

# A New Formula for Behaviorism

Gregory A. Kimble

The 80 years since the publication of "Psychology as the Behaviorist Views It" (Watson, 1913) have witnessed changes in psychology that require revisions of the behavioristic formula. The 2 most important of these changes were the introduction of the intervening variable approach and the understanding that psychology is 2 companion sciences: 1 experimental, 1 psychometric. The acceptance of those insights allows psychology, without abandoning behaviorism, to avoid the silliness that arises from mistaking the field for common sense, philosophy, or one of the arts. Beyond that such a liberalized behaviorism is psychology's best hope for becoming a unitary science.

My original behavioristic proclamation<sup>1</sup> (Watson, 1913) began with the assertion that, "Psychology as the behaviorist views it is a purely objective experimental branch of natural science" (p. 158; which does not deal with mental states). "I believe we can write a psychology [so defined] and never go back upon our definition: never use the terms consciousness, mental states, mind, content, introspectively verifiable, imagery and the like" (p. 166). I excluded mental content from psychology because it is private. Direct access to the operations of the mind is available only to the person who is having them. That same consideration led me to ban the introspective method of which mental states were the product.

## The Place of Mental Concepts in a World of Facts

From the beginning, many of my colleagues argued that my formula for behaviorism discarded from psychology everything of interest in the field. E. C. Tolman was in this group. He understood the scientific problem that private states create but, influenced by the Vienna Circle of logical positivists, he rejected my solution. He offered a "new formula for behaviorism" (1922) that accepted mental states, but rendered them objective by relating them to symptoms in behavior. For example, he defined an animal's "purpose" to obtain a certain goal as the observable quality of action that one might call "persistence until"—until that goal is reached (Tolman, 1925). Tolman was suggesting that what I called "the absurd position of attempting to *construct* the conscious content of the animal whose behavior we have been studying" (Watson, 1913, p. 159) might not be so absurd after all.

Making that assumption, Tolman (1922) proposed that

a true non-physiological behaviorism is really possible; and . . . when it is worked out . . . [it] will be found capable of covering not merely the result of mental tests, objective measurements of memory, and animal psychology as such, but also all that was valid in the results of the older introspective psychology. (pp. 46-47)

He called his new formula "a formula to bring formal peace,

not merely to the animal worker, but also to the addict of imagery and feeling tone" (p. 47). In this scheme of things, mental states gain scientific status from their ties to observation. A revised formula for behaviorism should incorporate this point of view.

## Two Disciplines of Scientific Psychology

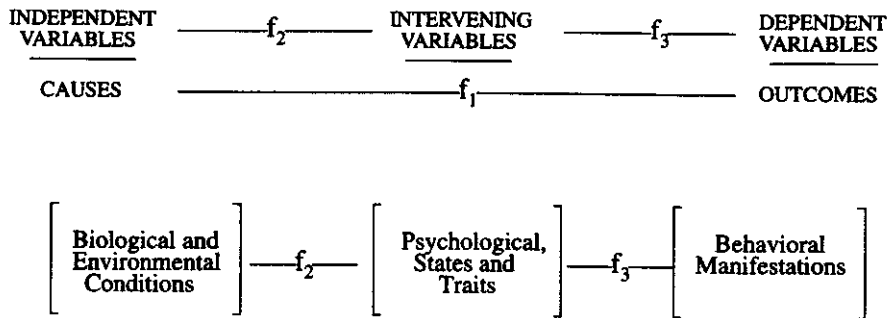
The thought that leads me to a second revision of my formula came from Cronbach's (1957) observation that there are two semi-independent sciences of psychology—experimental and psychometric. Let me introduce their difference with a recollection. Sometime back in 1951 or 1952 I heard Bertrand Russell give a talk at Yale, in which he twitted psychology for its silly squabbles. Suppose I have a scary dream, he said, and go to a psychologist for an explanation. What sort of explanation will I get? Well, it all depends. A behaviorist will tell me that I had the dream because I ate too much lobster that night for dinner. The psychoanalyst will heap ridicule on that interpretation and inform me that I had the dream because, unconsciously, I love my mother. Far be it from me to take sides in such disputes!

If, without taking sides, one asks about the evidence that might validate these explanations, the answer shows the structure of psychology's two sciences. As their bare-bones skeletons laid out in Figure 1 reveal, they deal with identical dependent variables (the bad dream) but with different independent variables (lobster versus love). The independent variables of Russell's behaviorists are biological and environmental causes, which enter into stimulus-response (S-R) laws: The probability of having a bad dream increases in the presence of the stimuli that come from eating lobster. The independent variables of the psychoanalysts are attributes of individuals. Russell's unconscious love for his mother might gain objectivity from his associations on a test of personality: The appearance of such-and-such responses on that test defines unconscious love of mother. The psychoanalytic account of Russell's dream, thus, is a re-

Correspondence concerning this article should be addressed to Gregory A. Kimble, Department of Psychology, Duke University, Durham, North Carolina 27708-0086.

<sup>1</sup> This title is the one that Tolman (1922) used for an article with the same intent as this one—to promote a liberalized behaviorism as the formula for all psychology. Please bear with me as I assume the identity of John B. Watson and attempt—borrowing his writing style as much as possible—to describe psychology as the father of behaviorism might view it in 1994—not so much as it is, as what it ought to be.

## Experimental Psychology



## Psychometric Psychology

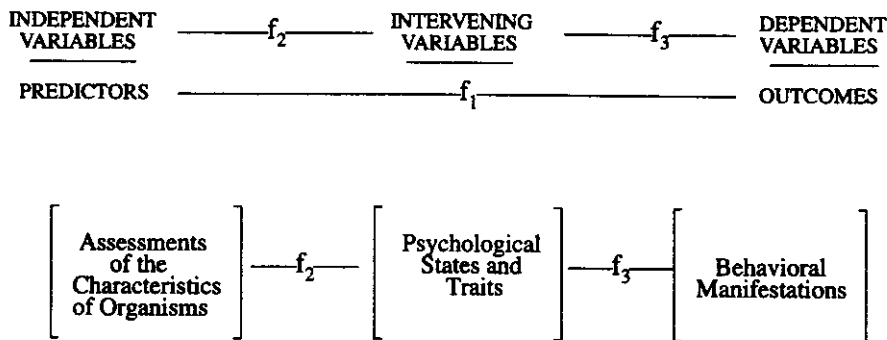


Figure 1. Psychology's two sciences. From left to right, the top and bottom panels in this figure present the independent, intervening, and dependent variables of experimental and psychometric psychology.

sponse-response (R-R) law relating two kinds of behavior: The probability of having a bad dream increases with the presence of certain responses on the Rorschach test. These S-R and R-R laws are the  $f_1$  laws shown twice in Figure 1.

Experimental and psychometric psychology are both behavioristic. They are based on observation and contain no mentalistic causes or effects. Nothing in the nature of their laws makes one science more scientific than the other.

### The New Formula

The ingredients of Tolman's new behaviorism were stimuli ("stimulating agency"), responses ("behavior act"), and what he later on (e.g., 1938) called intervening variables ("behavior cue" and "behavior object"). Tolman's agenda for the science of psychology was the discovery of the links among these elements: "(1) given the stimulating agency, determining the behavior cues, (2) given the behavior cues, determining the behavior object, and (3) given the behavior object, determining the behavior act" (1922, p. 51). This description of the architecture of be-

havior as a flow-chart that goes from causes (independent variables) through a chain of concepts (intervening variables) to responses (dependent variables) is the recognizable ancestor of the theories that Tolman (1938), Hull (1943), and others developed later.

Enlargements of this theory (Tolman, 1938) replaced the  $f_1$  laws with two other sets of laws:  $f_2$  laws relating intervening variables to independent variables, and  $f_3$  laws relating intervening variables to dependent variables (Figure 1). In experimental psychology, the  $f_2$  and  $f_3$  laws link situational variables and behavior. For example, Hull's (1943) concept of habit,  $H_r$ , connects numbers of reinforcements ( $N$ ) to such dependent variables as the number of nonreinforcements ( $n$ ) required to produce extinction. That is,

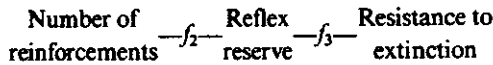
$$N \text{---} f_2 \text{---} H_r \text{---} f_3 \text{---} n.$$

In psychometric psychology, intervening variables connect behavior to other attributes of organisms, most important, to other behavior. The traits of differential psychology, such as in-

troversion, neuroticism, and intelligence, are examples. The concept of intelligence links measures of performance on certain tests (e.g., IQ tests) most closely to quality of school performance. Diagrammatically, again,



It is useful to distinguish between *methodological behaviorism*, which uses intervening variables, and *radical behaviorism*, which does not. Another way to put it is that radical behaviorism uses only  $f_1$  laws, whereas methodological behaviorism uses  $f_2$  and  $f_3$  laws. The behaviorism I described in 1913 was radical behaviorism. In my judgment that kind of behaviorism has nearly gone extinct. Even B. F. Skinner, often identified as the most important modern radical behaviorist, was a closet methodological behaviorist. His best known "non-theory" actually used intervening variables. For example, *reflex reserve* is formally the same as Hull's concept of habit. It intervenes between number of reinforcements and number of responses required to produce extinction:



Methodological behaviorism gained the dominance it now possesses because of two advantages of that approach. First, it rescues mentalistic concepts for the discipline; it allows psychology to be a science and also a psychology. Second, it reduces the number of laws required to account for the phenomena of psychology. If  $N$  independent variables are lawfully connected to  $M$  dependent variables,  $(N) \times (M) f_1$  laws are necessary to describe these relationships. The introduction of intervening variables reduces this number to  $(N) f_2$  laws +  $(M) f_3$  laws.

### The New Formula Expanded and Made General

One of the most serviceable ideas in psychology (Kimble, 1990a) accounts for behavior in terms of two sets of causes—relatively enduring *potentials* for and relatively temporary *instigations* to action. Potentials are the range of outcomes that are possible for an individual. They are like the geneticists' concept of *norm of reaction*. Musical aptitude and vulnerability to schizophrenia are examples. Everyone is born at some degree of risk for developing musical talent and schizophrenia. The extent to which people realize these potentials depends on instigation: amount of practice in the case of musical talent, and the stress of life in the case of schizophrenia.

Figure 2 incorporates these ideas and combines psychology's two disciplines. The best way to read it is from right to left. Note first that behavior is a manifestation of temporary states of organisms that depend on three classes of intervening variables: (a) what the figure calls "S-R realized potential," the product of an individual's biological "potential potential" and previous experience; (b) "psychometric realized potential," which, as the figure shows, is surely caused, but enters the science of psychology by way of tests or other observations of an individual; and (c) instigation. This system is the model that contemporary scientific psychology really follows, although some practitioners of that science deny it (Kimble, 1989, 1990b).

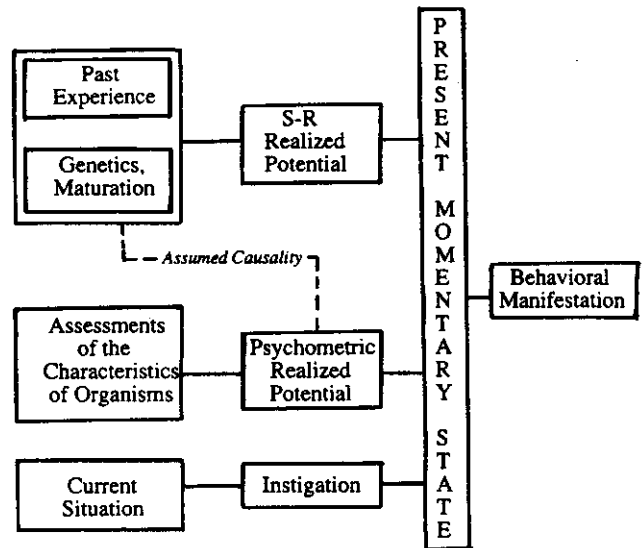


Figure 2. A new formula for behaviorism. This figure outlines the structure of a comprehensive science of psychology. It unites the two sciences shown in Figure 1. The layout is logically, not temporally, sequential. S = stimulus; R = response.

### Criticisms and Reactions

A part of the reason for such denial is that the fundamentally behavioristic character of psychology is poorly understood. Psychologists have forgotten that Tolman was a behaviorist. Some of them believe that he was merely a cognitive psychologist who joined in a conspiracy to assassinate behaviorism, a plot that would have ended in a mercy killing if it had only been successful. The most important misunderstandings of behaviorism include accusations of atomism, mechanistic explanation, neglect of physiology, and insensitivity to human values. I will dispose of them in that order.

#### Atomism Versus Holism

Celestial astronomy deals with the solar system as a whole, by equations that describe the interactions among the variables that control it. Some mini-theories in psychology are similar. Korte's (1915) theory of the phi phenomenon, Gestalt psychology's prototypical whole, was an early example. Korte's theory set forth three laws that stated the interactions among intensity, temporal separation, and the spatial distance of two stimuli that produce optimal apparent motion. One could have hoped that such theorizing would be what the holistically inclined psychologists have in mind when they complain about behaviorism's indifference to totalities. That is not the case at all, however. These psychologists imagine that the whole is somehow different from, and greater than, its parts. It gives meaning to the parts and is in charge of them. These fantasies reify the whole and make it worthy of a name, like "whole child" or "total personality." Now this baptized agency does things and owns things. It knows itself, or if it does not, it finds itself and seeks self-actualization. It has self-esteem, personal space, internal locus of control, and out-of-body experiences. This orgy of *hypo-*

*statization*, the assumption that abstract concepts have physical reality, creates a voodoo psychology that mistakes spirit-names for explanations.

### *Mechanistic Explanation*

The criticism of behaviorism as mechanistic is a poorly disguised expression of a missionary need that some psychologists have to help psychology save its soul. As I said in 1925,

All psychology except behaviorism is dualistic. That is to say we have both a mind (soul) and a body. . . . No one has ever touched a soul, or had one in a test tube, or has in any way come into relationship with it as he has with other objects of everyday experience. Nevertheless to doubt its existence [or that it initiates behavior] is to become a heretic. (Watson, 1925, p. 4)

The outlook in psychology that imagines a little person called cognition—sometimes, to make it worse, inside the head—who is busily processing information, retrieving memories, making plans, creating schemata, and parsing text is such a superstition. In something like the words of E. B. Holt (1931):

In such theorizing, bits of information go straight to the pineal gland, where they become cognitions that serve the pleasure and instruction of the homunculus residing there. After he encodes the information, the homunculus, if so inclined, may initiate and execute responses. In the pineal gland the charivari of mind goes on, a veritable tumbling ground for whimsies. (p. 254)

No doubt you detect the presence of Descartes in this bit of whimsy and realize that, for *cognition*, you could substitute *the soul* without damage to the science.

### *The Ghost in the Machine*

Although in 1913 I entertained the possibility that, "The findings of psychology [may] become the functional correlates of structure and lend themselves to explanation in physico-chemical terms" (Watson, 1913, p. 177), there is nothing in behaviorism that necessitates that hypothesis. Indeed, many behaviorists take the position that physiology is irrelevant and that the essentials of a theory are in its mathematical statements (Spence, 1944). Throughout his long career, Skinner was provocatively antiphysiological, announcing in 1938 that "The gain to the science of behavior from neurological hypotheses in the past is, I believe, quite certainly outweighed by all the misdirected experimentation and bootless theorizing that have arisen from the same source" (p. 426). Fifty years later (Skinner, 1990), he proposed that psychology treat physiological reactions as responses, just another class of things that organisms do.

This cheapening of the value of physiology troubled many psychologists, who felt that the behaviorists' "empty organism" or "black box" should be filled with something real. Instead of S-R psychology, they called for a stimulus-*organism*-response psychology, to make behavior the result of material causes that are primarily in the nervous system. Innocent as it may seem, that notion presents psychologists with the temptation—to which some of them have yielded—to commit two deadly sins. The second sin is sloth, a lazy contentment with a physiology that has no relation to behavior, and thus is not psychology. The

first sin is false pride, the presumption that explanations that invoke the sacred authority of the nervous system are more explanatory than others because only they are real. In actuality, until its functions are related to behavior, the nervous system is just the place where the cognitive psychologists' ghost-soul lives.

The progeny of this spirit-mating of physiology and cognition are a threat to the survival of psychology. Proclaiming themselves to be cognitive neuroscientists, psychoneuropharmacologists, or something equally peripheral, they are aiding and abetting the divisive actions of the specialists within the field and turning psychology into a discipline without a unifying theme. Instead of that we have a Byzantine array of what the introductory textbooks call "perspectives"—behavioristic, biological, cognitive, developmental, experimental, functional, holistic, humanistic, psychodynamic, psychometric, sociocultural, transactional, and no doubt some that I have repressed—all of them created equal. That *laissez-faire* consent to everything is the symptom of a field that soon may go extinct because of its lemming-like persistence in strategies that are sure to fail in the struggle for survival as a discipline.

### *Anti-Intellectualism Masquerading as Human Sensitivity*

Convinced by Tolman and other eminent psychologists that psychology can have its cake (mental states) and eat it too (remain a science) by treating psychic qualities as concepts, psychology bought the intervening variable approach and logical positivism as its philosophy of science. The impact of the purchase was enormous. It dictated topics for research and the content of our textbooks and our courses. So powerful was this influence that by 1940, psychology had invented an eighth deadly sin. In addition to greed, lust, the misuse of chi-square, and the rest, there was the failure to define terms operationally. Teamed up with the presumption that psychology had achieved a Newtonian level of development, there also was a new commandment, "Thou shalt discover the fundamental axioms of behavior." This edict led to some pretty dreary science, of which Kimble's (1947) dissertation on classical eyelid conditioning (at interstimulus intervals ranging from 0 to 400 ms) was a prototypical example.

The reaction was inevitable and, as can happen in psychology, too extreme. The awakenings of the 1960s led most psychologists to a search for relevance and to commerce with such concepts as cognition, volition, and consciousness. For many of them, positivism and operationism became dirty words because of the gossip that, back home in philosophy, they were in trouble. This development did psychology great harm. It legitimated undisciplined subjectivism and, in some parts of the field, it spawned a literature with jargon/substance and feeling/thinking ratios that are more appropriate to art criticism than science. It led to politically inspired restrictions on what psychologists could say and think about the substance of their science.

This politically correct attitude is fundamentally anti-intellectual; it fails to understand that the business of psychology is to understand behavior. The values that govern the endeavor are scientific values. They do not demand conformity to any other moral code. How you feel about a finding has no bearing on its truth.

## Conclusion

Nothing forces psychology to be a science; there are other ways to understand behavior. The poets, preachers, philosophers, and the people on the street also have their ways of knowing, but their criteria of truth are different. Science is empirical. Truth is in the confirmable facts of observation. For the poet, truth is in personal experience and intuition. The proclamation of those revelations as the basis for a science mistakes personal truth for public truth. In psychology, it spawns an epistemological elitist class, like Titchener's trained introspectionists, whose experiences are the only valid ones. For the preacher, truth is in the sacred texts and language of the church. Those truths replace observation with authority, sometimes with malignant consequences like "scientific creationism" and the Spanish Inquisition. For the philosopher, truth comes from the exercise of reason. The outside world, if it exists, is of secondary interest. For ordinary people, truth is what they have learned from experience, what everybody knows, and what only stands to reason. The current fad of seeking truth in intuition, argument, common sense, and literature accepts these other understandings without apparent comprehension that they may not be the same as, or even compatible with, scientific truth.

If psychology takes the scientific road to truth, it will discover that the only observables available are stimuli and responses. That reality means that, at bottom, psychology must be behavioristic. After that, it can be as biological, cognitive, or even humanistic as it wants to be. But disciplines that study something else—like brain, mind, or human potential—without connections to stimuli and responses may occasionally be science—even elegant science—but they are not psychology. Psychology is the science of behavior.

## References

- Cronbach, L. J. (1957). The two disciplines of scientific psychology. *American Psychologist*, 12, 671-684.
- Holt, E. B. (1931). *Animal drive and the learning process*. New York: Holt.
- Hull, C. L. (1943). *Principles of behavior*. New York: Appleton-Century.
- Kimble, G. A. (1947). Conditioning as a function of the time between conditioned and unconditioned stimuli. *Journal of Experimental Psychology*, 37, 1-15.
- Kimble, G. A. (1989). Psychology from the standpoint of a generalist. *American Psychologist*, 44, 491-499.
- Kimble, G. A. (1990a). Mother Nature's bag of tricks is small. *Psychological Science*, 1, 36-41.
- Kimble, G. A. (1990b). To be or ought to be? That is the question. *American Psychologist*, 45, 558-560.
- Korte, A. (1915). Kinematoscopische Untersuchungen. *Zeitschrift für Psychologie*, 72, 193-206.
- Skinner, B. F. (1938). *The behavior of organisms: An experimental analysis*. New York: Appleton-Century.
- Skinner, B. F. (1990). Can there be a science of mind? *American Psychologist*, 45, 1206-1210.
- Spence, K. W. (1944). The nature of theory construction in contemporary psychology. *Psychological Review*, 51, 47-68.
- Tolman, E. C. (1922). A new formula for behaviorism. *Psychological Review*, 29, 44-53.
- Tolman, E. C. (1925). Purpose and cognition: The determiners of animal learning. *Psychological Review*, 32, 285-287.
- Tolman, E. C. (1938). The determiners of behavior at a choice point. *Psychological Review*, 45, 1-41.
- Watson, J. B. (1913). Psychology as the behaviorist views it. *Psychological Review*, 20, 158-177.
- Watson, J. B. (1925). *Behaviorism*. New York: Norton.

Received July 6, 1993

Accepted August 9, 1993 ■