Foundations for a Natural Science of Philosophy

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The functional relations among philosophy, science, technology, and intuition are examined. Those domains are each defined as behaviors, and each of them is then classified either as verbal, nonverbal, or both. Finally, those classes of behavior are organized into one integral behavioral system. The concept of a science of philosophy is introduced. A science and technology of philosophy are not only possible but necessary. Such an approach to the discipline of philosophy could lead to a new disciplinary structure for philosophy. Philosophy could be taught in academic departments as a verbal behavioral *science*. The discipline of behaviorology provides the foundations necessary to capacitate the traditional discipline of philosophy as a science and technology of verbal behavior commensurate with its potential cultural mission.

DEFINING THE PROBLEM

How Scientists Regard Philosophy

Philosophy, as a product, is obviously a record of verbal behavior, and philosophy, as an event, is verbal behavior per se. Its potential form, to which we refer as a person's philosophical repertoire, is the person's conditioned capacity to exhibit philosophical verbal behavior. Many people in our field have doctor of philosophy degrees, and the term *philosophy* appears in many contexts, so inquiring into the nature and uses of philosophical verbal behavior by scholars and scientists of behavior seems relevant. *Philosophy* has many uses, but most of us were taught early in our careers that philosophy bears on how data are interpreted. That seems easy to demonstrate: Given a rock with a fossilized vertebrate animal exposed on its face, we present it respectively to a religious creationist and to a vertebrate paleontologist, and then compare their interpretations of that same piece of evidence. Both may claim to be "scientific," but it soon becomes clear that their respective sci-

entific activity exhibits very different characteristics, which is usually attributed in some way to their divergent philosophies.

When we inquire as to the nature of philosophy, and how it functions, the questions themselves imply the need for a science of philosophy. According to common wisdom, we need a natural science to conduct an effective study of the rocks beneath our feet, but whether a similar science can improve our study of philosophy remains more problematic. Yet, if philosophy is important to science, then philosophy per se deserves scientific attention. Insofar as science is the key to improved control over the production and application of anything, a science of philosophy should afford us more effective and efficient control over the production and application of philosophy. This conclusion is not altered by the facts that philosophy happens to be behavior, that it is verbal, or that such a scientific endeavor may involve interventions among independent variables many of which themselves are verbal in nature. Hayes and Brownstein (1986) conducted a probe along similar lines in their assault on mentalism and its contrast with a naturalistic account of so-called mental functions.

Regardless of the nature of philosophy and what it may do for a science,

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in the training curricula of most scientific fields the applicable philosophy gets little explicit attention beyond a few remarks that may be included in a textbook preface. I have taught science throughout my professional career. My own history of formal training for a science teaching career, which ranged broadly across a variety of sciences, reveals the typical place of philosophy: During my nine years and seven summers of university training, in addition to studies in other fields, I amassed about a hundred semester-hours of university credit distributed among mathematics, chemistry, physics, biology, and geology. The philosophy of science was not formally included in those curricula either as an aspect of those subject matters or for its potential heuristic functions. Beyond an occasional mention of the principle of parsimony, any further knowing about philosophy per se and its functional role with respect to the science being taught was typically left to emerge as private inductions.

A discipline, in the sense of a particular epistemological approach to a particular subject matter, may become an *organized* discipline when those who exhibit that repertoire form professional organizations, band together in academic departments within universities, and create a related body of literature. Members of the independently organized discipline of philosophy discern and describe a repertoire called the philosophy of science. However, as my own broadly distributed and rather extensive science training illustrates, the independent and remotely established discipline of philosophy has been somewhat ineffective in fostering a general respect for the functional role of philosophy among practitioners in the various scientific fields. In the training programs for most fields of science, whatever philosophy underlies the scientific activity may seem too esoteric, and often too controversial, for all but the most advanced students.

How Philosophers Regard Science and Their Relation to It

The neglect of philosophy in science training programs did not trouble me until, in my postdoctoral science training, I turned to the study of human behavior from a natural science perspective and began to study radical behaviorism, which was said to be the philosophy of that science (Skinner, 1980). But what, exactly, was its relation to the science? I began to inquire into the *function* of philosophy per se, and only then did I ask myself why philosophy had been largely absent from the training curricula of the physical and biological sciences that I had studied earlier. As my investigations led deeper into the study of verbal behavior, a tentative answer to that question began to emerge.

Perhaps philosophy as a discipline has failed to support science proactively because philosophy itself has not been established on a sufficient scientific foundation of its own. Most philosophers, including the philosophers of science, do not consider themselves to be applied scientists. They are not trained in a basic science that would support functional analyses of their philosophical statements when those statements appear in conjunction with other classes of statements upon which they presumably have some effect. As a consequence, although certain philosophical methods and products are generally construed to be relevant to any of the scientific disciplines, philosophy per se remains unfounded as a scientific discipline. Few if any formally trained philosophers of science construe their subject matter as verbal behavior in the functional behaviorological sense of that phrase. As a result, the existing discipline of philosophy, including the branch organized under the "philosophy of science" heading and sometimes called "science studies" by members of the Philosophy of Science Association (e.g., Giere, 1994, p. 13), is largely deprived of

a functional perspective on its own business.

Unlike the natural scientists who study behavior–environment functional relations, most traditional natural scientists have studied nonbehavioral subject matters and thus have not been in a position to rely on their own disciplines for analytical treatments of the verbal behavior through which their own professional activities are manifest. The members of the traditional natural sciences, although practicing an intuitive level of philosophy, have more or less looked to the independently organized philosophy of science discipline as a source for their philosophical needs. However, when a discipline like science studies, which is focused on a behavioral subject matter, forfeits the opportunity for a functional perspective in conducting its own inquiries, that portends a serious loss of disciplinary capability, and the question lingers as to whether those who have been dependent on a remotely and independently organized philosophy of science field could serve themselves just as successfully. Scholars and practitioners of an independently organized discipline of philosophy can be left ambivalent about the role of their own discipline. Ronald Giere, putting his best spin on it, revealed that ambivalence in his 1994 presidential address to the Philosophy of Science Association (Giere, 1994):

In my picture, science studies cannot be autonomous. Its inquiries must draw on knowledge from many disciplines, including some of the sciences it studies. But is there a special role for the philosopher of science in this enterprise? Yes and no. Current training in the philosophy of science prepares one to be a good synthesizer of scientific knowledge and to use this knowledge in constructing theoretical models of various aspects of science. It also prepares one to raise normative issues, that is, to be critical of specific scientific projects in light of acquired empirical knowledge of how science typically works. And it prepares one to take part in debates over the role of science in the larger society. On the other hand, none of these activities are ones that could not also be carried out by historians or sociologists

of science, or even scientists themselves, should they be so inclined. Just as philosophy can no longer claim to be queen of scientific studies, neither can philosophy of science claim to be queen of science studies. But so long as we are willing to put aside our pretensions to possessing autonomous forms of knowledge, philosophers of science have much to contribute to the larger enterprise. (p. 13)

In this assessment by the president of their association, philosophers of science may be trained to make important contributions to science, but they can do little beyond what potential consumers can do for themselves. Also, among the kinds of training that Giere described as characteristic of philosophy of science programs, he did not include training in a basic *science of philosophy* that would prepare the trainees to pursue the mentioned philosophical tasks with the special effectiveness afforded by a scientific approach. The price paid for that omission is flagship status for the discipline of philosophy. That scientifically emasculated discipline must simply cruise among the science fleet as another somewhat indistinguishable and arguably expendable service vessel.

Two years later, at the next biennial meeting of the Philosophy of Science Association, the next presidential address, by Abner Shimony (1997), touted a basic paradigm that he favored for the philosophy of science discipline. He called it by its historically recognized name, “Enlightenment,” and described it as a particular “mental outlook.” Core commitments to this perspective include (a) belief in “a universal human nature (except for abnormalities) in all places and times,” and (b) “a universality of human goals” as a corollary of the existence of the universal human nature. Shimony also had this to say about ethics:

Another corollary is that a basis for ethics is to be found in the constitution of every normal human being, though there is disagreement concerning the exact character of that basis; among the prescriptions of the naturally based ethics are universal benevolence toward human beings and condemnation of punishment and constraint

beyond what is needed for the common good. (p. S3)

Although theorists of the Enlightenment posit a fixed and common human nature to account for common patterns of behavior, that nature paradoxically includes a "protean mode of flexibility" (p. S7). Nevertheless, according to Shimony's view of the presumably fixed aspects of human nature, the basic paradigm called Enlightenment "allows for some cultural universals, including the universal structural principles which constrain the diversity of languages" (p. S7), an allusion to the views popularized by cognitive linguist Noam Chomsky (Chomsky, 1975). In discussing ethics, Shimony exhibits explanatory reliance on "such things in the human psyche as moral imperatives, coexisting with desires, aversions, and preferences" (p. S7).

While touting the efficacy of natural science methodology for the study of human behavior, as do many traditional psychologists, Shimony, like those psychologists, resorted to invented constructs of the kind that seem compelling in the absence of a functional analysis of behavior-environment relations. Shimony posits human behavior driven by a human nature and human goals. His account also includes an inherent endowment of ethics as driving forces, and internal flexibility as a trait that accounts for individual and situational differences in behavior. Also, language is driven by Chomskian structures that putatively inhere in all normal human beings and account for the common characteristics of all human languages. Explanations that rely on internal behavior-originating constructs have been common since antiquity and represent the expedient class of explanation to which people quickly retreat in the absence of functional analyses of the events of concern. Shimony, in alluding to Chomskian structures, follows Chomsky's lead in neglecting universal contingencies of reinforcement and the commonalities of

language that they produce (see Skinner, 1957, Appendix). That kind of explanatory approach carries the inquiry away from the intellectual style of the natural sciences, which relies on functional analyses for the study of any kind of phenomena and which avoids the substitution of invented constructs for real if often elusive independent variables.

When objective independent variables are ignored, the effects defined by the dependent variables seem to appear miraculously. If such miracles cannot be tolerated, then the analyst is left to search among the mediating linkages between the independent and dependent variables for something that can be proffered as an origin for those effects. It was there that Chomsky posited his language-forming structures, traditional psychologists have putatively found body-driving self agents, and Shimony, representing the organized discipline of philosophy, has lodged the behavior-causing elements of the universal human nature in which he believes.

One need only to listen to the presidents of its professional organization to conclude that the philosophy of science discipline is in scientific disarray. The discipline of philosophy, in general, has traditionally been built around the sets of ideas recorded by its prominent thinkers (e.g., Edwards, 1967). In defining their discipline, philosophers have focused on the nature or characteristics of philosophical works, plus the classes of problems to which philosophers have addressed their efforts, rather than on the functional relations between other human behavior and philosophical verbal behavior. Rather than focusing on the functional relations in which philosophy arises as verbal behavior as well as those in which it subsequently shares control, the traditional approach has remained largely descriptive, of what are construed to be *examples* of philosophy. More emphasis is placed on the topographical characteristics of instances of philosophical behavior, which serve taxonomic pur-

poses, than on the functional relations in which philosophical behavior may subsequently play a role, which would serve scientific and technological purposes.

The Concept of a Science of Philosophy

Science of philosophy, as a concept, appeals to a level of analysis seldom entertained or recognized within the organized discipline of philosophy. The well-established facet of philosophy called logic pertains to the internal consistency within and among statements—relations of statements, or their parts, to each other. But logic pertains less to the functional relations between those statements and the environments of the speakers. The conclusions from logical analyses lead to rules about what one may say in relation to what one has said, but such logical analyses pertain more to internal relations within the verbal stream and are therefore limited in their capacity to strengthen and expand speakers' controls over their environments. Recall Skinner's often-repeated admonitions that statements are important to behavioral scientists *as verbal behavior* (see Skinner, 1993, for one of his later instances). Skinner implied that analyses of statements are more usefully focused on the contingencies under which statements are exhibited as verbal behavior and on the functional effects of those statements on subsequent behavior. Logicians will occasionally speak likewise of logical statements (see, e.g., the introduction in Quine, 1982), but that is not the primary level of analysis pursued by the majority of philosophers. Therefore, the subdiscipline of logic, upon which philosophers have so long relied, is too limited in what it can do to serve as the comprehensive science of philosophy.

The point of such a science would be to gain useful control over the phenomena of interest, and the direct control of any phenomenon results from changes to the independent variables of

which it is a function. That kind of activity must be preceded by accurate functional analyses by which the relevant relations are clearly delineated, and the kind of science necessary to that approach must lend itself to such analyses. However, efforts to explicate the nature and role of philosophy may stray from these steps and be misdirected. For example, efforts to understand philosophical behavior by examining the physiological structure of the brain feature the wrong level of analysis; efforts centering on hypothetical cognitive constructs tend to rely on the agentive fallacy imported from mentalistic psychology; and efforts dependent on spiritual assumptions represent continuing appeals to even more explicitly mystical postulates. None of these approaches reveal the necessary kind of behavior–environment functions that can support a practical natural science of philosophical behavior.

A natural science of behavior features the particular kind of basic science necessary to capacitate the discipline of philosophy for scientific production rather than mere description, so that philosophers of science may proactively generate new products more useful to scientific activity than descriptive reflections of what is already being done. When a powerful science of philosophy treats philosophy as verbal behavior with all of the functional implications connoted by that phrase, the kinds of definitive functional relations that surround philosophical behavior can be analyzed, delineated, and taught to new students.

The development of a science of philosophy begins with a search for functional relations among philosophy, science, technology, and intuition, but we must first define each of those terms as classes of behavior and denote each of them either as verbal, nonverbal, or both. This raises the question of how they are now being regarded.

Current References to Philosophy, Science, and Technology

The importance of philosophy has varied among natural scientists who

are concerned with behavior. In Skinner's approach, which focuses on functional relations, the behavioral practitioner's philosophy of science, radical behaviorism, shares closely in the control of scientific activities (Skinner, 1980). But in sharp contrast, the relevance of philosophy has also been denied (Epstein, 1984):

Where data and formal theory are relatively sparse . . . philosophical arguments will naturally be taken more seriously (after all, they're all we've got), but *once* the scientific attack on some phenomenon is successful, philosophical arguments fall by the wayside. (p. 110)

Epstein implied that philosophy is some sort of ineffective substitute for good science. He further argued that philosophy is so irrelevant to an experimental science that he would open the behavioral scientific profession to persons "with no particular philosophical bent, or with views that change radically from time to time, or even views that are antithetical to behaviorism" (p. 110). The implication is that a science of behavior can best mature under the natural contingencies of the work place and neither gains support nor suffers interference from what is connoted by the term *philosophy*.

The lack of agreement about the function of philosophy may reflect some vagueness about its nature, and similar confusion is associated with the terms *science* and *technology*. The term *science* is commonly evoked on occasions of new and better machines or more effectively designed procedures. But so is *technology*, and in common parlance speakers often interchange those terms. "Chinese space technology has recently shown significant advances" gets about the same response as "Chinese space science has recently shown significant advances."

The scientific community exhibits a vague tendency to reserve *science* as a descriptor of practices for enhancing the effectiveness of certain nonverbal repertoires and *technology* as a label for tools and applied tool use as part

of those practices, a distinction implicit in the dictionary definitions of those terms. According to another common distinction, *science* pertains to knowing and to the practices that yield systematized knowing, whereas *technology* pertains to practical applications; that is, to manipulating independent variables in the environment to produce useful effects, usually with the aid of equipment.

A more functional contrast between science and technology relies on implied differences in contingencies on the practitioners. For example, in *Beyond Freedom and Dignity*, Skinner (1971, p. 146) notes that "in an experiment we are interested in what happens," whereas in designing a culture we are interested in "whether it will work." Skinner then observed that this is the difference between science and technology. The implied difference pertains to differences in the prevailing contingencies on the behavior of the practitioners and to their different conditioning histories. Scientific experimenting is reinforced by discovering functional relations. Scientists will systematically alter independent variables to bring their own behavior under control of the resulting changes in the dependent variables. The practice of science may thus be analogous to a kind of inductive probing for new relations. On the other hand, the contingencies operating on a technologist tend to feature previously specified reinforcers acquired by manipulating previously described functional relations. Technology could thus be likened to deductive prompting. (For Skinner's definitions of *prompting* and *probing*, see Skinner, 1953, pp. 213–216.)

The term *science* occasionally describes verbally mediated procedures to control certain classes of variables during searches for functional relations, regardless of the subject matter. According to that distinction, properly planning an experiment to insure that the results will be valid and reliable is science, whereas technology may imply the skilled manipulative operations

involved in conducting the experiment, including any necessary tools and their usage. The term *technology* may thus imply some blend of behaviors and tools. Science–technology distinctions at this level of analysis validly imply that scientific and technological repertoires can predominate in the behavior of different people and thus correctly anticipate teams of scientists, technologists, and technicians working cooperatively.

A SCIENCE OF PHILOSOPHY

Natural Science

This section proceeds from a natural scientific perspective: All real events have a *natural* history, meaning that events chain back through the time intervals that they share in defining, and do so in a continuous functional (causal) sequence without discontinuities such as spurious origins of the kind, for example, that would be expected if personal autonomy were possible. Psychology may tolerate an inner-dwelling self that autonomously generates verbal behavior, but behaviorology,¹ a nat-

ural science of behavior, does not entertain that possibility. From the perspective of a natural science, no event occurs in the absence of strict functional relations with other events—the fundamental assumption of deterministic philosophy. Confidence in the control implicitly inhering in a functional relation is proportional to the observed reliability of that relation.

Concepts of randomness and chaos do not contradict the deterministic postulate (Fraley, 1994). Rather, they merely shift the analysis away from an impractical analytical level at which we may futilely attempt, beyond the range of our capacity, to trace the implications of a deterministic world across sequences of events. The mathematics by which concepts of randomness and chaos are treated represent practices by which we manage our ignorance of controlling factors once they have become too complex for the capacity of our more direct measuring capabilities. However, we have no reason to suppose that the functional relations that define nature are suspended merely because we reach the limits of our capacity to take into account a sufficient number of the many controlling factors in complex situations and are forced to shift to a different level of analysis. The assumption of determinism is a basic philosophical tenet of all natural sciences and is therefore an element of radical behaviorism, which is the particular philosophy of science that informs the discipline of behaviorology (the most stringently “natural” of all extant disciplines that focus on behavior and its controlling relations).

Because philosophy occurs as verbal behavior, it follows that philosophy, as

¹ The term *behaviorology* denotes the comprehensive and independently organized natural scientific discipline devoted to the study of the relations between behavior and the environmental events that functionally determine (i.e., control) that behavior. Behaviorology encompasses technical, scientific, and philosophical domains. The foundation philosophy of behaviorology is called radical behaviorism (“radical” in the sense of fundamental or root), and the basic science is an experimental analysis of behavior. The principal professional organizations of this discipline are the International Behaviorology Society (IBS) and The International Behaviorology Institute (TIBI) and its association, TIBIA. A journal called *Behaviorology* is published. For a comprehensive history of the emergence of the organized discipline of behaviorology, see Fraley and Ledoux (1997). For other brief discussions about the origins of the term *behaviorology*, see Fraley and Vargas (1986) and Comunidad Los Horcones (1986). The name behaviorology is potentially applicable to *independent* academic departments, within institutions of higher education, in which training in that discipline is to be provided. The cultural mission of this discipline is to provide basic scientific

foundations to support the behavior-related work of practitioners in scores of applied fields and professions. For more detail on the integrity and mission of the discipline of behaviorology, see Fraley (1987) and Vargas (1987). Extensive detail about the relation of behaviorology to other behavior-related disciplines is also included in Fraley and Ledoux (1997).

a verbal behavioral phenomenon, is therefore at all times controlled through functional relations with other events. Without that fundamental assumption, an effective natural science of philosophy could not emerge, because we could not rely on the existence of contingent relations between philosophical verbal behavior and other events (antecedent or postcedent), which are precisely the kind of relations that afford the requisite opportunities for intervention (see Vargas, 1984, about the terms *antecedent* and *postcedent*). After all, the ultimate functionality of any sample of scientific behavior (including those in a science of philosophy) involves that sample of scientific verbal behavior sharing in the control of behaviors of intervention (that is what sciences does). Because of that scientific contribution to their antecedent controls, those behaviors of intervention (in the environment), in turn, yield more reinforcing (effective) outcomes among the environmental events of concern—or as the average citizen might say, “the application of science yields more desirable results.”

In a given instance of scientific intervention to improve effectiveness, the environmental events of concern can be any phenomenon that is definable in terms of measurable variables (i.e., anything that is real). If philosophical behavior is the kind of environmental event about which we are concerned (i.e., the subject matter upon which we are scientifically focused), a desirable result of a science of philosophy is a better or more effective philosophical repertoire—meaning better in its functional capacity to share in the control of other classes of events. Scientific control over dependent variables that consist of verbal behavior, including the philosophical kind, is gained *only* through practical interventions among the independent variables that evoke the verbal behaviors in question, antecedent variables that could *not* be found if philosophical behavior simply originated spontaneously, without a functional (i.e., natural) history, as the

creative product of an autonomous, and thus, unnatural, self.

To proceed on the basis of these foundation principles, I will begin by rendering more precise and relevant definitions of some common terms and specifying the relations among them. *Technology* refers to the verbally supported practices by which effects are produced in the environment. That is, verbal events supplement the antecedent controls on technological behaviors, which in turn affect the environment. *Science* pertains to those special antecedent verbal controls on the behaviors that constitute a technology. Thus, science consists entirely of verbal behavior, and it functions antecedently. Technological behaviors are identified as such precisely because those supplementary scientific verbal controls are present among their functional antecedents.

In that sense, if those supplementary verbal controls are absent, leaving a behavior to occur only under contingencies featuring nonverbal antecedent stimuli, the resulting behavior merely exhibits *technique* in the sense of occurring under entirely nonverbal controls. And, as may usefully be emphasized, such technical behavior occurs unconsciously or intuitively. A typical example is the tying of a shoelace by a preoccupied person who remains unaware of the manipulations being exhibited to accomplish the act. The lace gets tied, but the person is not following (“thinking through”) the steps in the ongoing process and may not even know that he or she is doing it. A person will often describe such behaviors as “things I do naturally without thinking about them.” Only with the addition of—and because of—functionally related verbal behavior among the controlling antecedents, including visual and other forms of conscious awareness (Skinner, 1953, pp. 260–261), would those operants change classification from technical to technological.

It is noteworthy that most behavior is technical; that is, most human be-

havior occurs in the absence of any thought or other verbal behaviors among its functional antecedents, often including even consciousness and visual awareness. Such behavior occurs under direct stimulus control of the nonverbal environment. That may seem strange to those people who assume that they are aware of most of what they do, perhaps because the smaller part of our total behavior that is controlled in part by verbal behavior tends to be relatively important. Also, we can remember only those parts of our total exhibited behavior that, in their prime instance, evoked the concomitant verbal behavior of awareness (see Skinner, 1974, pp. 220–222, for details about the concept of awareness as verbal behavior). If awareness responses are evoked only by the smaller part of what we do, the larger part remains immune to recollection (meaning that verbal behavior that did not occur initially cannot subsequently be reevoked).

When we say that scientists practice science, we usually mean that the events under inquiry, and their relations to those events, will evoke pre-conditioned scientific verbal behavior (e.g., the reiteration of a relevant principle or law of nature). But a complete scientist is more broadly prepared than merely to respond scientifically in such ways. A well-trained scientist is also conditioned to produce new science. Skinner (1953) noted early in *Science And Human Behavior* that “science supplies its own wisdom.” “Science,” he said, “leads to a new way of thinking about that part of the world to which it has addressed itself” (p. 6). Discounting accident, science is needed to generate more science. To insure that this will occur, a special conditioning history is necessary, to which we often refer as the shaping of a scientist. For example, the experimental tradition in scientific disciplines serves that function: Its products consist of new and more useful things to say (or think) on occasions of scientific reaction to events of concern.

How Science Shares in the Control of Behavior

One commonly employed intellectual template for analyzing the control of operant behavior is the three-or-more-term contingency of reinforcement—a set of relations among three classes of events: (a) a behavior, (b) the antecedent events that immediately precede and evoke that behavior, and (c) the postcedent environmental events, immediately following the behavior, that affect the behaving organism in ways that render the organism more or less behaviorally susceptible to the same kind of behavior-evoking antecedent events on the occasion of a future encounter (see Vargas, 1984, for a discussion of the relevant functions and terms).

Contingencies that occur without human contrivance and that do not include verbal behavior either as the antecedent or consequent stimuli, are often called *natural* contingencies. Worthwhile implications of this distinction have often been pursued (e.g., Skinner, 1974, pp. 125–127; Vargas & Fraley, 1984). In most cases, the term *nonverbal* is more precise than *natural*, because verbal events are natural too, and increasingly, references to “non-verbal contingencies” appear in the literature. Such contingencies, occurring as relations between a behaving organism and its environment, are without any verbal supplements among the antecedents. For example, as a consequence of approaching certain wild animals from downwind, the stalker gets closer before the prey bolts (given the prey animal and a detectable air flow). The hunter moves so as to keep facing the wind as the prey is approached and is reinforced by increasing proximity to the prey—a formulation featuring (a) the prey as a function-altering stimulus that renders the wind evocative for the behavior of advancing with wind in face, and (b) reductions in the distance to the prey as a conditioned positive reinforcer. Such contingencies alone, without either antecedent verbal sup-

plements or verbal consequences, can condition and refine skills. (For a textbook explication of function-altering stimuli, see Fraley, 1999, chap. 15.)

Supplementary verbal behavior among the antecedents accelerates what otherwise would be a natural conditioning process and can render the conditioning more efficient and effective. However, the complex and refined skills of nonverbal animals, especially, for example, those skills pertinent to survival, exemplify the effectiveness of natural contingencies *without* supplements of verbal behavior. Powerful phylogenetic endowments expedite that kind of learning. That is, severe contingencies of survival have left a genetic residue, selected from vast historical gene pools, that yields individuals that are physically prepared for rapid operant learning in the relatively narrow but often somewhat intrinsically inconsistent settings that we call their niches. We may say that a particularly successful predatory individual, having acquired many skills, is "cunning" or "clever," but significantly, if it is a member of a nonverbal species, we tend not to say that it is "scientific." Its skills are simply exhibited intuitively in response to situational changes.

How then are we to label a human, also skilled through nonverbal contingencies, whose activities remain largely intuitive? The nonverbal wisdom of the old and long-feral hermit has been shaped by the nonverbal contingencies in a lifetime of encounters with a demanding environment. He copes effectively. In contrast, consider a verbally skilled newcomer to the old hermit's environment who, for whatever reasons, is under contingencies to be equally effective. Suppose that the newcomer conducts experiments, formulates rules, and engages in various verbally mediated self-management practices to acquire and maintain useful behavior-controlling relations between himself and critical aspects of that environment. In a relatively short time the newcomer will have devel-

oped an extensive and relevant verbal repertoire evoked under stimulus control of his own behavior in relation to that environment. That is, the person will have developed a relevant science, a verbal repertoire that, in turn, shares in the control of further contacts with the environment. Eventually, the newcomer may operate at skill levels approximating those of the feral old-timer, but does so in significantly less time than the older counterpart had required.

If an observer, ignorant of their respective histories, then examines the effective practices of these two persons, the observer could conclude that two practitioners of *survival science* were operating successfully in that hostile environment and that their coping technologies were comparable. Their essential difference may not be evident at that level of analysis. However, their difference would become more obvious if each of these persons were hired for a complex new job in which only limited variations of the present skills were applicable. The different quality of their respective sciences would then be revealed to observers as differences in their respective rates of adapting. Questions may then arise about whether the old hermit is scientific to *any* extent.

To distinguish between (a) a person's behavior under direct stimulus control of the nonverbal environment and (b) behavior that occurs under the shared control of the nonverbal environment plus some verbal supplements occurring to that person, in this article the former is called *technical* behavior and the latter is *technological* behavior. The hermit's technical behavior would not become technological (or only slightly so), because it would remain, for the most part, verbally unsupplemented. The behavior of the more verbal counterpart is technological instead of technical, because a verbal repertoire of science shares in its antecedent control along with other environmental events, thereby bringing it under more precise control and rendering it not only more effective but also more

quickly responsive to changes in the environment.

Upon encounter with a putative technologist at work, the immediate question is whether any descriptive or prescriptive verbal behavior is occurring to that person in the first place; that is, whether or not any verbal scientific behavior shares in the control of what would otherwise be technical activity. Effective nonverbal controls over human technical practice can be conditioned naturally, if slowly, by the outcomes of practices that some would mistakenly call scientific, although technical would be correct. A practitioner of that sort is said to be *intuitively* effective. But that is to be a good technician for reasons mysterious even to the behaving individual, because that person's conditioning occurred under natural, or nonverbal, contingencies that that person is unable to describe. Given an appropriately manding² verbal community, such a practi-

tioner may be led to describe his or her own technical behavior and to abstract inductively the principles of its control, arriving eventually at what may be described as a self-generated repertoire of principles and rules (i.e., the person would thus be led by the verbal community to acquire a *science* of his or her business). Elements of that verbal repertoire would then share in the control of subsequent technical practices and thereby qualify those practices as technological practices. The person, thus transformed from technician to technologist, would probably be described as "self-taught" in science, although the "self" is unwarranted, because the role of the verbal community is obvious.

But scientific self-management can also be facilitated by more deliberate design. It is that *planned* production of a good scientist that interests science educators more than a slower course of natural conditioning or the promotion of a somewhat informal introspective trend among the members of a verbal community that eventually may lead to acceptably effective practices. Deliberately contrived arrangements to produce a scientist in a more expeditious way involve arranging to condition verbal scientific self-management practices; that is, arranging the kind of training that will produce verbal behavior that supplements, to improved effect, the uncontrived, or "natural," controlling antecedent and postcedent variables that serve to focus the technological behavior of scientists.

The critical emergent distinction in this section separates the following two classes of behavior: (a) the behaviors by which a person effectively manipulates environmental variables through effective technical practice—a person whose technical practice lacks supplementary antecedent verbal controls and with respect to whom assigning a label

² *Manding*, the gerund form of the verb to *mand* (a Skinnerian coinage), is a technical verb from the science of verbal behavior meaning the act of imposing a contingency on another person to respond, after which the consequences of that person's responding are to be mediated by the party arranging or imposing the contingency. The community of persons who arrange such contingencies is called a *verbal community*. Chapter 3 in Skinner's *Verbal Behavior* (1957) describes the *mand*, which in its noun form refers to the antecedent verbal stimulus in a three-term contingency of reinforcement being arranged by the party who is manding a listener to respond. The mand is exhibited as a verbal operant under antecedent stimulus control of a relevant establishing operation such as a state of deprivation or other aversive stimulation. The manding party may say, "Pass the salt" (a mand). For the mand to prove effective, the listener must have been conditioned such that unresolved mands are aversive. The listener, upon complying, is subject to negative reinforcement, perhaps afforded by the speaker in some way then removing any threat of punishment contingent on noncompliance (which provides relief to the listener-complier). Also, in some cases, the listener is subject to automatic negative reinforcement if the mand has elicited conditioned aversive emotions in the listener from which the listener has escaped by passing the salt. The mand presumably plays a major functional role in shaping both the skills of introspection, which

feature effective self-probing, and the special repertoire of verbal operants that we call consciousness and awareness (see, e.g., Skinner's discussions, 1953, pp. 260–261, 288–289).

of *scientific* would therefore be unwarranted, and (b) the verbal self-management behaviors (i.e., scientific behaviors) that, if present, share in the stimulus control of those technical behaviors to render them more effective (and change their classification to technological), and by their presence justify the person being called a scientific practitioner. Science is not the former technical activity, which the science helps to bring under a better kind of control. Nor is science the improved behavior, which became technological instead of merely technical when scientific verbal stimuli began to share in its control. Science, as behavior, is the verbal self-management behavior, which, upon occurring, functions as the verbal part of the antecedent stimulus controls that evoke technological behavior. *Science* is thus defined as a class of verbal behavior that has a certain kind of supplemental, antecedent, behavior-controlling function.

When an element of science shares in the antecedent control of a technological response, we may trace the recent history of that element of science. For example, the scientific verbal behavior pertinent to a given scientific episode may first appear as a functional consequent event, as when a previously exhibited behavior such as pitching a baseball evokes a consequential operant response such the observation as "the result of that move exemplified Bernoulli's principle," a statement that may, along with other outcomes, function as a reinforcer of the pitch, and which, once it is exhibited, can then evoke additional and potentially useful verbal behavior that can share in the antecedent control of further environmental interventions. For instance, given a pitcher who has studied Bernoulli's principle and has ready a repertoire of interpretative statements based on that principle, the previous response, which merely related that principle to a curving baseball trajectory and the throwing move that produced it, may in turn evoke a self-instruction such as "put even more spin on the ball next

time," a scientific response that, when sharing in the antecedent control of the next pitch, results in a trajectory characterized by a more extreme curve.

According to the previous distinction between technical and technological behavior, a bird building a complex nest is never a scientist (for lack of a verbal component in the controls on nest building, an activity that for birds remains purely technical). Nor is a human being a scientist when he or she performs effective technical acts on the environment under verbally unsupplemented direct stimulus controls (e.g., a scribe who unconsciously dips a quill pen in the inkwell when the line that it leaves on the paper grows faint is not exhibiting the verbal self-management behaviors called science). The variables definitive of science reside, not in the intervention practices that directly affect the environmental variables of concern, but in one of the kinds of events that share in controlling those practices. A person can qualify as scientific only if the person's own verbal behaviors share in keeping that person in appropriate contact with the phenomena of concern.

The Addition of One Qualitative Criterion for the Science Category

This preliminary definition of science needs one further tweak. A supplementary verbal repertoire that shares in the control of other kinds of behavior is not necessarily helpful in all instances. The technical practices pertinent to a particular subject matter may not yield more effective behaving with the addition of supplementary verbal antecedents that some may, at first, want to call science. For example, consider the previous baseball pitcher who needed to produce a sharply curving trajectory. Suppose that instead of the statement about putting more spin on the ball, that pitcher had said "the ball will curve more if it is severely punished before being thrown. Upon its release, it will then curve in a move to avoid recapture. Therefore, as a

form of punishment, squeeze the ball as hard as possible until the instant of releasing it." It is unlikely that such a pitch would have resulted in the ball exhibiting a greater curve. The question is whether we should refer to the verbal antecedent supplement (about putting an aversive squeeze on the ball) as science.

A quality differential, across differing scientific verbal repertoires, is indirectly revealed by the corresponding ranges of efficiency and effectiveness of the technological behaviors that occur under partial control of those verbal antecedent supplements. Thus, it follows that we can speak of worthwhile science (in the sense of effective), of worthless science (in the sense of ineffective), or of intermediate grades, depending on the improvement in efficiency and effectiveness of the technological activity that the science shares in controlling.

This conclusion leads to a previously implicit and worthwhile refinement in the preceding definition of science. A scientific repertoire, sharing in the control of technological behavior, must result in outcomes deemed better than if no supplementary verbal repertoire were involved. The descriptor *science* is thus made contingent on such a positive quality difference in the behavior of environmental intervention. This imposes on the definition of science one qualitative feature in addition to the purely functional qualities. One is compelled to determine whether the products of a technology are improved or degraded by the controlling effects of a verbal repertoire before that verbal repertoire can be classified as science in the first place.

The purely functional aspects of a science can be detected and measured through an experimental analysis of the controls on behaviors that affect the environment, and relative differences in the efficiency and effectiveness among sciences can serve as criteria by which to sort those antecedent controls according to quality. But when the efficiency and effectiveness of a given

technology are at or below the levels that would result without the contribution of the verbal antecedents in question, that controlling verbal repertoire should not be called a science. Simply put, a scientific repertoire has to help in gaining control over the environment, or we do not call it science. So, although any verbal repertoires may function in a manner similar to how science relates to technology, only if the technology is thereby rendered more efficient or effective do we call the supplementary antecedent verbal repertoire a science. This closely approximates current common practice insofar as most people intuitively withhold the science label from the kinds of antecedent verbal supplements that yield no demonstrable improvement in intervention behaviors (e.g., superstitious antecedent utterances of what are assumed to be lucky nonsense words).

This functional definition of science does not pertain to long-term effects. Here science is defined only in terms of the immediate effects of an antecedent stimulus on an immediately evoked behavior in a single contingency of reinforcement, although I would not be surprised were a metacontingent extension (Glenn, 1988) of the concept to emerge eventually. True, cosmologists and paleontologists have little technological effect on their subject matters in the sense that stars cannot yet be moved and dinosaurs cannot be made to redie in places that would make excavation of their bones more convenient. Yet cosmology and paleontology are both respectable natural science disciplines. It is just that the practices of science in those disciplines afford improved interventions that pertain more to the methods by which practitioners measure and describe ancient effects than to any technologies by which such effects are produced. In a behavior science, where the phenomena of concern tend to occur in the present, the contingencies in which science plays a functional role can often have an interventionist effect. Thus, behavior scientists can go beyond improving

their methods of study by also changing what they are studying.

Nonscientific Verbal Controls

Behavior that would occur under socially arranged contingencies may not comport with behavior that would occur under the natural contingencies imposed by nonsocial environments. Although such socially arranged contingencies can become intense, a nonsocial environment can usually provide natural contingencies so strong that nonconformance will prove lethal. Nevertheless, although featuring lethal implications for neglect, the evocative stimuli in nonsocial contingencies may remain less functional than the strongly conditioned evocative stimuli in the competing social contingencies. In that case, the socially controlled behavior continues until the individual dies from neglected realities of the environment. For example, many people, behaving in ways that comport with previous social conditioning, have starved to death with 150 pounds of edible meat nearby (e.g., the Antarctic explorer Robert F. Scott and his last two surviving companions), because their unscientific verbal behavior functioned to weaken the capacity of that food to evoke acquiring and eating behaviors. The ultimate demonstration of effectiveness is survival, and a verbal repertoire can weaken rather than strengthen the behaviors necessary to pass such an environmentally imposed test.

Consider another example: Suppose that a thirsty person, while crossing a desert, encounters a dried stream bed. Water may or may not have flowed there recently. Perhaps moist sand could be found beneath the dry bottoms of former pools. This person could potentially profit from a well-digging technology. If the person proceeds at once to dig unconsciously, no question of science or technology arises. That person's technical practices would be occurring in a manner similar to those of desert-dwelling nonhuman species that respond directly to such

places with digging behaviors that occur under direct stimulus control (i.e., intuitively). However, if relevant verbal behavior is evoked concurrently—for example, the reiteration of principles pertinent to ground water reserves beneath stream beds—and acting under partial control of those statements the person precisely locates a dig in a place that more quickly, and with relatively little effort, yields any water present, that verbal repertoire of recited principles constitutes a science.

In contrast, suppose that while the person's loss of body fluids approaches critical limits, those circumstances evoke sitting down cross-legged in the hot sun and meditating about that plight. Perhaps the person cyclically repeats a water-related mantra or more directly exhorts a deity either to impart some useful wisdom or to intervene directly to produce water. That person's meditative verbal repertoire would not exemplify science if subsequent behavior that it shared in controlling proved to be ineffective and perhaps harmful. Verbal antecedents that do not contribute functionally to effective practical action (in this case, locating drinkable water) would not be called science.

Ambiguous cases, usually unimportant, can arise if the obvious effects of verbal supplementary controls are small and any help or hindrance resulting from those controls is not clear.

Philosophy and How It Shares in the Control of Behavior

A verbal repertoire of the kind called science, once conditioned, is not fixed. It is subject to further conditioning. But there is no guarantee that further conditioning is going to improve that scientific repertoire. In many cases, a person's science has been observed to "drift." To maintain science in a maximally effective form requires special attention. It is possible to become scientific about science per se so that degradation in effectiveness is prevented and continued improvement in effec-

tiveness is probable. That requires the development of a somewhat abstract verbal behavioral repertoire that solves problems in behaving scientifically. Such second-order science has been called philosophy of science, and the particular philosophy being addressed here is called *radical behaviorism*.

In his elegant statement, "The Validity of the Author's Verbal Behavior,"³ Skinner (1957) addressed the question of validity in his own verbal behavior. Here, the scientist, who over the years had exhibited his own verbal behavior with enhancing effect on his otherwise direct responses to complex sets of environmental variables, was addressing the quality control of those verbal enhancements. This was an examination of his philosophical practices and their effects on his scientific repertoire. He reviewed the practices of his science as follows:

I exposed myself to a great deal of material in the field of verbal behavior. . . . Hundreds of books and articles which I read were not a direct exposure to the subject matter of verbal behavior itself, but they generated verbal tendencies with respect to it which showed an enormous variety and a fabulous inconsistency. I have also read books, not for what they said about verbal behavior, but as records of verbal behavior. I have done my share of comma-counting. I have listened to people speaking and jotted down slips, curious phrases, or interesting intraverbal sequences, and I have watched subjects in the laboratory responding to the faint patterns of the verbal summator, filling out word-association blanks, and so on.

The notes which I made of all this were my first reaction—both to verbal behavior itself and to verbal behavior about verbal behavior. In the course of time I arranged and rearranged this material many times, using several sorts of mechanical filing systems and an elaborate decimal notation, so that similarities and differences might be detected and respected. I discarded many classifications and arrived at what seemed to be useful and productive

properties of verbal behavior—properties which proved to be worth talking about.

Gradually I settled upon a minimal repertoire which singled out those aspects of verbal behavior which appeared to be useful as dependent variables, and identified and classified various kind of circumstances in the present and past environments of the speaker which seemed to be relevant independent variables. So far as possible, I have tried to conform to the special reinforcing contingencies of the scientific community in the representation and analysis of these relationships. (Skinner, 1957, pp. 454–455)

Here Skinner's activities are reminiscent of a similar period in the work of the naturalist Charles Darwin. Naturalists have been especially quick to reaffirm that the kinds of scientific practices reported in the preceding quote from Skinner produce maximally effective outcomes. In the quoted passage, three important levels of behavior, discriminable on the basis of their controls and effects, can be noted: (a) The implication about the appropriateness of such activities plus the verbal activities for presenting the delineated evidence (in this context about how to develop a science) exemplify exercises in the *philosophy* of science. (b) Any one of the described verbal practices, each of which involved, in some fashion, bringing the author's behavior more effectively under control both of the author's textual records and the natural environmental events that had controlled the author's behavior, constituted *scientific* exercises. (c) The direct interventions among the environmental variables to produce his final products (apparatus, books, new behaviors, etc.), interventions rendered more effective by a philosophically influenced set of scientific practices, were *technological* exercises.

To extract a microexample, consider Skinner's practice of rearranging notes using a filing system so that similarities and differences could be detected and respected. (a) Philosophy: A relevant philosophical event was reassuring himself that it was worthwhile to incur the cost of exploiting his voluminous notes in order to acquire any potential-

³ One of the two personal epilogues at the conclusion of *Verbal Behavior* (Skinner, 1957) reported by the author to be drawn essentially unaltered from the closing material of his William James Lectures at Harvard in 1947.

ly valuable behavior that those records may then have evoked. (b) Science: Thoughts about the nature and operation of a particular filing system and its relevance to the task of reordering notes are examples of the verbal behavior of science—responses that occur under partial stimulus control of the philosophical verbal behavior. (c) Technology: Physically using the filing system to rearrange the notes is a technological activity, which is classified as such because it occurs under the requisitely shared antecedent stimulus controls—mainly control exerted by the notes, the filing system equipment, and the scientific verbal behavior. When Skinner then confronted those new arrangements of his notes, he was, in effect, confronting new antecedent stimulus controls. New responses were then probable. In some cases new principles, rules, or descriptions, not previously in his repertoire, were then induced. (For technical detail on how this functions, see Sidman, 1987.) Because, in this particular example, the final product was itself some new scientific verbal behavior, Skinner could be said to have enlarged or improved his science.

In this example, the part of the environment being affected was the behaviorally defined person (Fraley, 1998), that is, Skinner himself, so here the particular technology was the behavioral technology of self-conditioning. The environmental events to be changed by that technology were Skinner (at the microscopic neural structural level) and subsequently his own behavior toward his subject matter.⁴ That

is, his own science was the targeted environmental phenomenon. He was not then attacking the outside world, but was instead bolstering his own initially inadequate verbal responses to the external variables defining his subject matter. Sometimes, when one's science is not capable of helping evoke effective interventions with respect to what one is investigating, one's science is nevertheless capable of evoking some behavior by which one changes oneself so that one can behave differently, and hopefully more effectively, toward what one is studying. That is, we can find our science inadequate for sharing in the control of behavior that can produce desired environmental effects yet adequate to produce some additional science that, once it can be exhibited, *will* afford us the necessary behavior-controlling capacity for effective action toward the external challenge. The application of our science is shifted to the partial control of a new kind of technological activity (called self-conditioning) that produces some new scientific verbal behavior—new verbal behavior that, when functioning in combination with the external environmental events of ultimate concern, *will* evoke effective interventions among those external environmental variables.

In his chapter called "Logical and Scientific Verbal Behavior," Skinner mentioned several verbal practices of the scientific community that exemplify the functional classes described in this article (Skinner, 1957, pp. 419–420). He began by saying explicitly that the verbal practices of a scientific community encourage "the precise stimulus control under which an object

⁴ Conditioning does not change behavior directly, but has only an indirect effect on behavior. A conditioning procedure can only result directly in a change to the structure of the body, apparently at the neural molecular level. The discovery and description of the precise nature of those changes remain tasks for the neural physiologists. When such an altered body next comes under contingencies to behave in some way for which those structural changes have implications, that changed body behaves differently than it would have behaved with its precon-

ditioning structure. Thus, operant or respondent conditioning changes the structure of the body, and new forms of behavior are subsequently exhibited by that altered body if and when it is next subjected to certain contingencies of reinforcement. These facts are seldom relevant during practical operations to change behavior, so behaviorists typically ignore them when describing conditioning procedures and speak of such procedures as if they directly change the form or frequency of behavior.

or property of an object is identified or characterized in such a way that practical action will be more effective" (p. 419). Here are some verbal practices of a scientific community that Skinner discussed:

1. The discriminative control of verbal responses is sharpened with classificatory schemes. With appropriate conditioning, one responds differently under antecedent control of a more finely discriminated object. For instance, the initial tact⁵ "insect," under the additional control of such a classification scheme and its rules, can be reiterated through categorical reductions to the level of "wasp," "ant," and "bee." "Bee," upon further reduction, can become "genus *Apis*" or "genus *Bombus*," and beyond that level comes species differentiation. A person under contingencies to follow a creature home and get its honey could follow anything identifiable as "insect" or, alternatively, anything identifiable as species "*Apis mellificia*." But when those forms of verbal behavior serve as a functional antecedent (re-

cast in the form of an autoclitically contextualized tact), the general form "there goes an insect" and the specific form "there goes an *Apis mellificia*" evoke similar behaviors (pursuing the creature to its home) that are then advantageously subject to differential conditioning. One pursuit class gets reinforced and the other does not. The formerly indiscriminate and hence inept honey harvester who used to follow anything having six legs, with the con-

⁶ The *autoclitic* is a class of verbal behavior, described by Skinner in chapter 12 of *Verbal Behavior* (1957), by which speakers incorporate, into their statements about other events, elements that indicate to listeners something about the circumstances or controls that evoke the speakers' statements. Through autoclitic verbal behavior, other sorts of controls, not immediately apparent or accessible to the listener, are indicated to the listener or are made more explicit, so that, from the perspective of the speaker, the listener responds more effectively or appropriately. Even if the audience simply ignores the speaker, the speaker is thereby deprived of a reinforcing response, and that can be aversive for the speaker. Speakers produce the tact-supplementing autoclitics because in the past audiences have reacted in more reinforcing ways when such autoclitics have been included in those kinds of statements. Here is an example: Although a cow is the most common occasion on which a speaker is likely to emit the simple tact "cow," that one-word response, produced in vocal isolation, is seldom sufficient for an audience (which probably will reinforce, punish, and extinguish as appropriate to produce a more satisfying elaboration by the speaker). Some examples of autoclitics of potential relevance to this example are italicized in the following statements: *I see a cow. I think that is a cow. I said "cow." I infer that it's a cow. I'm reminded of a cow. I doubt that it's a cow. I'm expecting a cow.* In general, speakers are likely to go unreinforced until some autoclitics are added to their simple tacts. When the audience responds in a reinforcing way to the autoclitically elaborated statement, it is also necessarily reinforcing those included relevant autoclitics that suggest the controls on the speaker's "cow" remark. In everyday language, the audience "wants" to know why the speaker said that and perhaps also is curious about other circumstances such as the time of its emission (if the time is not already known). Autoclitics let the audience take into account some of the important relations between speakers' verbal responses and the environmental events that have evoked those responses. Members of the audience can then respond more appropriately to what speakers say.

⁵ The *tact* is a class of verbal responses, shaped by a verbal community that reinforces those responses. Tacts are exhibited in the presence of specific environmental events, which evoke those responses. Once the person is conditioned through such reinforcement provided by a verbal community, the resultant tact will subsequently occur under stimulus control of those environmental events. When a person contacts an environmental event—for example, a tree—and under current stimulus control of that event emits the vocal response "tree," that response is defined as a tact. The consequences for emitting tacts are supplied by the speaker's verbal community, which not only conditions those relations but maintains them in the repertoires of the community members. If the members of the verbal community in the above example stop reinforcing speakers for saying "tree" upon encountering that particular environmental event and instead begin to reinforce speakers only for emitting "bush" on occasions of encounter, then the tact, as emitted by members of that verbal community, will change from "tree" to "bush." Tacts are often names or identities of things. Chapter 5 in Skinner's *Verbal Behavior* (1957), entitled "The Tact," provides a 63-page introduction to the concept.

ditioning of some better science, will now pursue only an *Apis mellifica*.

2. Prescriptions are maintained for the punishment or extinction of metaphorical, metonymical, and solecistic extensions. The chemist who, in an article for publication, would report that the color change *told* him that the titration was coming to an end may be required by the editor to say "the color change *indicated* that," because color changes do not actually talk.

3. Rules limiting audience variables are maintained so that exaggeration or understatement, misrepresentation, lying, and fiction are punished or extinguished. Scientific verbal behavior is thus kept relatively free of humor, wit, style, poetic devices, and other forms that reflect irrelevant or potentially misleading sources of strength.

4. Rules for scientific composition prescribe that the speaker include appropriate autoclitics that describe (often in an implicit way) the speaker's behavior—perhaps to qualify, quantify, or indicate frequency, and, as appropriate, to suggest the strength of the controls on the speaker's own behavior and somehow inform the listener of how best to interpret interrelations among separate parts of the speaker's verbal behavior.

Among the above-described verbal practices of a scientific community can be found both scientific and philosophical activities. Consider first a response that affects the environment and is exhibited under shared antecedent controls that consist of both a verbal classificatory scheme *and* certain environmental events. That response is classified as technological (a technological linguistic response). For example, confronted with an outdoor audience trying to identify a confusing cloud passing overhead, you announce "lenticular cloud" in response to the following set of antecedent stimuli: (a) that particular cloud in the sky, (b) gestures of confusion being exhibited by audience members, and (c) a handheld printed chart of cloud shapes, with labels.

Suppose that one is to develop such

a classificatory scheme by delineating the respective criteria to be featured in its categories. One's incipient steps are often the outcome of a philosophical intervention, insofar as doing so is partly controlled by antecedent philosophical statements that increase the probability of actually beginning the production of the new classification scheme. An example of such a philosophical intervention may be the reiteration of the assumption that it is useful to have procedures and categories by which to sort events. That philosophical verbal behavior would share in the control of verbal activities conducive to the production of the new science (the new classification scheme). Producing that new science, in the form of descriptions of properties, procedures, and rules, may subsequently require elements of a science and technology of science. But when those descriptions of properties, procedures, and rules are finally conditioned and can subsequently occur as responses in the repertoire of individuals, they are regarded as elements of those persons' specific sciences (e.g., geology or meteorology). If asked to teach their sciences, those individuals would teach those sets of descriptions, rules, and procedures. When the descriptions of, or thoughts about, those same properties, procedures, and rules are exhibited as responses that function as antecedent stimuli sharing in the control of other responses directed at the environment, we can refer to them as scientific stimuli sharing in the control of some behavior that, because of their contributions to its controls, are classed as technological. That sort of operation is often described simply as the "application of science," although technically, of course, science is not something that a scientific person-agent does, but rather something verbally behavioral that is made to happen to the body of the scientist by its current environment.

Philosophy, then, like science, has been identified as a special verbal repertoire—in the case of philosophy,

consisting of criteria, principles, and rules for interpreting data in certain ways. Note that the term *interpreting* implies the exhibition of scientific verbal behavior that presumably, in turn, is under partial control by philosophical verbal behavior, which imposes a quality control upon the science.

A theory, *prima facie*, may be classified as science, but that classification may or may not withstand the quality test. Consider, for example, the theory that the moon is made of green cheese. Given the rising moon and that theory, an observer may report that "the celestial cheese ball has just come up." Philosophy may come into play if such a technological statement, by its incredible nature, evokes the philosophical proposition that all events have a natural history. Then, under partial control of that philosophical assumption, a self-challenge may emerge in the form of a scientific probe: "What sequence of natural history could produce a green cheese moon?" Given the moon and that unanswerable philosophically stimulated question, the scientific theory about green cheese would be unlikely to emerge and thus would no longer be available to share in the control of one's reactions to the moon. Note that a theory with no evidence behind it is subject to a philosophically supported culling and is thereby disqualified as science under the "no help" criterion that was discussed earlier. A more plausible theory—that is, one that is a response to supporting evidence—retains its classification as science even though it too may be subject to eventual elimination from one's scientific repertoire. In that case the elimination results from displacement by a more strongly conditioned but incompatible theory or description.

Unlike science, in which the verbal practices supplement natural environmental stimuli to yield more effective behavior acting on the nonverbal environment, philosophy consists of verbal practices that affect other verbal practices, namely, those of the science.

Whereas the verbal repertoire of science reveals its effects in improved technological interventions in the usually, though not necessarily, external environment, the verbal repertoire of philosophy has its effects in improving the organization and effectiveness of scientific verbal behavior. The philosophy–science functional relation is thus a behavior–behavior relation (Hayes & Brownstein, 1986) in which both kinds of behavior are verbal.

Consider the following example of this quality control function in which philosophical verbal behavior constrains scientific verbal behavior. Skinner (1953) observed that "scientists have also discovered the value of remaining without an answer until a satisfactory one can be found" (p. 13). When prescribed in the form of a rule, this statement functions to restrict the classes of stimulus controls that are to evoke the descriptive or explanatory verbal behavior of the scientist. This rule implies that when explanations occur, the antecedent stimuli pertaining to the phenomena of concern must consist of scientifically adduced evidence. The function of this rule is therefore philosophical, because it exerts a form of quality control over the kind of science that the prevailing circumstances can evoke. The substantial reinforcers gained through effective scientific practices have in the past diminished when scientists have proffered solutions invented as expedient escapes from negatively reinforcing social pressures to provide premature answers. The rule leads to two kinds of outcomes. First, it acts to preserve justified ignorance by increasing the probability of contact with whatever social reinforcers are contingent on such rule following *per se* (a kind of social reinforcement typically described as "respect for the scientific integrity of a person"). Second, it acts to sharpen the occasion for disapproving reactions contingent on faulty premature explanations. The reiteration of the rule against fallacious explanations implies that subsequent potential costs can fol-

low from expedient spurious explanations and exemplifies a philosophical self-management practice by which scientists avoid compromising the truth or validity of their own work in response to aversive social demands for premature explanations. The scientific integrity of the community is thus protected through the functioning of an element of the philosophy of science. (For descriptions of contemporary natural scientists whose behavior seems to violate this rule, see Begley, 1998.)

A further example of the functional role of philosophy was of historical importance in the evolution of the natural science of behavior. Working with old science, early experimental analysts of behavior were developing new science. Like other scientists, they often found themselves under contingencies to establish reliability. One element of the science that they had inherited was a rule that two independent observers must be affected in the same way before a stimulus can be "taken for granted." This rule had substantial implications about how behavior could be measured validly. The reiteration of the rule calling for confirmation by a second observer provided a kind of safeguard. However, when that rule was applied in studies of private behavioral events, it proved troublesome, because the internal location of the relevant variables precluded a second observer's access. Thus, the scientific exploration of private events was being hindered by the very science then available with which to pursue such studies.

The philosophical verbal practices of the newly evolving discipline eventually yielded a potential circumvention of that obstructing rule. The key to circumvention was the fundamental philosophical assumption, characteristic of radical behaviorism, that, in theory, a behavior need not be confirmed if a sufficient description of the current controls along with a sufficient behavioral and genetic history of the behaving organism are available, because under those circumstances the eminent behavior is inevitable and, in theory,

confidently predictable. In the case of public behavior, trainers have often become familiar with a trainee's genetically determined propensities and know well the results of the recent conditioning that in many cases they themselves arranged for the trainee. On that basis, those trainers will often feel confident that the trainee will behave predictably in future situations in which the trainers cannot accompany the trainee. In fact, that is often precisely the point of a training program.

Similarly, confidence in the occurrence of an unobserved private behavior need not be based on observations by multiple observers if (a) one can validly anticipate the subject's contact with antecedent controls that could produce the private behavior, and (b) one can describe a conditioning history that would have rendered those antecedents appropriately functional. For example, if we know the details of a particular history of punishment to which a person has been subjected and we are satisfied that that person's body functions systemically within normal ranges, we can then be relatively sure of the occurrence within that person, on certain specifiable occasions, of respondent behaviors (detectable from their subsequent systemic effects in the form of private feelings of guilt, sin, or shame) even in the absence of other confirming evidence.⁷ That is the nature of training that is typically if fallaciously described as "instilling a conscience." No such trainers have ever contacted the private behaviors that they are nevertheless confident will occur in their trainees under the appropriate circumstances.

When analysis revealed that the es-

⁷ The respondent behavior, of the kind featured in this example, is the automatically elicited behavior of a gland such that it dumps chemicals into the bloodstream of the organism. The subsequent effects of those chemicals on the body are sensed as the feelings that are mentioned. The respondent behaviors are the actions of those glands, not the feelings, although those feelings are inevitable though indirect sensory effects of those respondent glandular behaviors.

sence of the two-observer rule pertained only to increasing the reliability of private events for a remote audience, it was an appeal to some relevant philosophy that allowed the adjustment of what would otherwise have been fixated science practices. The appeal to determinism and its implications opened the possibility of substituting another scientific approach to reliability, such as a delineation of (a) the current events that may function as antecedent controls, (b) the genetic preparedness to behave in certain ways, and (c) the relevant conditioning history. The practices of the science were then reorganized—a change made possible by a shift from dependence on a safeguard-type rule (that had gotten in the way) to some analytical alternative science of a generically different nature—free of the attached disadvantage and potentially even more effective for measuring reliability.⁸ Without the

availability of the new radical behaviorist philosophy with which to intervene among the controlling variables of the science to open that new scientific approach, practitioners would have been stuck with a kind of science that precluded their scientific investigation of a whole domain of interesting and important phenomena and hindered their gaining control over that class of events.

CONCLUSION

The traditional meaning of the term *philosophy*, though vague, usually implied either something endowed with intrinsic importance or something that leads to important outcomes, which implies its capacity to share in the control of behavior that is strongly consequated. However, the functional definition advanced in this article requires only that philosophical verbal behavior function in a certain way. True, to be maintained it must be reinforced, but the strength of the reinforcer is irrelevant to the classification. Philosophy can therefore function in the requisitely definitive manner yet enter into functions with other behavior that remains relatively unimportant, as some of the examples in this section may have illustrated.

Although the work of Skinner, who was frequently cited as the world's foremost behavioral scientist, implicitly suggested that philosophy functioned as quality-controlling verbal stimuli for science—a position explicitly advanced in this article—Willard Van Orman Quine, perhaps the most important American philosopher of the past half century, approached the same conclusion by way of his discipline. In the scientific enterprise, Quine assigns to philosophy a role characterized as science taking a scientific look at its own methods—science gone self-reflective (Shebar, 1987). The thesis of

⁸ Using two or more observers to establish the reliability of reports is of the statistical genre. Under that approach, the assumption of validity becomes more confident as the reports of more observers agree (i.e., the assumption of validity is based on interobserver reliability). A radical behavioral alternative approach follows from the deterministic implication that, because all behavior is precisely controlled, any variability in behavioral data not attributable to instrumental variations in measurement must reflect variation in the control on the described behavior or on the behavior of the describer. Thus an analysis of the controls on both the observer and the subject can account for critical kinds of variation in data on the subject's behavior. Such a contingency analysis is essentially the analysis of validity per se. The statistical approach can show agreement among various observers and thereby establish a degree of reliability, but, unlike a tight investigation of the contingencies, it cannot analytically penetrate directly to the question of validity. If a set of contingencies and a common history affect all members of a universe of observers, then, as a result of that sharing, all observers may agree, but all may be agreeing on an invalid report. A contingency analysis of the controls on any one of them would theoretically be sufficient to detect that invalidity. Thus, behaviorologically, the validity of the report of a single observer is established through the study of the controls governing that report, and such a generically different approach theoretically circumvents a requirement for multiple observers.

In any given case, that theoretical circumvention can then become as practical as the effectiveness of the contingency analysis will permit.

this article is that modern behaviorology serves as the science of science and as the science of philosophy, not only to explain the relation between science and philosophy, but to develop the verbal technology for producing more effective philosophical repertoires.

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