

## BEHAVIORISM AND COGNITIVISM IN EDUCATION

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*Dissatisfied with the results of research into human mental processes, American psychologists of the late 19th century turned to studying observable behavior instead. At that time, the methodological approach of behaviorism brought about a scientific revolution in the practice of psychology. This approach has also been productive in the field of education. Nonetheless, behaviorism can offer only limited explanations for human behavior. With respect to learning, for example, organisms are by no means capable of making every connection desired. Behaviorism can not give satisfactory explanation for language acquisition and the rate at which individuals learn languages. Equally inadequate are the explanations offered for problems arising during man-machine interaction. Ultimately it became necessary to look into the "black box"; in other words, to formulate assumptions concerning the processes that take place in the human brain.*

The most important mainstreams in psychology today are behaviorism, psychoanalysis and cognitive psychology. In the past two decades, educational psychology has been dominated by the cognitive approach. In the late 19th and early 20th century, however, the overriding trend in educational psychology, both in the United States and in Europe, was associationist in nature. School subjects were viewed as a collection of relationships or associations that students were supposed to learn. In short, the focus was on the associations between stimuli and responses. For example, a stimulus might be the problem  $13 \times 13$ ; the response is 169. Exercises were organized in such a way as to strengthen these associations.

In this article we shall describe the behavioristic approach, proceeding in the following manner. We begin by describing the dissatisfac-

tion felt in the United States in the late 19th century concerning European studies into human consciousness. We then describe how behaviorists set about learning more about human beings. Next we describe briefly the three types of behavior that humans exhibit in order to survive. We also note the most important features of behaviorism, the influence of Thorndike and Skinner, and a few applications in the field of education. Finally we describe those areas where the explanations offered by behaviorism fall short, and explore which new school perhaps do a better job of describing and explaining human behavior.

### THE STUDY OF CONSCIOUSNESS

If we study the history of psychology, we find that even before the turn of the century, a few American psychologists had begun to apply

the scientific method. From Galileo (1546-1642) onward, this method had contributed enormously to the growth of knowledge in the natural sciences.

The method applied in (natural) sciences, or better yet the opinion held concerning science, can be described in the following general terms (Rosenberg & Birdzell, 1991). In the first place, science is objective. Second, this objectivity is shaped by observation and the experimental registration of natural facts or quantities. Third, scientific knowledge is the result of combining acquired facts and formulating them into laws or other generalizations.

American researchers were particularly unhappy with the results of research into consciousness achieved by European psychologists between 1875 and 1920. In general, the Europeans employed the method of introspection and their reports concerning the workings of the brain were based on that particular method. Attempts were naturally made to rationalize the perceived phenomena and reduce them to a certain pattern. The method of introspection was abandoned, however, because it ultimately turned out to be impracticable (Linschoten, 1964). It was adequate neither for the subject nor the researcher, because too many aspects of affective and cognitive processes remained inaccessible. Some researchers have attempted to solve this problem by comparing human cognition metaphorically with various technical achievements of our culture, such as the clock, the steam engine, the radio, radar, and the computer (Vroon, 1986).

In addition to applying what would later prove to be the impracticable method of introspection, psychologists at that time showed very little concern for the validity of their theories, or rather specula-

tions. Nor did they worry much about their practical application. The argument that verification was on the whole unusual in that day and age is incorrect: both natural scientists and engineers viewed verification as a matter of course in their activities.

#### BEHAVIOR INSTEAD OF MENTAL PROCESSES

Behaviorists, recognizing that there was apparently no appropriate method to study human mental processes, tried to circumvent the problem by claiming that one did not need to study them in order to make a contribution to the field of psychology. In their view, behavior should serve as the primary research theme, because unlike mental processes, behavior was observable. They concluded that research should focus exclusively on observable behavior and not on the unobserved phenomena of consciousness.

For the behaviorists, then, explanations that had no basis in human and animal behavior were irrelevant. It is important to note that in behaviorism, the term "behavior" actually refers to observations of the consequences of this behavior. For a more detailed discussion, see the passage concerning the determinants of behavior in Crombag (1981).

Despite the accusations levelled by critics of behaviorism, behaviorists by no means sought to imply that consciousness or mental processes did not exist. Their possible existence, however, did not make them suitable objects of scientific study from a methodological point of view. The focus on methodology was characteristic for behaviorism and at that time signified a scientific revolution in the practice of psychology.

We can clearly discern the influence of logical positivism on be-

haviorism, specifically in the writings of Watson (1878-1958) and Skinner (1904-1990). According to logical positivism, theories are only defensible if they refer to observable facts. This means that concepts and theories must be defined entirely in terms of observable data. The goal is to eliminate those metaphysical assertions that bypass observation altogether. Psychologists found it particularly difficult to meet the strict requirements of logical positivism, however, and this led them to formulate less stringent demands.

According to Mace (cited in Eysenck, 1972), in addition to the methodological aspect discussed above, behaviorism also demonstrates many of the characteristics of materialism. Many of the views held in behaviorism can be traced to those of materialism as formulated by De la Mettrie (1709-1751) in France (De la Mettrie, 1978). In his opinion, behavior, including human behavior, was determined entirely by positive and negative reinforcement.

#### "SCHOOL"

Behaviorism does not qualify as a true "school" in psychology because it has no principles with a specific content. It is therefore not synonymous with a single, special theory of behavior as in the case of other important schools, such as psychoanalysis today and Gestalt theory before World War II. According to Robinson (1970), behaviorism might be seen as a certain culture within psychology, more a habit or a thought than a system or "school." We might also claim that behaviorism is rather a way of approaching an object of study, a methodology that until now has been more generally successful than any other rival approach. Crombag (1981) stated it aptly when he wrote that in many circles re-

searchers routinely dismiss the behavioristic approach as naive because its results do not always agree with their own unverified observations.

#### THE ABILITY TO LEARN

The primary concern in behaviorism is the ability of humans and animals to learn. Both human beings and animals are a *tabula rasa* at birth. Behaviorism claims that both are able to survive by reacting with three types of behavior: instinctive behavior, operant behavior and intelligent behavior. Each of these behaviors has a distinct phylogenetic history; in other words, instinctive, operant and intelligent behavior developed one after the other in evolution.

An instinct does not contain within it the ability to learn, in other words it cannot be influenced by the consequences of behavior. For this reason we shall not describe instinctual behavior here, referring interested readers instead to Gleitman (1981) or Gould & Marler (1988).

The ability to learn is essential, not only to survive in a demanding environment, but also to survive in a society made increasingly complex by the discoveries of science and technology. We must be able to feel, as it were, that certain behaviors are useful and positive while others on the contrary do us harm. To do this, we must be able to see the relationship between a behavior and its consequences. Behavior that is shaped by and retained because of its consequences is called operant behavior. This type of learning, called operant conditioning, depends to a certain extent on the amount of time that has passed between the behavior and the perception of its consequences. When too much time has passed, we are unable to see the rela-

relationship between behavior and consequence, and as a result do not learn. This type of learning is therefore suitable for short-term survival, but the consequences of behavior in the long run are not clear. Vroon (1989) appropriately calls operant behavior "near-sighted." Two examples from educational practice might serve to clarify this: a) a student is given the results of a test some two weeks after he or she has taken it; b) a student has misbehaved during the first hour of class and is told to report after school -after a period of at least five hours- to receive his or her punishment.

In both cases the student involved will have a very difficult time making the connection between his or her behavior and the consequence of this behavior. It is important, therefore, that we are made aware of the consequences of our behavior almost immediately.

Operant behaviors are not enough to ensure long-term survival. It is naturally important that we are aware not only of the direct consequences of our behavior, but also of the consequences that arise at a later date. This type of behavior, called intelligent behavior, is the result of sound reasoning. Behaviorist principles do not deny the existence of this type of behavior.

#### CHARACTERISTICS OF BEHAVIORISM

Behaviorism attempts to describe, explain and influence behavior. In the following section we will describe the most important features of behaviorism, based on Bakker (1987).

First of all, the most important causes of or motivations for behavior lie outside rather than within the individual, according to the behaviorists.

Second, the dualistic portrayal of mankind which distinguishes between mental processes and observable behavior is scientifically unproductive. The explanation is as follows: in everyday life it is all too often the case that explanations for human behavior are sought in inner motives and disposition. Many of us believe that pronouncements such as "Carl does poorly in school because he's stupid" or "Mary loses control of herself because she's aggressive" actually mean something. Apparently we think that something in Carl or Mary is the cause of their observable behavior. However, the only way to detect the inner characteristic serving to explain behavior in such pronouncements is to observe this very behavior. We see that cause and effect have the same source. Moreover, they can change places, so that we arrive at the following: "Carl is dumb because he does poorly in school." Pronouncements such as these are tautologies and fall short as explanations.

Third, the scientific study of mankind should be restricted as much as possible to directly observable quantities.

Fourth, explanations of human behavior are simple in principle, as behavior arose out of elementary learning processes, but in practice, however, behavior is quite complex. Both the behavioral patterns of and the outside influences that affect human beings are complicated.

Fifth, man is generally a shallow and imprecise observer of both his own and others' behavior. The dualistic portrayal of mankind forces him to propose all sorts of dubious explanations.

Sixth and last, attempts to influence behavior must be preceded by a thorough behavioral analysis. This analysis functions as an interim model. If the attempt to influence be-

havior fails, then the analysis is incorrect or incomplete and must be revised.

#### THORNDIKE AND SKINNER

Thorndike (1874-1949) introduced careful experimental procedures in the area of research into learning. He formulated an important law which later influenced research into instrumental conditioning: the law of effect (Thorndike, 1898). According to this law, the consequence -in Thorndike's terms the "effect"- of a response determines whether the inclination to repeat the same response will grow stronger or weaker. A suitable reward may result, for example, in an animal displaying a certain behavior more quickly.

In instrumental conditioning, an animal or human being is given a reward, for example in the form of food, at the moment that they display the desired behavior. A student who has done well on an assignment or test is rewarded by the teacher, for example with a high grade. A reward, in this context usually referred to as positive reinforcement, consists of offering something that is known to have reinforcing effect immediately after the behavior which is being reinforced has been displayed. In this way, the person in question will recognize the direct relationship between his behavior and the reinforcement (Eysenck, 1972). In reinforcement the emphasis is on immediate reward. If the reward is delayed, and the relationship to the desired behavior is not explicit, then it is not positive reinforcement.

Positive reinforcement is an important part of many theories of learning. Theoreticians agree that if the learning process is to be successful, the learner must experience a reward in one form or another. In a teaching-learning environment, this

means giving a student information concerning the nature of his or her response. It generally means a verbal message on the part of the teacher: "Correct," "You're very close," or "The first part of your answer is correct," etc.

Under Skinner's influence, educational psychology in the United States leaned heavily toward behaviorism. Skinner made a large contribution to research into instrumental conditioning and into directing the learning process. In instrumental conditioning, the learner is much less at the mercy of external stimuli. His or her actions and reactions seem to come from within, as if at random. Skinner called such instrumental reactions "operants." They serve to manipulate the environment in order to effect a change which will result in a reward. The impulse to perform operants will become stronger or weaker depending on their consequences. Skinner and his followers believe that a learner can learn a response if his or her behavior is shaped in the correct fashion. Indeed, this technique is called "shaping," and it uses the method of successive approximations.

#### SOME APPLICATIONS IN EDUCATION

In the 1950s a number of educational technologies were developed that are still applied on a large scale. Programmed instruction is one of these technologies, perhaps the most famous direct application of the behaviorist approach in education. In addition to the principle of shaping, programmed instruction also applies the principle of faultless learning in the design of educational material. The attempts made to optimize programmed instruction have resulted in highly usable technology, for example task analysis,

still used in instructional design today.

A second application of behaviorist principles of psychology in education is the strategy of mastery learning. This strategy is based on the cumulative nature of learning. It states expressly that each and every student must have mastered every unit of a curriculum at a minimum level before moving on to a new unit. The school must naturally allow the students all the time they need to master a unit, and must also see to it that they receive adequate instruction.

A third application in education is behavior modification, in which the principles of reinforcement are used to help maintain order and to change the behavior of students from undesirable to desirable.

#### SOME COMMENTS

At this juncture we would like to make two important remarks concerning the preceding. In the first place, many behaviorist researchers have supported the idea that mental processes are not a suitable object of study in psychology. In other words, they do not feel it is necessary to look into the "black box" in order to describe, explain and influence the behavior of man and beast. This is probably why the processes that take place in the brain have been neglected. We must remember, however, that during the heyday of behaviorism -approximately 1910-1950- there were no instruments available for inspecting the black box. Only recently, because of technological developments and impulses from other disciplines, has this become possible, albeit on a limited scale (Lassen, Ingvar & Skinhøj, 1978).

In the second place, we should note that it was specifically in experimental psychology, the subdisci-

pline now known as psychonomics, that behaviorism dominated. Areas such as educational and social psychology have always given a great deal of attention to cognitive subjects, certainly in Europe.

#### CRITIQUE OF BEHAVIORISM

Behaviorist researchers believed that their admittedly limited collection of principles and patterns would serve to explain and influence a great deal, if not all of our behavior. They attempted to explain learning processes with one single set of conditioning principles. The idea that almost all knowledge and behavior is based on learning proved indefensible, however. By the 1960s behaviorist explanations were under increasing attack. Below we list four objections.

To begin, studies showed that learning processes are not the same for all animals, and that certain animal behavior is hereditary (Vroon & Draaisma, 1985). For example, by applying instrumental conditioning or "shaping," a dog can be taught to offer a forepaw, but any effort spent trying to teach it to offer a hind paw is wasted (Razran, 1971). It became increasingly evident that animals were not able to learn nearly as much as behaviorists once thought. For example, Breland and Breland (1961), who trained animals for the entertainment industry, demonstrated that a pig can only acquire behavior that is related to its species-specific instinct. It is almost impossible to teach it other behavior.

Garcia, Ervin and Koeling (1966) reported experimental results that contradict the underlying principles of instrumental conditioning. It appears that organisms, far from being able to recognize every connection that a researcher wants them to recognize, only see those that increase

the probability of survival. This is known as the Garcia effect, for the researcher who first described the phenomenon. Apparently there are phylogenetically significant relationships between stimuli and responses.

Second, behaviorists believe that language acquisition is based on the simple application of three principles. In the first place, behaviorists view language production, such as speech and writing, as a chain of associations between words in a series. The relationship here is between the perception of an object and the sound of a word. The second principle is the imitation of pronunciation and sentence structure. The third principle is that conditioning and reinforcement, which we can observe whenever parents or other adults concur with a child's correct choice of words or a successful pronouncement.

Young children learn language at a tremendous rate. Moreover, children are already able to understand 10 to the power of 20 different sentences. The enormous speed with which they learn language, coupled with the gigantic number of sentences that they can understand, make it clear that the behaviorist explanation is inadequate. Chomsky (1957) was the first to express this criticism. With a finite number of linguistic rules we can produce an almost infinite number of correct linguistic utterances. For example, the production of a completely new sentence cannot be explained by referring to acquired stimulus-response relationships. Children are able to produce sentences that they have never heard before quite early in their language development. They naturally make grammatical errors, but these errors are not so serious that we cannot understand what they are saying. Linguists believe that human beings may have an innate ability to

apply the syntax -the grammatical arrangement of words in sentences- of a language.

Chomsky (1968) assumes that the brain must have a specialized system which stores a priori knowledge about language. He believes that the circuits in our brains are organized in such a way that grammar is built in genetically ahead of time, long before we have learned to talk. He calls this genetically determined structure the Language Acquisition Device or L.A.D. This probably means that children first develop a set of rules which they then apply in order to construct what for them are entirely new sentences.

Unlike adults, young children can learn to speak every language entirely without accent. To date no satisfactory theory has been found to explain why the ability to learn new words decreases during puberty and why a child's accent is almost completely formed by adolescence.

Third, linguistics offers another example of behavior that behaviorist researchers are unable to explain: the ability to shift from active to passive voice. From about the age of 12 children are able to make this shift effortlessly. We will not offer any explanations for this phenomenon here, but refer instead to Chomsky (1968) or Gleitman (1981).

The failure of behaviorism to explain language acquisition has made it more plausible to assume that something in the organism itself, in its "black box," possesses the complex ability to save, process and use information. In the words of Crombag (1981), we cannot escape postulating that the organism possesses a memory.

Fourth, during the Second World War psychologists were confronted with problems that they were unable to solve on the basis of existing psychological knowledge base. For

the most part these problems involved errors made while interpreting signals on radar screens and while operating machinery. Countless mistakes made in airplane cockpits, for example, were attributed to incorrect readings of instruments whose design appeared to be faulty. Messages transmitted via radio or telephones were often interpreted incompletely or incorrectly. These human behavior problems, which manifested themselves in the interaction between man and machine, could not be solved without first making assumptions about the processes that take place in the brain.

We would like to conclude this section with a remark. The impression in certain circles in Europe is that behaviorism views man as nothing more than a dumb reflex machine. We are campaigning against this impression. Neo-behaviorism, which developed in the 1930s under the influence of Tolman (1886-1959), saw man and beast as beings capable of meaningful, purposeful action based on actively employed schemata of reality. The behaviorists call these schemata "cognitive maps." It is important to note that they play an important role in cognitive psychology. What we wish to emphasize, in other words, is that it is impossible to separate behaviorism and cognitive psychology completely.

#### CONCLUDING REMARKS

In all fairness to behaviorism, we must report that in the field of education it has been a resounding success. We refer here to programmed instruction, mastery learning and behavior modification in the classroom.

Behaviorism is able to explain and influence certain phenomena, but certainly not all. The explanations it

offers for higher processes such as language and thought are inadequate.

The change that psychology underwent around the Second World War was prompted first of all by the inadequacies of behaviorism itself, and second of all by new problems requiring a different approach. The cognitive view in educational psychology has a better chance of solving the above-mentioned problems.

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