A Historical Perspective on the Future of Behavior Science

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Abstract Like all natural sciences, behavior science has much to offer toward an understanding of the world. The extent to which the promise of behavior science is realized, though, depends upon the extent to which we keep what we know before us. This paper considers fundamental concepts in behavior science, including the concepts of behavior, stimulation, setting conditions, and language. In considering these concepts, we revisit comments from B. F. Skinner and J. R. Kantor and also consider some areas of behavior analytic research and the implications they have for reconsidering long-held assumptions about the analysis of behavior. We hope that, in considering our foundations, the vitality and strength of the discipline might be enhanced, our impact on science improved, and our future secured.

Keywords Behavior · Behavior science · Stimulation · System building · Language

All natural sciences have the potential to improve our understanding of the world. The natural science of behavior has the potential to improve our understanding of behavior, the subject matter of the discipline. The extent to which this potential is realized, though, depends upon several factors. These factors involve fundamental issues and have grave consequences for the entire discipline, the entire group of workers in behavior science, and the impact our discipline will make to the understanding of our part of the world, behavior. Indeed, much is at stake.

Along these lines, we have previously addressed the value of becoming involved in interdisciplinary work and the problems associated with doing so in ways that diminish

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the significance of behavior science as a member of the scientific family (Hayes and Fryling 2009b). We have cautioned against practices that foster disciplinary reductionism and confusion and have urged for conceptual clarity regarding the subject matter of behavior science along with the implications of these proposals for the development of genuine interdisciplinary relations. As the emphasis on interdisciplinary sciences is likely to continue for the foreseeable future (Hayes 2001), these issues continue to be particularly relevant.

Unfortunately, though, these and related fundamental issues that impact the extent to which behavior science might contribute to a greater understanding of the world continue to loom on our horizon. Some of these issues are especially foundational in behavior analysis as a natural science of behavior, and we have always needed to be especially vigilant of them. Indeed, the magnitude of the unique contribution behavior science makes to the understanding of the world depends on the extent to which we stay the course we have set for ourselves. This requires resisting the subordination of our science to other seemingly more deserving disciplines (disciplinary reductionism) and calling out the infestation of scientific knowledge from occult sources (dualism), wherever they appear and however well they may be disguised. Most importantly, this requires keeping before us what we know about our subject matter. The question remains, though, what do we know about the subject matter of behavior science? The goal of the current paper is to carefully consider some of the most fundamental concepts in our science, such that we might establish and affirm our conceptual foundations, assess the validity and significance of those foundations, and promote a comprehensive science of behavior; all so that we might increase the impact our science has on our understanding of the world. Importantly, while our work is significantly influenced by the work of J. R. Kantor, we consider what both Kantor and B. F. Skinner have said about our subject matter to guide our discussion. To start, given that we are considering the science of behavior, it would make sense to begin with what we know about behavior and to preface our analysis by clarifying what we mean by “behavior” in behavior science.

What is Behavior?

Oddly enough, after a hundred years of asking the question, “What is behavior?,” the answer remains the subject of debate, as was evidenced at a recent Association for Behavior Analysis, International conference on behavior theory and philosophy (e.g., Baum 2013; Hayes 2013; Marr 2013; Rachlin 2013). Among the matters under debate were the entities presumed to be engaging in behavior, the problem of decipherable units, and the authenticity of unobserved occurrences of behavior. No agreement as to what behavior means to a behavior scientist was apparent from the outset of this meeting, and none was achieved by its conclusion.

The implications of the lack of agreement on the subject matter of behavior science are troubling: When behavior means different things to different behavior scientists, different behavior scientists are no doubt investigating different things and the products of their investigations thereby do not all elaborate upon the collective works of other behavior scientists. In this sense, their work is not cumulative in nature but rather dispersed across a number of related, perhaps, but nonetheless *other* disciplines (e.g.,

biology). This is a happy circumstance for these other disciplines, of course, but its outcome for behavior science in particular is to diminish its productivity and therein its significance within the larger family of sciences (Hayes and Fryling 2009a, b; Kantor 1958).

The fact that “what we know” as behavior scientists does not appear to include a common understanding as to what behavior is, is not a good beginning to the topic of what we know, at least not if the aim of this exercise is to consider the great promise of our science for understanding the world. Having a common conception of behavior matters. It matters, to reiterate, because its absence has a deleterious impact on the productivity of our science. Given the importance of this issue, it seems worth considering how we might resolve it and bring clarity to the concept of behavior. One obvious source of guidance is the work of B. F. Skinner. In addressing this topic, Skinner stated, “As distinct from other activities of the organism, the phenomena of behavior are held together by a common conspicuousness. Behavior is what an organism is *doing*...” (Skinner 1938, p. 6, emphasis his). The implication of “conspicuousness” here is that what an organism is doing may be contacted directly, that it is not hidden in the operation of its parts, be they visceral, glandular, or neural. More generally, it may be said that for a behavior scientist of Skinner’s variety, it is not the paw that presses the lever or the fingers that play the piano. It is not the foot that takes a step or the legs that walk. It is the whole organism that does these things. Likewise, and importantly, it is not the brain that thinks or imagines, not the brain that solves problems or remembers. Here too, it is the *whole organism*. J. R. Kantor agrees with Skinner on this point. In Kantor’s words:

Psychological events involve the participation of total organisms, not merely special organs and tissues. In contrast with the classical assumption that psychological events are processes correlated with particular organs, interbehavioral psychology assumes that the activities of the total organism are always involved in such events. Specifically, this means that no organ is primary to or in control of any other organ. Interbehavioral psychology does not attribute greater importance to any one structure over any other, whether it be a cerebral or glandular organ or system (Kantor 1958, p. 79).

Conceptualizing behavior as the action of the whole organism was not an aimless matter to the founders of our science, it was a fundamental proposition. It isolated a unique subject matter for the science of behavior, a unique set of events to be investigated by behavior scientists, one that would permit them to make a unique contribution to the corpus of facts comprising what we know about our world. It differentiated the science of behavior from other sciences. It *established* the science of behavior. To be sure, this is certainly not to say that behavior science should avoid interdisciplinary relationships or isolate itself from the larger scientific community. Rather, this is about our unique contribution to such interactions; in other words, how behavior science adds to the greater body of knowledge in the sciences. Reducing our subject matter to those of other sciences will not add to the value of the contribution from behavior science; rather, it will ensure its redundancy.

Therefore, assuming that we would do well to follow the lead of our founders in this regard, some consideration as to the character of whole organism action seems

warranted. The action of the whole organism is not something that can be said to occur on the part of anything less than the whole organism, and the complexity of the whole organism action is not reflected in anything less than the whole organism. In addition, the action of the whole organism cannot be conceptualized as the sum of the actions of its lesser parts. In the first place, the actions of organismic parts are the subject matter of another science, namely biology, which has its own work to do; and secondly, the relations sustained among organismic parts, even for biologists, are not subject to notions of additive summation. Rather, as conceptualized by behavior scientists, the action of the whole organism is the organization and coordination of its constituents such as to culminate in and be constituted as a unique event. Kantor characterizes this notion of whole organism action as follows:

We never make only one kind of contact with a stimulating object. We do not hear through our ears alone, but through our eyes also. And conversely, we see things through our ears and touch reactions too. In all cases we do nothing less than act as a complete and complex person with all the numerous reaction systems which make a complex response to a stimulus situation, and which moreover may be influenced by a very elaborate setting (Kantor 1977, p. 127).

In answer to the question “What is behavior to a behavior scientist?” then, we may answer: Behavior is the action of the whole organism, not its parts considered separately.

To reiterate, the value of this conceptualization of behavior lies in the possibility it affords for the isolation of a unique subject matter for behavior science, whereby its investigators may contribute to the same body of knowledge (Hayes and Fryling 2009b). In other words, the importance of this definition has to do with the productivity of behavior science.

Important here is more than what is meant by the action of the whole organism, however. The implications of these issues raise other questions related to the subject matter of behavior science. Indeed, even when behavior is conceptualized as the action of the whole organism as prescribed by the founders of our science, *behavior*, in and of itself, is not the subject of investigation in the science of behavior. The subject of investigation in the science of behavior is not “movement,” in other words. Skinner made this clear from the beginning when he stated:

It is more to the point to say that behavior is that part of the functioning of an organism which is engaged in acting upon or having commerce with the outside world. The peculiar properties which make behavior a unitary and unique subject matter follow from this definition. (Skinner 1938, p. 6)

This is to say, the subject of investigation in the science of behavior is not behavior *per se*, however conceptualized. Rather, the subject of investigation in behavior science is behavior *in relation to stimuli*.

We will consider what we know about stimuli in the following section. Before we do so, though, it is important to be clear about our aim in drawing attention to the concept of the whole organism as a foundational proposition in behavior science. As mentioned above, we need to be especially careful to avoid certain hazards if we are to assure the

continued vitality and significance of our science. One of these hazards has to do with relinquishing *our* interests in those of other scientific disciplines in efforts to participate in interdisciplinary endeavors. Sustaining an interest in the actions of the whole organism, and not its parts considered separately, protects our interests in such circumstances.

We also suggested that we needed to protect behavior science from infection by mysterious entities from occult sources. In other words, we need to protect behavior science from dualism, in all of its forms. Overcoming this threat to the well-being of behavior science depends in part on how we conceptualize stimuli. Given this rationale, we may continue with what we know about stimuli, and as a preliminary to this discussion, we ask: “What is a stimulus to a behavior scientist?”

What is a Stimulus?

While the term stimulus is central to the science of behavior, it turns out that what we know about stimuli is also interpreted in various ways (e.g., Parrott 1983b, 1986). One aspect of this debate concerns the definition of a stimulus. More specifically: Is a stimulus better conceptualized as an object or as an action of an object? This is not an insignificant matter, as the implications of adopting one or the other of these alternatives are quite different.

First, we will consider the implications of the first alternative, that a stimulus is a thing or object. Objects have characteristics that may make them especially attractive to scientists. They are concrete. They have material properties that are relatively stable. They take up space. They have position and may thereby sustain side-by-side positions with other objects (Fryling and Hayes 2009; Kantor and Smith 1975). Inert objects, however, in and of themselves, do not constitute the stimulatory aspects of functional relations. Implied by the concept of function or functional relation is a mutuality or reciprocity of action (Kantor 1950, 1953; also see Fryling and Hayes 2011). No such mutuality or reciprocity of action is possible when one of the participants is an inert object.

Two solutions to this problem have been proposed, neither of which are satisfactory. One solution to the problem of inert stimuli has been to give mysterious powers of agency to the organism. Here, the environment is envisaged as the dead background upon which the lively, willful organism parades. In short, what the environment cannot do by definition, the organism acquires as an invented capacity. Sometimes, too, the incapacity of inert stimulus objects to interact with behaving as actions is overcome by giving those things equally mysterious powers of “making things happen,” powers of “causation” beyond what is implied by the manipulation of elements in an investigative space (Hayes et al. 1997; Kantor 1950; Parrott 1983a).

Added to these dualistic solutions is the second alleged solution to the problem of inert stimuli—one that shows up when behavior appears to occur in the absence of relevant stimulus objects. The solution to the problem of conceptualizing stimuli as inert objects in this case is to unabashedly violate the proposition that behavior implies stimulation and vice versa. Behavior is said to just occur, presumably in some random fashion, without mention, much less detection, of related stimulating conditions. As Skinner noted, “The impossibility of defining a functional stimulus without reference to

a functional response, and *vice versa*, has been especially emphasized by Kantor” (Skinner 1938, p. 35). But, Skinner also abides by this proposition, as seen in the following remarks:

The environment enters into a description of behavior when it can be shown that a given part of behavior may be induced... according to certain laws... by a modification in part of the forces affecting the organism. Such a part, or modification of a part, of the environment is traditionally called a *stimulus* and the correlated part of the behavior a *response*. Neither term may be defined as to its essential properties without the other (Skinner 1938, p. 9).

The problem of stimuli interpreted as objects, along with the unacceptable solutions to this problem, is overcome when stimuli are interpreted not as objects but rather as actions of objects (Fryling and Hayes 2009; Parrott 1983b, 1986). This interpretation does not eliminate objects as aspects of the physical world, of course; they are just relegated to source roles. This is to say, objects are conceptualized as sources of stimulation, not simulation per se. Stimulation, as relevant to a science of behavior, is action emanating from such sources. For example, a picture of an old friend may be a source of stimulation, though not the stimulating action itself. The stimulating action is rather that involved in seeing a restaurant you frequented with that friend at some previous time.

It is possible that some may be inclined to dismiss the notion of objects acting, but remember that we talk about the actions of objects and events all the time in our field. Stimulus objects are said to reinforce, elicit, and evoke behaviors. These are all actions of objects, and while these are not exactly the sorts of actions being addressed here, the point is that the notion of actions on the parts of objects should not seem foreign. That being said, we can take the position that, for a behavior scientist, stimuli are not objects, but rather, actions of objects.

Interpreting stimuli in this way permits the actions of objects to be isolated from their sources, which is required for a more coherent understanding of multiple phenomena in our field of study (e.g., imagining and reminiscing). More importantly, conceptualizing stimuli as actions of objects is in keeping with what we know about stimuli. For example, we know that the action of a thing does not depend on the physical presence of that thing: Behaving with respect to the action of a food thing occurs in the absence of that thing when salivating action occurs to the sound of a bell. In such cases, the action of food is operating from another source, namely the bell. This understanding of such events eliminates the need to fill the organism with “expectations” or “anticipations” of future happenings, as is required by a stimulus-as-object interpretation.

Phenomena of this sort are ubiquitous in the operant case as well. Here, the inquiry has centered on the interpretation of such phenomena as stimulus equivalence or how it is that an organism comes to respond to one stimulus in terms of, or as though it were, another. Events of these sorts are often said to reflect “transfer of function”¹ from one source of stimulation to another (e.g., Dymond and Rehfeldt 2000) and are the subject

¹ The term “function” here is roughly synonymous with “action” as we have been using this term. It refers to the participation of stimulation in a mutual and reciprocal relation with responding.

of much theoretical and investigative work in behavior analysis (e.g., Hayes et al. 2001; Sidman 2000; Tonneau 2001). Presupposed by the notion of function transfer is an interpretation of stimuli as actions isolable from their sources. Here again, interpreting stimuli as actions supplants the practice of filling the organism with whatever capacities may be needed to complete the account, among them capacities to “associate” or “relate” one thing with another. In other words, the value of interpreting stimuli as actions of objects rather than as objects per se is the opportunity it affords to thwart dualism.

Moreover, while evidence of function transfer is seen in responding to stimulation arising from one source as though it were another, evidence of transfer does not itself explain the process of transfer. This is to say, in arguing that the transfer of stimulus function from one object to another is not usefully attributed to miraculous powers of things or invented capacities of organisms, we are obliged to provide an alternative interpretation of this process.²

Stimulus Substitution

When an organism responds to one stimulus object as though it were another, it is clear that some relation of association is involved. The problem is to specify what is meant by a “relation of association” and given this specification, to identify the events involved in such a relation. Kantor (1924) suggests that relations of association are essentially relations of spatial proximity in particular temporal frames and that what are involved in such relations are sources of stimulation, that is to say objects or “things.” For clarity: A transfer of stimulus function from one object to another may occur under conditions of association. One such condition of association is a relation of spatial proximity between things in a particular temporal frame of reference. For example, when a particular person is situated in space and time with a particular car (e.g., a corvette), the car may develop the stimulus functions of the person (e.g., you may see the person when you see the car).

From this perspective, an association is not something an *organism* makes with respect to things encountered in a proximal relation with one another. An association is not an act. The organism does not “make connections,” relate, or associate objects. Rather, an association is the proximal relation itself. It is an aspect of the setting in which particular responses with respect to particular stimulations occur. The important point here is that patterns or arrangements of envioning factors are held to constitute “conditions of association.” The value of locating relations of association in the pattern of factors comprising the envioning circumstance is that it renders the topic of association amenable to investigative practices, as well as promotes more coherent interpretive activities.

We also know that stimulation operating from sources that are not currently present is not always an outcome of proximal relations among sources of stimulation. Stimulation inhering in one source may operate from another source when the second

² Importantly, while we acknowledge that behavior analysts have provided a number of ways to interpret various phenomena (e.g., Hayes et al. 2001; Sidman 2000; Tonneau 2001), Kantor’s conceptualization of stimulus substitution seems to be the most consistent with the aims we have described thus far, and a detailed consideration of the various theories on this topic is far beyond the scope of the current paper.

source shares formal properties with the first such as to be partially similar to it. In behavior science, we know this phenomenon as “stimulus generalization.”

Finally, to circumstances in which stimulation operates from sources that are not currently present by way of their transfer from other sources or by means of shared features, we may add circumstances in which the functional properties of objects arise from the manner in which their physical properties make contact with particular organisms. In other words, some stimulus functions are a result of the manner in which the object properties of the stimulus interact with the biological features of the organism. For example, the human organism is biologically constituted in such a way that a response of eye blinking occurs with respect to stimulation in the form of a particle of dust. Similarly, the various reflexes of infants demonstrate this phenomenon. Generally speaking, all unconditioned stimulus-response relations are of this sort.

By way of summary, we have argued that the functional properties of stimulus objects may arise directly from the physical properties of those objects, or indirectly, by transfer from other objects bearing relations with them based on spatial/temporal proximity or partial physical similarity. Before moving on to the implications of this analysis of stimulation, it is important to reiterate two important issues. First, as already discussed, stimulation implies responding, which means that there are no stimulus functions in the absence of coordinated response functions. Together, they constitute a unit. Second, evidence of the functional properties of objects are observed in the actions of organisms with respect to them, whereby multiple forms of responding are indicative of multiple functions of stimuli.

By way of the analysis we have been making thus far, it is obvious that a given source of stimulation is likely to be home to multiple stimulus actions or functions with which responding on the parts of particular organisms may be coordinated. Both Skinner and Kantor have commented on this issue. The following, a passage from Skinner's book *Verbal Behavior*, exemplifies his position:

Two facts emerge from our survey of the basic functional relations in verbal behavior: 1) the strength of a single response may be, and usually is, a function of more than one variable and 2) a single variable usually affects more than one response. (Skinner 1957, p. 227)

Kantor makes roughly the same point in the following passage:

Stimuli and responses must be differentiated from the ... organisms and objects which constitute their vehicles or carriers. This contrast can be illustrated by considering that, 1) different objects harbor the same (or similar) stimulus functions, while 2) the same object harbors different stimulus functions... (Kantor 1958, p. 85)

The notion that a given source of stimulation may be home to multiple stimulus functions, directly by way of its physical properties or indirectly by way of its partial similarities or proximal relations with other sources, has enormous implications. Consider the fact that every stimulus object is situated proximally with respect to a myriad of other objects in the experience of any given organism, and further, that no object is so unique as to be completely dissimilar to every other object. Putting these

facts together with the notion that stimulation implies coordinated behavior, we get a picture of the extraordinary complexity of our subject matter.

At the same time, this analysis might raise questions about how it is that an organism's history participates in each occurrence of behavior. In particular, if a given source of stimulation, a given object, is home to multiple stimulus functions coordinated with multiple forms of responding, then it sounds like *anything* might happen on a given occasion. Relations of stimulation and responding do not occur in isolation, however. They obtain in a context. In other words, conceptualizing this issue further requires a consideration of the factors comprising the occasions in which functional relations are situated, an analysis of setting conditions.

Setting Conditions

To begin, we must acknowledge that the settings in which functional relations are observed are multifaceted. As Kantor (1958) puts it, the setting includes such factors as “the hungry or satiated condition of the organism, its age, hygienic or toxic condition, as well as the presence or absence of certain environing objects” (p. 86). Among those environing objects, and bearing particular relevance to the selection of functional relations of the verbal sort, are Skinner's (1957) audience factors, comprised primarily of other persons. Along similar lines, we study conditional discrimination and the function altering effects of motivating operations, both of which highlight the role of setting conditions. To these factors, we may add the presence of other functional relations, as investigated in studies of behavioral contrast and concurrence. In short, we know a great deal about the occasion, the setting, in which functional relations are situated and how it is, thereby, that not just anything might happen on a given occasion. In other words, we know that settings inhibit, enable, or otherwise select the functional relations observed on given occasions.

The proposition that any stimulus object may involve multiple forms of stimulation coordinated with multiple forms of responding affords an interpretation of an organism's history, or it's “repertoire,” as Skinner has called it (Hayes 1992). That is, an organism's repertoire might be conceptualized as the multiplicity of ways the organism might respond with respect to a particular stimulus, given its behavioral history. Indeed, which functional relation is observed on a given occasion is a matter of the setting in which it is situated. Therefore, the consideration of setting conditions has important implications for understanding the complexity of behavior.

Human Considerations

To approach the significance of setting conditions, we begin by noting that the responses of some organisms correspond to the stimulation of objects when the objects themselves are not physically present. That is, some organisms engage in responding having formal properties commensurate with the physical properties of objects when only the functional properties of those objects are immediately present. Such occurrences are obviously not unique to the human species. Dogs salivate to bells, for example. The significance of this happening becomes apparent when we consider the reportorial circumstance of a species in which this sort of behavior is not observed, as is presumably the case for species having exceedingly short lifespans. In the absence of

this behavior, the historical interactions of organisms have no bearing on their current interactions, which is to say, their responses to previously encountered sources of stimulation are invariant from one occasion to the next. When an organism does not respond to stimulation having its sources in historical circumstances, its actions are interpretable as biological in type and its behavior life is restricted to the exigencies of immediately present conditions (also see Kantor 1958, pp. 38–43, 79–80). While history may impact the behavior of short-lived organisms in some very basic ways (e.g., habituation processes), the repertoire of such organisms is not significantly elaborated by its historical circumstances.

By contrast, acting with respect to stimulation having its origins in historical sources is not only present in the repertoires of many species; it is pervasive. This is by no means a trivial matter. The psychological potential of most organisms, or in other words, the magnitude and complexity of the behavioral repertoires they develop, depends on the extent to which previous encounters with stimulation are actualized in the present circumstance; it is only when an organism's historical interactions with its environment are afforded a place in the effective present that such complex repertoires are possible (Hayes 1992). It might be noted that what is implied by this analysis is that an organism's history is not lost to time past. It is not unknown or inaccessible by virtue of the time or place of its occurrence (also see Hayes 1998). It is rather observed in the organism's current interactions with its environment. Significant promise of accomplishment is afforded our science by locating an organism's history in the present circumstance (Hayes 1992).

Leaving this matter aside for the moment, we may conclude that the cumulative outcome of the observation that some organisms engage in responding having formal properties commensurate with the physical properties of objects when only the functional properties of those things are immediately present is an exceedingly complex, conditional behavioral repertoire related to an equally complex envining circumstance.

The Human Environment The environment of human beings has an additional source of complexity, however, about which further comment is warranted. In as much as stimulus function transfer from one source of stimulation to another depends on the presence of envining things under conditions of association, the more complex an organism's environment in terms of the number and variety of things with which it interacts, the more pervasive are events of function transfer likely to be in its behavior life. In other words, because the human environment is comprised of a wide range of factors, transfer of stimulus function is especially pervasive. To a very large extent, the human environment is a constructed environment, populated with an enormous quantity of an endless variety of things deposited as the material products of human action. All such things are potential sources of stimulation for human action, and more importantly, their proximal relations and partial similarities to one another are conditions favoring the transfer of stimulus functions. No other species modifies its environment in this manner and in none, thereby, is the opportunity greater for the expansion of the repertoire by this means. To reiterate, because the human environment is a vast, constructed environment, the human environment is particularly well suited for association conditions and the development of substitute stimulus functions. The human environment seems to be particularly unique in this regard.

Added to the plethora of variant things in the human envining circumstance is the presence of other human beings. Hence, a major source of stimulation for the behavior

of any individual member of the human species is the behavior of other members. Due to the fact that persons are also responding entities, they are sources of a larger number of stimulus functions relative to inanimate objects. As such, their stimulus functions arise not only from their physical properties but also from their actions, and because these are constantly changing, so too are the responses of other persons coordinated with them. Hence, the functional relations involving animate things change and develop more rapidly than those involving inanimate things. More plainly, the stimulus functions of persons are varied and continuously evolving; and as such, human interactions with other humans are especially contextual in nature. While complex interactions involving animate things are not necessarily unique to the human circumstance, they are especially pervasive in the lives of humans.

Moreover, a unique property of human behavior is manifested in these sorts of interactions and its participation so drastically changes those interactions as to render whatever commonalities there may be between human and nonhuman intra-species interactions insignificant by comparison (Hayes and Delgado 2005; 2007). We turn now to this all-important feature of human behavior and its implications for the science of behavior.

Human Behavior Up to this point, we have said very little about the form or topography of responses. The unique property of human behavior we are preparing to address has to do with this issue, so let us make some preliminary comments about response form before proceeding. First, the form of a response coordinated with stimulation inhering in the physical properties of objects is commensurate with those physical properties. Moreover, when a stimulus function inhering in one source operates from a new source, the form of the response coordinated with the new source remains the same, roughly speaking.

For example, the act of seeing someone's face when only her voice is present, as when talking on the phone, is formally similar to the act of seeing her face when her face is present in the immediate situation. Likewise, the act of salivating with respect to food when only the sound of the bell is present is formally similar to the act of salivating when the food is present. In other words, the development of substitute stimulus functions (transfer of stimulus function from one source to another) does not imply a new response form. The response forms are the same, more or less, and they are further commensurate with the physical properties of the original source thing. As previously acknowledged, this circumstance is not peculiar to human beings. Unlike nonhumans, though, humans engage in responses having formal properties that are *not* determined by the physical properties of source objects, either when those objects are present in the immediate situation or when they are absent and their functional properties are operating from other sources. This is to say, the forms of some human responses are arbitrary. For instance, the formal characteristics of the vocal response "chair" have nothing whatsoever to do with the size, shape, weight, or any other physical property of a chair. All responding of the genuinely verbal sort has this character.

As previously discussed, the complexity of a behavioral repertoire increases with opportunities to respond with respect to stimulation inhering in animate sources as opposed to nonanimate sources. These opportunities are greatly enhanced by the addition of stimulation inhering in the enormous quantity of arbitrary response forms characteristic of the human circumstance. Moreover, responses having formal properties that are not determined by the physical properties of stimulus things, even in their

presence, are particularly well suited for occurrence in the absence of those things (Hayes 1992; Parrott 1984). In other words, engaging in the response of sitting on a chair depends on the physical presence of a chair in a manner that engaging in the response of saying chair does not. In this sense, a person may say or think anything, anywhere, and it is this sort of behavior that is pervasive in the lives of human organisms.

Given this, the environment of a human being includes not only that which is physically present as well as that which had been present in an individual's experience but also that which has never been present in an individual's experience because it happened prior to the onset of their life experience, or because it has yet to happen in anyone's life experience, or because it has always been present in a distant location, or because it has never been present in any location by virtue of its nonexistence. The human environment, then, is exceedingly substitutional. This is not the environment in which nonhuman organisms live and their repertoires have none of the expansive properties that living in such an environment affords.

So, what does all of this tell us? It tells us that the complexity of the behavior lives of human beings is much greater than that of any other species. Moreover, this difference will not be diminished unless and until a greater prevalence of arbitrary response forms is seen in the repertoires of other species. While this circumstance is certainly possible, the likelihood of its happening is not great. As a consequence, it may be time to revisit the proposition that the "simple" will one day add up to the "complex." It may not. And, if it does not, an understanding of human behavior will necessitate the investigation of human behavior. While such a suggestion may be at odds with long-held assumptions in the analysis of behavior, others have expressed related concerns (e.g., Baron, Perone, and Galizio 1991; Hayes et al. 2001), and an extensive consideration of the unique features of human behavior is at the foundation of modern behavioral approaches to language (Hayes et al. 2001).

Conclusion

To conclude our consideration of what we know about the science of behavior, we would like to make one final comment. We realize that one reaction to these issues may be that "it's all a matter of semantics." Yes, it *is* a matter of semantics, at least in part, but this should not deter us from taking the matter seriously. How we conceptualize our most central constructs has consequences for our science, among them enhancing its productivity, assuring its significance in the larger scientific domain, preserving its validity, promoting its comprehensiveness, and sustaining its naturalism (Kantor 1958). These are not unimportant consequences, not only for our science but for all other circumstances in which an understanding of behavior is of paramount importance.

It was our goal to consider what we know about the subject matter of behavior science, to promote its mission, protect it from dangers that might compromise its integrity, and to enhance its contribution to an understanding of the world. Further, in considering what we know about our subject matter, we have identified some long-held assumptions that might warrant reconsideration. It is our hope that in reflecting and commenting on what we know, we may increase the likelihood that the great promise of a science of behavior will be more fully realized.

References

- Baron, A., Perone, M., & Galizio, M. (1991). Analyzing the reinforcement process at the human level: can application and behavioristic interpretation replace laboratory research? *The Behavior Analyst*, 14, 95–105.
- Baum, W. M. (2013). What counts as behavior: the molar multiscale view. *The Behavior Analyst*, 36, 283–293.
- Dymond, S., & Rehfeldt, R. A. (2000). Understanding complex behavior: the transformation of stimulus functions. *The Behavior Analyst*, 23, 239–254.
- Fryling, M. J., & Hayes, L. J. (2009). Psychological events and constructs: an alliance with Smith. *The Psychological Record*, 59, 133–142.
- Fryling, M. J., & Hayes, L. J. (2011). The concept of function in the analysis of behavior. *Mexican Journal of Behavior Analysis*, 37, 11–20. doi:10.5514/rmac.v37.i1.24686.
- Hayes, L. J. (1992). The psychological present. *The Behavior Analyst*, 15, 139–145.
- Hayes, L. J. (1998). Remembering as a psychological event. *Journal of Theoretical and Philosophical Psychology*, 18, 135–143.
- Hayes, L. J. (2001). Finding our place in a constructed future. In L. J. Hayes, J. Austin, R. Houmanfar, & M. C. Clayton (Eds.), *Organizational change* (pp. 349–372). Reno: Context Press.
- Hayes, L. J. (2013). Theory and philosophy: future directions. *The Behavior Analyst*, 36, 373–374.
- Hayes, L. J., Adams, M., & Dixon, M. R. (1997). Causal constructs and conceptual confusions. *The Psychological Record*, 46, 97–111.
- Hayes, L. J., & Delgado, D. (2005). Transgenic and knockout models: the problem of language. In G. Fish & J. Flint (Eds.), *Transgenic and knockout models of neuropsychiatric disorders* (pp. 45–67). Towanta: Humana.
- Hayes, L. J., & Delgado, D. (2007). Animal models of non-conventional human behavior. *Behavior Genetics*, 37, 11–17. doi:10.1007/s10519-006-9126-z.
- Hayes, L. J., & Fryling, M. J. (2009a). Overcoming the pseudo-problem of private events in the analysis of behavior. *Behavior and Philosophy*, 37, 39–57.
- Hayes, L. J., & Fryling, M. J. (2009b). Toward an interdisciplinary science of culture. *The Psychological Record*, 59, 679–700.
- Hayes, S. C., Barnes-Holmes, D., & Roche, B. (2001). *Relational frame theory: a post-Skinnerian account of human language and cognition*. New York: Kluwer Academic/Plenum.
- Kantor, J. R. (1924). *Principles of psychology* (Vol. I). Bloomington: Principia Press.
- Kantor, J. R. (1950). *Psychology and logic* (Vol. II). Chicago: The Principia Press.
- Kantor, J. R. (1953). *The logic of modern science*. Chicago: Principia Press.
- Kantor, J. R. (1958). *Interbehavioral psychology*. Chicago: Principia Press.
- Kantor, J. R. (1977). *Psychological linguistics*. Chicago: The Principia Press.
- Kantor, J. R., & Smith, N. W. (1975). *The science of psychology: an interbehavioral survey*. Chicago: The Principia Press.
- Marr, M. J. (2013). Theory and philosophy: Themes and variations. *The Behavior Analyst*, 36, 193–195.
- Parrott, L. J. (1983a). Similarities and differences among Skinner's Radical Behaviorism and Kantor's Interbehaviorism. *Mexican Journal of Behavior Analysis*, 9, 95–115.
- Parrott, L. J. (1983b). Systemic foundations for the concept of 'private events'. In N. W. Smith, P. T. Mountjoy, & D. H. Ruben (Eds.), *Reassessment in psychology: the interbehavioral alternative* (pp. 251–268). Lanham: University Press of America.
- Parrott, L. J. (1984). Listening and understanding. *The Behavior Analyst*, 7, 29–39.
- Parrott, L. J. (1986). On the role of postulation in the analysis of inapparent events. In H. W. Reese & L. J. Parrott (Eds.), *Behavior science: philosophical, methodological, and empirical advances* (pp. 35–60). Hillsdale: L. Erlbaum Associates.
- Rachlin, H. (2013). About teleological behaviorism. *The Behavior Analyst*, 36, 209–222.
- Sidman, M. (2000). Equivalence relations and the reinforcement contingency. *Journal of the Experimental Analysis of Behavior*, 74, 127–146. doi:10.1901/jeab.2000.74-127.
- Skinner, B. F. (1938). *The behavior of organisms*. New York: Appleton-Century-Crofts.
- Skinner, B. F. (1957). *Verbal behavior*. New York: Appleton-Century-Croft.
- Tonneau, F. (2001). Equivalence relations: a critical analysis. *European Journal of Behavior Analysis*, 2, 1–33.