Behaviorism at Fifty

The rapid growth of a scientific analysis of behavior calls for a restatement of the philosophy of psychology.

B. F. Skinner

Behaviorism, with an accent on the last syllable, is not the scientific study of behavior but a philosophy of science concerned with the subject matter and methods of psychology. If psychology is a science of mental life—of the mind, of conscious experience—then it must develop and defend a special methodology, which it has not yet done successfully. If it is, on the other hand, a science of the behavior of organisms, human or otherwise, then it is part of biology, a natural science for which tested and highly successful methods are available. The basic issue is not the nature of the stuff of which the world is made, or whether it is made of one stuff or two, but rather the dimensions of the things studied by psychology and the methods relevant to them.

Mentalistic or psychic explanations of human behavior almost certainly originated in primitive animism. When a man dreamed of being at a distant place in spite of incontrovertible evidence that he had stayed in his bed, it was easy to conclude that some part of him had actually left his body. A particularly vivid memory or a hallucination could be explained in the same way. The theory of an invisible, detachable self eventually proved useful for other purposes. It seemed to explain unexpected or abnormal episodes, even to the person behaving in an exceptional way because he was thus "possessed." It also served to explain the inexplicable. An organism as complex as man often seems to behave capriciously. It is tempting to attribute the visible behavior to another organism inside—to a little man or homunculus. The wishes of the little man become the acts of the man observed by his fellows. The inner idea is put into outer words. Inner feelings find outward expression. The explanation is satisfying, of course, only so long as the behavior of the homunculus can be neglected.

Primitive origins are not necessarily to be held against an explanatory principle, but the little man is still with us in relatively primitive form. He was recently the hero of a television program called "Gateways to the Mind," one of a series of educational films sponsored by Bell Telephone Laboratories and written with the help of a distinguished panel of scientists. The viewer learned, from animated cartoons, that when a man's finger is pricked, electrical impulses resembling flashes of lightning run up the afferent nerves and appear on a television screen in the brain. The little man wakes up, sees the flashing screen, reaches out, and pulls a lever. More flashes of lightning go down the nerves to the muscles, which then contract, as the finger is pulled away from the threatening stimulus. The behavior of the homunculus was, of course, not explained. An explanation would presumably require another film. And it, in turn, another.

The same pattern of explanation is invoked when we are told that the behavior of a delinquent is the result of a disordered personality, or that the vagaries of a man under analysis are due to conflicts among his superego, ego, and id. Nor can we escape from primitive features by breaking the little man into pieces and dealing with his wishes, cognitions, motives, and so on, bit by bit. The objection is not that these things are mental but that they offer no real explanation and stand in the way of a more effective analysis.

It has been about 50 years since the behavioristic objection to this practice was first clearly stated, and it has been about 30 years since it has been very much discussed. A whole generation of psychologists has grown up without really coming into contact with the issue. Almost all current textbooks compromise: rather than risk a loss of adoptions, they define psychology as the science of behavior *and* mental life. Meanwhile the older view has continued to receive strong support from areas in which there has been no comparable attempt at methodological reform. During this period, however, an effective experimental science of behavior has emerged. Much of what it has discovered bears on the basic issue. A restatement of radical behaviorism would therefore seem to be in order.

Explaining the Mind

A rough history of the idea is not hard to trace. An occasional phrase in classic Greek authors which seemed to foreshadow the point of view need not be taken seriously. We may also pass over the early bravado of a La Mettrie who could shock the philosophical bourgeoisie by asserting that man was only a machine. Nor were those who, for practical reasons, simply preferred to deal with behavior rather than with less accessible, but nevertheless acknowledged, mental activities close to what is meant by behaviorism today.

The entering wedge appears to have been Darwin's preoccupation with the continuity of species. In supporting the theory of evolution, it was important to show that man was not essentially different from the lower animals—that every human characteristic, including consciousness and reasoning powers, could be found in other species. Naturalists like Romanes began to collect stories which seemed to show that dogs, cats, elephants, and many other species were conscious and showed signs of reasoning. It was Lloyd Morgan, of course, who questioned this evidence with his Canon of Parsimony. Were there not other ways of accounting for what looked like signs of consciousness or rational powers? Thorndike's experiments, at the end of the 19th century, were in this vein. They showed that the behavior of a cat in escaping from a puzzle box

The author is Edgar Pierce professor of psychology at Harvard University, Cambridge, Mass. This paper will be published in *Behaviorism and Phenomenology: Contrasting Bases for Modern Psychology*, T. W. Wann, Ed., by the University of Chicago Press. It was presented at a symposium on behaviorism and phenomenology held at Rice University in March 1963. An earlier version was given as the R. M. Elliott lecture at the University of Minnesota in December 1962.

might seem to show reasoning but could be explained instead as the result of simpler processes. Thorndike remained a mentalist, but he greatly advanced the objective study of behavior which had been attributed to mental processes.

The next step was inevitable: if evidence of consciousness and reasoning could be explained in other ways in animals, why not also in man? And in that case, what became of psychology as a science of mental life? It was John B. Watson who made the first clear, if rather noisy, proposal that psychology be regarded simply as a science of behavior. He was not in a very good position to defend the proposal. He had little scientific material to use in his reconstruction. He was forced to pad his textbook with discussions of the physiology of receptor systems and muscles, and with physiological theories which were at the time no more susceptible to proof than the mentalistic theories they were intended to replace. A need for "mediators" of behavior which might serve as objective alternatives to thought processes led him to emphasize subaudible speech. The notion was intriguing because one can usually observe oneself thinking in this way, but it was by no means an adequate or comprehensive explanation. He tangled with introspective psychologists by denying the existence of images. He may well have been acting in good faith, for it has been said that he himself did not have visual imagery, but his arguments caused unnecessary trouble. The relative importance of a genetic endowment in explaining behavior proved to be another disturbing digression.

All this made it easy to lose sight of the central argument—that behavior which seemed to be the product of mental activity could be explained in other ways. In any case, the introspectionists were prepared to challenge it. As late as 1883 Francis Galton could write (*1*): "Many persons, especially women and intelligent children, take pleasure in introspection, and strive their very best to explain their mental processes." But introspection was already being taken seriously. The concept of a science of mind in which mental events obeyed mental laws had led to the development of psychophysical methods and to the accumulation of facts which seemed to bar the extension of the principle of parsimony. What might hold for animals did not hold for men, because men could *see* their mental processes.

Curiously enough, part of the answer was supplied by the psychoanalysts, who insisted that although a man might be able to see some of his mental life, he could not see all of it. The kind of thoughts Freud called unconscious took place without the knowledge of the thinker. From an association, verbal slip, or dream it could be shown that a person must have responded to a passing stimulus although he could not tell you that he had done so. More complex thought processes, including problem solving and verbal play, could also go on without the thinker's knowledge. Freud had devised, and he never abandoned faith in, one of the most elaborate mental apparatuses of all time. He nevertheless contributed to the behavioristic argument by showing that mental activity did not, at least, *require* consciousness. His proofs that thinking had occurred without introspective recognition were, indeed, clearly in the spirit of Lloyd Morgan. They were operational analyses of mental life—even though, for Freud, only the unconscious part of it. Experimental evidence pointing in the same direction soon began to accumulate.

But that was not the whole answer. What about the part of mental life which a man can see? It is a difficult question, no matter what one's point of view, partly because it raises the question of what "seeing" means and partly because the events seen are private. The fact of privacy cannot, of course, be questioned. Each person is in special contact with a small part of the universe enclosed within his own skin. To take a noncontroversial example, he is uniquely subject to certain kinds of proprioceptive and interoceptive stimulation. Though two people may in some sense be said to see the same light or hear the same sound, they cannot feel the same distension of a bile duct or the same bruised muscle. (When privacy is invaded with scientific instruments, the form of stimulation is changed; the scales read by the scientist are not the private events themselves.)

Mentalistic psychologists insist that there are other kinds of events uniquely accessible to the owner of the skin within which they occur which lack the physical dimensions of proprioceptive or interoceptive stimuli. They are as different from physical events as colors are from wavelengths of light. There are even better reasons, therefore, why two people cannot suffer each other's toothaches, recall each other's memories, or share each other's happiness. The importance assigned to this kind of world varies. For some, it is the only world there is. For others, it is the only part of the world which can be directly known. For still others, it is a special part of what can be known. In any case, the problem of how one knows about the subjective world of another must be faced. Apart from the question of what "knowing" means, the problem is one of accessibility.

Public and Private Events

One solution, often regarded as behavioristic, is to grant the distinction between public and private events and rule the latter out of scientific consideration. This is a congenial solution for those to whom scientific truth is a matter of convention or agreement among observers. It is essentially the line taken by logical positivism and physical operationism. Hogben (*2*) has recently redefined "behaviorist" in this spirit. The subtitle of his *Statistical Theory* is, "an examination of the contemporary crises in statistical theory from a behaviorist viewpoint," and this is amplified in the following way: "The behaviorist, as I here use the term, does not deny the convenience of classifying *processes* as mental or material. He recognizes the distinction between personality and corpse: but he has not yet had the privilege of attending an identity parade in which human minds without bodies are by common recognition distinguishable from living human bodies without minds. Till then, he is content to discuss probability in the vocabulary of *events,* including audible or visibly recorded assertions of human beings as such. . . ." The behavioristic position, so defined, is simply that of the publicist and "has no concern with structure and mechanism."

The point of view is often called operational, and it is significant that P. W. Bridgman's physical operationism could not save him from an extreme solipsism even within physical science itself. Though he insisted that he was not a solipsist, he was never able to reconcile seemingly public physical knowledge with the private world of the scientist (*3*). Applied to psychological problems, operationism has been no

more successful. We may recognize the restrictions imposed by the operations through which we can know of the existence of properties of subjective events, but the operations cannot be identified with the events themselves. S. S. Stevens has applied Bridgman's principle to psychology, not to decide whether subjective events exist, but to determine the extent to which we can deal with them scientifically (*4*).

Behaviorists have from time to time examined the problem of privacy, and some of them have excluded so-called sensations, images, thought processes, and so on, from their deliberations. When they have done so not because such things do not exist but because they are out of reach of their methods, the charge is justified that they have neglected the facts of consciousness. The strategy is, however, quite unwise. It is particularly important that a science of behavior face the problem of privacy. It may do so without abandoning the basic position of behaviorism. Science often talks about things it cannot see or measure. When a man tosses a penny into the air, it must be assumed that he tosses the earth beneath him downward. It is quite out of the question to see or measure the effect on the earth, but an effect must be assumed for the sake of a consistent account. An adequate science of behavior must consider events taking place within the skin of the organism, not as physiological mediators of behavior but as part of behavior itself. It can deal with these events without assuming that they have any special nature or must be known in any special way. The skin is not that important as a boundary. Private and public events have the same kinds of physical dimensions.

Self-Descriptive Behavior

In the 50 years which have passed since a behavioristic philosophy was first stated, facts and principles bearing on the basic issues have steadily accumulated. For one thing, a scientific analysis of behavior has yielded a sort of empirical epistemology. The subject matter of a science of behavior includes the behavior of scientists and other knowers. The techniques available to such a science give an empirical theory of knowledge certain advantages over theories derived from philosophy and logic. The problem of privacy may be approached in a fresh direction by starting with behavior rather than with immediate experience. The strategy is certainly no more arbitrary or circular than the earlier practice, and it has a surprising result. Instead of concluding that man can know only his subjective experiences—that he is bound forever to his private world and that the external world is only a construct—a behavioral theory of knowledge suggests that it is the private world which, if not entirely unknowable, is at least not likely to be known well. The relations between organism and environment involved in knowing are of such a sort that the privacy of the world within the skin imposes more serious limitations on personal knowledge than on scientific accessibility.

An organism learns to react discriminatively to the world around it under certain contingencies of reinforcement. Thus, a child learns to name a color correctly when a given response is reinforced in the presence of the color and extinguished in its absence. The verbal community may make the reinforcement of an extensive repertoire of responses contingent on subtle properties of colored stimuli. We have reason to believe that the child will not discriminate among colors—that he will not see two colors as different—until exposed to such contingencies. So far as we know, the same process of differential reinforcement is required if a child is to distinguish among the events occurring within his own skin.

Many contingencies involving private stimuli need not be arranged by a verbal community, for they follow from simple mechanical relations among stimuli, responses, and reinforcing consequences. The various motions which comprise turning a handspring, for example, are under the control of external and internal stimuli and are subject to external and internal reinforcing consequences. But the performer is not necessarily "aware" of the stimuli controlling his behavior, no matter how appropriate and skillful it may be. "Knowing" or "being aware of" what is happening in turning a handspring involves discriminative responses, such as naming or describing, which arise from contingencies necessarily arranged by a verbal environment. Such environments are common. The community is generally interested in what a man is doing, has done, or is planning to do, and why, and it arranges contingencies which generate verbal responses which name and describe the external and internal stimuli associated with these events. It challenges his verbal behavior by asking, "How do you know?" and the speaker answers, if at all, by describing some of the variables of which his verbal behavior was a function. The "awareness" resulting from all this is a social product.

In attempting to set up such a repertoire, however, the verbal community works under a severe handicap. It cannot always arrange the contingencies required for subtle discriminations. It cannot teach a child to call one pattern of private stimuli "diffidence" and another "embarrassment" as effectively as it teaches him to call one stimulus "red" and another "orange," for it cannot be sure of the presence or absence of the private patterns of stimuli appropriate to reinforcement or lack of reinforcement. Privacy thus causes trouble first of all for the verbal community. The individual suffers in turn. Because the community cannot reinforce self-descriptive responses consistently, a person cannot describe or otherwise "know" events occurring within his own skin as subtly and precisely as he knows events in the world at large.

There are, of course, differences between external and internal stimuli which are not mere differences in location. Proprioceptive and interoceptive stimuli may have a certain intimacy. They are likely to be especially familiar. They are very much with us: we cannot escape from a toothache as easily as from a deafening noise. They may well be of a special kind: the stimuli we feel in pride or sorrow may not closely resemble those we feel in sandpaper or satin. But this does not mean that they differ in physical status. In particular, it does not mean that they can be more easily or more directly known. What is particularly clear and familiar to the potential knower may be strange and distant to the verbal community responsible for his knowing.

Conscious Content

What *are* the private events which, at least in a limited way, a man may come to respond to in ways we call knowing? Let us begin with the oldest and in many ways the most difficult

kind, represented by "the stubborn fact of consciousness." What is happening when a person observes the conscious content of his mind, when he looks at his sensations or images? Western philosophy and science have been handicapped in answering these questions by an unfortunate metaphor. The Greeks could not explain how a man could have knowledge of something with which he was not in immediate contact. How could he know an object on the other side of the room, for example? Did he reach out and touch it with some sort of invisible probe? Or did he never actually come into contact with the object at all but only with a copy of it inside his body? Plato supported the copy theory with his metaphor of the cave. Perhaps a man never sees the real world at all but only shadows of it on the wall of the cave in which he is imprisoned. (The "shadows" may well have been the much more accurate copies of the outside world in a camera obscura. Did Plato know of a cave at the entrance of which a happy superposition of objects admitted only the thin pencils of light needed for a camera obscura?) Copies of the real world projected into the body could compose the experience which a man directly knows. A similar theory could also explain how one can see objects which are "not really there," as in hallucinations, after-images, and memories. Neither explanation is, of course, satisfactory. How a copy may arise at a distance is at least as puzzling as how a man may know an object at a distance. Seeing things which are not really there is no harder to explain than the occurrence of copies of things not there to be copied.

The search for copies of the world within the body, particularly in the nervous system, still goes on, but with discouraging results. If the retina could suddenly be developed, like a photographic plate, it would yield a poor picture. The nerve impulses in the optic tract must have an even more tenuous resemblance to "what is seen." The patterns of vibrations which strike our ear when we listen to music are quickly lost in transmission. The bodily reactions to substances tasted, smelled, and touched would scarcely qualify as faithful reproductions. These facts are discouraging for those who are looking for copies of the real world within the body, but they are fortunate for psychophysiology as a whole. At some point the organism must do more than create duplicates. It must see, hear, smell, and so on, and the seeing, hearing, and smelling must be forms of action rather than of reproduction. It must do some of the things it is differentially reinforced for doing when it learns to respond discriminatively. The sooner the pattern of the external world disappears after impinging on the organism, the sooner the organism may get on with these other functions.

The need for something beyond, and quite different from, copying is not widely understood. Suppose someone were to coat the occipital lobes of the brain with a special photographic emulsion which, when developed, yielded a reasonable copy of a current visual stimulus. In many quarters this would be regarded as a triumph in the physiology of vision. Yet nothing could be more disastrous, for we should have to start all over again and ask how the organism sees a picture in its occipital cortex, and we should now have much less of the brain available in which to seek an answer. It adds nothing to an explanation of how an organism reacts to a stimulus to trace the pattern of the stimulus into the body. It is most convenient for both organism and psychophysiologist, if the external world is never copied—if the world we know is simply the world around us. The same may be said of theories according to which the brain interprets signals sent to it and in some sense reconstructs external stimuli. If the real world is, indeed, scrambled in transmission but later reconstructed in the brain, we must then start all over again and explain how the organism sees the reconstruction.

An adequate treatment of this point would require a thorough analysis of the behavior of seeing and of the conditions under which we see (to continue with vision as a convenient modality). It would be unwise to exaggerate our success to date. Discriminative visual behavior arises from contingencies involving external stimuli and overt responses, but possible private accompaniments must not be overlooked. Some of the consequences of such contingencies seem well established. It is usually easiest for us to see a friend when we are looking at him, because visual stimuli similar to those present when the behavior was acquired exert maximal control over the response. But mere visual stimulation is not enough; even after having been exposed to the necessary reinforcement, we may not see a friend who is present unless we have reason to do so. On the other hand, if the reasons are strong enough, we may see him in someone bearing only a superficial resemblance to him, or when no one like him is present at all. If conditions favor seeing something else, we may behave accordingly. If, on a hunting trip, it is important to see a deer, we may glance toward our friend at a distance, see him as a deer, and shoot.

It is not, however, seeing our friend which raises the question of conscious content but "seeing that we are seeing him." There are no natural contingencies for such behavior. We learn to see that we are seeing only because a verbal community arranges for us to do so. We usually acquire the behavior when we are under appropriate visual stimulation, but it does not follow that the thing seen must be present when we see that we are seeing it. The contingencies arranged by the verbal environment may set up self-descriptive responses describing the *behavior* of seeing even when the thing seen is not present.

If seeing does not require the presence of things seen, we need not be concerned about certain mental processes said to be involved in the construction of such things—images, memories, and dreams, for example. We may regard a dream not as a display of things seen by the dreamer but simply as the behavior of seeing. At no time during a day-dream, for example, should we expect to find within the organism anything which corresponds to the external stimuli present when the dreamer first acquired the behavior in which he is now engaged. In simple recall we need not suppose that we wander through some storehouse of memory until we find an object which we then contemplate. Instead of assuming that we begin with a tendency to *recognize* such an object once it is found, it is simpler to assume that we begin with a tendency to *see* it. Techniques of self-management which facilitate recall—for example, the use of mnemonic devices—can be formulated as ways of strengthening behavior rather than of creating objects to be seen. Freud dramatized the issue with respect to dreaming when asleep in his concept of dreamwork—an activity in which some part of the dreamer played the role of a theatrical producer while another part sat in the audience. If a dream is, indeed, something seen,

then we must suppose that it is wrought as such, but if it is simply the behavior of seeing, the dreamwork may be dropped from the analysis. It took man a long time to understand that when he dreamed of a wolf, no wolf was actually there. It has taken him much longer to understand that not even a representation of a wolf is there.

Eye movements which appear to be associated with dreaming are in accord with this interpretation, since it is not likely that the dreamer is actually watching a dream on the undersides of his eyelids. When memories are aroused by electrical stimulation of the brain, as in the work of Wilder Penfield, it is also simpler to assume that it is the behavior of seeing, hearing, and so on which is aroused than that it is some copy of early environmental events which the subject then looks at or listens to. Behavior similar to the responses to the original events must be assumed in both cases—the subject sees or hears—but the reproduction of the events seen or heard is a needless complication. The familiar process of response chaining is available to account for the serial character of the behavior of remembering, but the serial linkage of stored experiences (suggesting engrams in the form of sound films) demands a new mechanism.

The heart of the behavioristic position on conscious experience may be summed up in this way: seeing does not imply something seen. We acquire the behavior of seeing under stimulation from actual objects, but it may occur in the absence of these objects under the control of other variables. (So far as the world within the skin is concerned, it always occurs in the absence of such objects.) We also acquire the behavior of seeing-that-we-are-seeing when we are seeing actual objects, but it may also occur in their absence.

To question the reality or the nature of the things seen in conscious experience is not to question the value of introspective psychology or its methods. Current problems in sensation are mainly concerned with the physiological function of receptors and associated neural mechanisms. Problems in perception are, at the moment, less intimately related to specific mechanisms, but the trend appears to be in the same direction. So far as behavior is concerned, both sensation and perception may be analyzed as forms of stimulus control. The subject need not be regarded as observing or evaluating conscious experiences. Apparent anomalies of stimulus control which are now explained by appealing to a psychophysical relation or to the laws of perception may be studied in their own right. It is, after all, no real solution to attribute them to the slippage inherent in converting a physical stimulus into a subjective experience.

The experimental analysis of behavior has a little more to say on this subject. Its techniques have recently been extended to what might be called the psychophysics of lower organisms. Blough's adaptation of the Békésy technique—for example, in determining the spectral sensitivity of pigeons and monkeys—yields sensory data comparable with the reports of a trained observer (*5*). Herrnstein and van Sommers have recently developed a procedure in which pigeons "bisect sensory intervals" (*6*). It is tempting to describe these procedures by saying that investigators have found ways to get nonverbal organisms to describe their sensations. The fact is that a form of stimulus control has been investigated without using a repertoire of self-observation or, rather, by constructing a special repertoire the nature and origin of which are clearly understood. Rather than describe such experiments with the terminology of introspection, we may formulate them in their proper place in an experimental analysis. The behavior of the observer in the traditional psychophysical experiment may then be reinterpreted accordingly.

Mental Way Stations

So much for "conscious content," the classical problem in mentalistic philosophies. There are other mental states or processes to be taken into account. Moods, cognitions, and expectancies, for example, are also examined introspectively, and descriptions are used in psychological formulations. The conditions under which descriptive repertoires are set up are much less successfully controlled. Terms describing sensations and images are taught by manipulating discriminative stimuli—a relatively amenable class of variables. The remaining kinds of mental events are related to such operations as deprivation and satiation, emotional stimulation, and various schedules of reinforcement. The difficulties they present to the verbal community are suggested by the fact that there is no psychophysics of mental states of this sort. That fact has not inhibited their use in explanatory systems.

In an experimental analysis, the relation between a property of behavior and an operation performed upon the organism is studied directly. Traditional mentalistic formulations, however, emphasize certain way stations. Where an experimental analysis might examine the effect of punishment on behavior, a mentalistic psychology will be concerned first with the effect of punishment in generating feelings of anxiety and then with the effect of anxiety on behavior. The mental state seems to bridge the gap between dependent and independent variables, and a mentalistic interpretation is particularly attractive when these are separated by long periods of time—when, for example, the punishment occurs in childhood and the effect appears in the behavior of the adult.

Mentalistic way stations are popular. In a demonstration experiment, a hungry pigeon was conditioned to turn around in a clockwise direction. A final, smoothly executed pattern of behavior was shaped by reinforcing successive approximations with food. Students who had watched the demonstration were asked to write an account of what they had seen. Their responses included the following: (i) the organism was conditioned to *expect* reinforcement for the right kind of behavior; (ii) the pigeon walked around, *hoping* that something would bring the food back again; (iii) the pigeon *observed* that a certain behavior seemed to produce a particular result; (iv) the pigeon *felt* that food would be given it because of its action; and (v) the bird came to *associate* his action with the click of the food-dispenser. The observed facts could be stated, respectively, as follows: (i) the organism was reinforced *when* its behavior was of a given kind; (ii) the pigeon walked around *until* the food container again appeared; (iii) a certain behavior *produced* a particular result; (iv) food was given to the pigeon *when* it acted in a given way; and (v) the click of the food-dispenser *was temporally related* to the bird's action. These statements describe the contingencies of reinforcement. The expressions "expect," "hope," "observe," "feel," and "associate" go beyond them to identify effects on the pigeon. The effect actually observed was clear enough: the pigeon turned more skillfully and more

frequently. But that was not the effect reported by the students. (If pressed, they would doubtless have said that the pigeon turned more skillfully and more frequently *because* it expected, hoped, and felt that if it did so food would appear.)

The events reported by the students were observed, if at all, in their own behavior. They were describing what *they* would have expected, felt, and hoped for under similar circumstances. But they were able to do so only because a verbal community had brought relevant terms under the control of certain stimuli, and this had been done when the community had access only to the kinds of public information available to the students in the demonstration. Whatever the students knew about themselves which permitted them to infer comparable events in the pigeon must have been learned from a verbal community which saw no more of their behavior than they had seen of the pigeon's. Private stimuli may have entered into the control of their self-descriptive repertoires, but the readiness with which they applied these repertoires to the pigeon indicates that external stimuli had remained important. The extraordinary strength of a mentalistic interpretation is really a sort of proof that, in describing a private way station, one is to a considerable extent making use of public information.

The mental way station is often accepted as a terminal datum, however. When a man must be trained to discriminate between different planes, ships, and so on, it is tempting to stop at the point at which he can be said to *identify* such objects. It is implied that if he can identify an object he can name it, label it, describe it, or act appropriately in some other way. In the training process he always behaves in one of these ways; no way station called "identification" appears in practice or need appear in theory. (Any discussion of the discriminative behavior generated by the verbal environment to permit a person to examine the content of his consciousness must be qualified accordingly.)

Cognitive theories stop at way stations where the mental action is usually somewhat more complex than identification. For example, a subject is said to *know* who and where he is, what something is, or what has happened or is going to happen, regardless of the forms of behavior through which this knowledge was set up or which may now testify to its existence. Similarly, in accounting for verbal behavior, a listener or reader is said to understand the *meaning* of a passage although the actual changes brought about by listening to or reading the passage are not specified. In the same way, schedules of reinforcement are sometimes studied simply for their effects on the *expectations* of the organism exposed to them, without discussion of the implied relation between expectation and action. Recall, inference, and reasoning may be formulated only to the point at which an experience is remembered or a conclusion is reached, behavioral manifestations being ignored. In practice the investigator always carries through to some response, if only a response of self-description.

On the other hand, mental states are often studied as causes of action. A speaker thinks of something to say before saying it, and this explains what he says, although the sources of his thoughts may not be examined. An unusual act is called "impulsive," without further inquiry into the origin of the unusual impulse. A behavioral maladjustment shows anxiety, but the source of the anxiety is neglected. One salivates upon seeing a lemon because it reminds one of a sour taste, but why it does so is not specified. The formulation leads directly to a technology based on the manipulation of mental states. To change a man's voting behavior we change his opinions, to induce him to act we strengthen his beliefs, to make him eat we make him feel hungry, to prevent wars we reduce warlike tensions in the minds of men, to effect psychotherapy we alter troublesome mental states, and so on. In practice, all these ways of changing a man's mind reduce to manipulating his environment, verbal or otherwise.

In many cases we can reconstruct a complete causal chain by indentifying the mental state which is the effect of an environmental variable with the mental state which is the cause of action. But this is not always enough. In traditional mentalistic philosophies various things happen at the way station which alter the relation between the terminal events. The effect of the psychophysical function and the laws of perception in distorting the physical stimulus before it reaches the way station has already been mentioned. Once the mental stage is reached, other effects are said to occur. Mental states alter each other. A painful memory may never affect behavior, or it may affect it an unexpected way if another mental state succeeds in repressing it. Conflicting variables may be reconciled before they have an effect on behavior if the subject engages in mental action called "making a decision." Dissonant cognitions generated by conflicting conditions of reinforcement will not be reflected in behavior if the subject can "persuade himself" that one condition was actually of a different magnitude or kind. These disturbances in simple causal linkages between environment and behavior can be formulated and studied experimentally as interactions among variables, but the possibility has not been fully exploited, and the effects still provide a formidable stronghold for mentalistic theories designed to bridge the gap between dependent and independent variables.

Methodological Objections

The behavioristic argument is nevertheless still valid. We may object, first, to the predilection for unfinished causal sequences. A disturbance in behavior is not explained by relating it to felt anxiety until the anxiety has in turn been explained. An action is not explained by attributing it to expectations until the expectations have in turn been accounted for. Complete causal sequences might, of course, include references to way stations, but the fact is that the way station generally interrupts the account in one direction or the other. For example, there must be thousands of instances in the psychoanalytic literature in which a thought or memory is said to have been relegated to the unconscious because it was painful or intolerable, but the percentage of instances in which even the most casual suggestion is offered as to why it was painful or intolerable must be very small. Perhaps explanations *could* have been offered, but the practice has discouraged the completion of the causal sequence.

A second objection is that a preoccupation with mental way stations burdens a science of behavior with all the problems raised by the limitations and inaccuracies of self-descriptive repertoires. We need not take the extreme position that mediating events or any data about them obtained through introspection must be ruled out of consideration, but we should certainly welcome other ways of treating the

data more satisfactorily. Independent variables change the behaving organism, often in ways which persist for many years, and such changes affect subsequent behavior. The subject may be able to describe some of these intervening states in useful ways, either before or after they have affected behavior. On the other hand, behavior may be extensively modified by variables of which, and of the effect of which, the subject is never aware. So far as we know, self-descriptive responses do not alter controlling relationships. If a severe punishment is less effective than a mild one, this is not because it cannot be "kept in mind." (Certain behaviors involved in self-management, such as reviewing a history of punishment, may alter behavior, but they do so by introducing other variables rather than by changing a given relation.)

Perhaps the most serious objection concerns the order of events. Observation of one's own behavior necessarily follows the behavior. Responses which seem to be describing intervening states alone may embrace behavioral effects. "I am hungry" may describe, in part, the strength of the speaker's ongoing ingestive behavior. "I was hungrier than I thought" seems particularly to describe behavior rather than an intervening, possibly causal, state. More serious examples of a possibly mistaken order are to be found in theories of psychotherapy. Before asserting that the release of a repressed wish has a therapeutic effect on behavior, or that when one knows why he is neurotically ill he will recover, we should consider the plausible alternative that a change in behavior resulting from therapy has made it possible for the subject to recall a repressed wish or to understand his illness.

A final objection is that way stations are so often simply invented. It is too easy to say that someone does something "because he likes to do it," or that he does one thing rather than another "because he has made a choice."

The importance of behaviorism as a philosophy of science naturally declines as a scientific analysis becomes more powerful because there is then less need to use data in the form of self-description. The mentalism which survives in the fields of sensation and perception will disappear as alternative techniques prove their value in analyzing stimulus control, and similar changes may be anticipated elsewhere. Cognitive psychologists and others still try to circumvent the explicit control of variables by describing contingencies of reinforcement to their subjects in "instructions." They also try to dispense with recording behavior in a form from which probability of response can be estimated by asking their subjects to evaluate their tendencies to respond. But a person rarely responds to a description of contingencies as he would respond under direct exposure to them, nor can he accurately predict his rate of responding, particularly the course of the subtle changes in rate which are a commonplace in the experimental analysis of behavior. These attempts to short-circuit an experimental analysis can no longer be justified on grounds of expedience, and there are many reasons for abandoning them. Much remains to be done, however, before the facts to which they are currently applied can be said to be adequately understood.

Behaviorism and Biology

Elsewhere, the scientific study of man has scarcely recognized the need for reform. The biologist, for example, begins with a certain advantage in studying the behaving organism, for the structures he analyzes have an evident physical status. The nervous system is somehow earthier than the behavior for which it is largely responsible. Philosophers and psychologists alike have from time to time sought escape from mentalism in physiology. When a man sees red, he may be seeing the physiological effect of a red stimulus; when he merely imagines red, he may be seeing the same effect re-aroused. Psychophysical and perceptual distortions may be wrought by physiological processes. What a man feels as anxiety may be autonomic reactions to threatening stimuli. And so on. This may solve the minor problem of the nature of subjective experience, but it does not solve any of the methodological problems with which behaviorism is most seriously concerned. A physiological translation of mentalistic terms may reassure those who want to avoid dualism, but inadequacies in the formulation survive translation.

When writing about the behavior of organisms, biologists tend to be more mentalistic then psychologists. Adrian could not understand how a nerve impulse could cause a thought. The author of a recent article on the visual space sense in *Science (7)* asserts that "the final event in the chain from the retina to the brain is a psychic experience." Another investigator reports research on "the brain and its contained mind." Pharmacologists study the "psychotropic" drugs. Psychosomatic medicine insists on the influence of mind over matter. And psychologists join their physiological colleagues in looking for feelings, emotions, drives, and the pleasurable aspects of positive reinforcement in the brain.

The facts uncovered in such research are important, both for their own sake and for their bearing on behavior. The physiologist studies structures and processes without which behavior could not occur. He is in a position to supply a "reductionist" explanation beyond the reach of an analysis which confines itself to terminal variables. He cannot do this well, however, so long as he accepts traditional mentalistic formulations. Only an experimental analysis of behavior will define his task in optimal terms. The point is demonstrated by recent research in psychopharmacology. When the behavioral drugs first began to attract attention, they were studied with impromptu techniques based on self-observation, usually designed to quantify subjective reports. Eventually the methods of an experimental analysis proved their value in generating reproducible segments of behavior upon which the effects of drugs could be observed and in terms of which they could be effectively defined and classified. For the same reasons, brain physiology will move forward more rapidly when it recognizes that its role is to account for the mediation of behavior rather than of mind.

Behaviorism in the Social Sciences

There is also still a need for behaviorism in the social sciences, where psychology has long been used for purposes of explanation. Economics has had its economic man. Political science has considered man as a political animal. Parts of anthropology and sociology have found a place for psychoanalysis. The relevance of psychology in linguistics has been debated for more than half a century. Studies of scientific method have oscillated between logical and empirical analyses. In all these fields, "psychologizing" has

often had disappointing results and has frequently been rejected in favor of an extreme formalism which emphasizes objective facts. Economics confines itself to its own abundant data. Political scientists limit themselves to whatever may be studied with a few empirical tools and techniques, and confine themselves, when they deal with theory, to formalistic analyses of political structures. A strong structuralist movement is evident in sociology. Linguistics emphasizes formal analyses of semantics and grammar.

Straight-laced commitments to pure description and formal analysis appear to leave no place for explanatory principles, and the shortcoming is often blamed on the exclusion of mental activities. For example, participants at a recent symposium on "The Limits of Behavioralism in Political Science" (*8*) complained of a neglect of subjective experience, ideas, motives, feelings, attitudes, values, and so on. This is reminiscent of attacks on behaviorism. In any case, it shows the same misunderstanding of the scope of a behavioral analysis. In its extension to the social sciences, as in psychology proper, behaviorism means more than a commitment to objective measurement. No entity or process which has any useful explanatory force is to be rejected on the ground that it is subjective or mental. The data which have made it important must, however, be studied and formulated in effective ways. The assignment is well within the scope of an experimental analysis of behavior, which thus offers a promising alternative to a commitment to pure description on the one hand and an appeal to mentalistic theories on the other. To extend behaviorism as a philosophy of science to the study of political and economic behavior, of the behavior of people in groups, of people speaking and listening, teaching and learning—this is not "psychologizing" in the traditional sense. It is simply the application of a tested formula to important parts of the field of human behavior.

References and Notes

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News and Comment

High-Energy Physics: Panel Proposes Construction, Operation Program To Run through 1981

A federally convened panel on future needs in high-energy accelerator physics issued an $8-billion, 18-year shopping list last week, and, in doing so, served up a nice case study on the complexities of deciding how much should be spent for what in science. (Copies of the study, entitled *Report of the GAC-PSAC Panel on High Energy Accelerator Physics*, may be obtained without charge from the U.S. Atomic Energy Commission, Division of Technical Information Extension, P.O. Box X, Oak Ridge, Tenn.)

In some fields, such as medical and agricultural research, long-standing and widespread public support exerts constant pressure for greater expenditures. As a result, one of the principal tasks facing the political decision makers and their scientific advisors is to guard against excess. But in fields that are largely beyond public view and comprehension, such as high-energy physics and radio astronomy, the decisions are virtually unencumbered by political considerations, and it is easier to shoot for a rational assessment of the "right amount." The main impediments to reaching that goal are the competing demands of other fields of science. The federal money pie, which is the largest source of sustenance for basic research, is just so big, and a fatter slice here means a thinner slice there; but in the more esoteric fields of science it is possible, within fairly generous bounds, to make the needs of the field the main criterion for federal support. The reason for this is that Congress is strongly inclined toward the promotion of science; it tends to dabble and display its prejudices and sentiments in those areas that it can begin to comprehend, such as medical research, but where its own knowledge is glaringly insufficient, it will go along with the experts and scarcely offer a quibble. This practice raises some serious and disturbing questions about the role of Congress in a critically important and expensive area of national activity; the best that can be said is that that's the way it is, and that's the way it will continue to be until someone figures out a way to raise the level of scientific competence within Congress. In the meantime, Congress's inadequacy in such matters places an unusually heavy burden of responsibility on those who are summoned to make recommendations for scientific investment, for, in the absence of a critical performance by the Congress, a formalized recommendation by a prestigeful advisory body is likely to carry the day. The main potential counterweight to such a recommendation is the science advisory organization at the presidential level, but in practice the relationship between advisory panels and the presidential advisors tends to be one of cooperation rather than opposition. This is not to suggest that it should be otherwise, but the fact is that in the case of high-energy physics, for example, an $8 billion proposal has been set afloat without any audible hard questioning. Eight billion dollars may be precisely the right figure, but, if competing, or even sympathetic, interests should feel otherwise, it is difficult to see how they are going to get their views taken into consideration.