories of science. As this work progresses, and as our discipline matures, deductive experimentation, that is, experiments motivated by theory, will no doubt rise in importance as a second experimental tradition to complement our original tradition of inductive research. (pp. 401–402)

Clearly, McDowell et al. are referring to developments in the most advanced basic-research domain of behavior analysis. Nevertheless, the suggestion underscores the status of the empirical base of behavior analysis and the need for additional conceptual and theoretical work in the organization, clarification, and extension of that base. In this and the other areas of behavior-analytic research, application, and theory, the scientific verbal and cultural contingencies that may be called radical behaviorism serve as an integrative and generative force for the continuing development of behavior analysis.

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