WHAT IS DEFINED IN OPERATIONAL DEFINITIONS? THE CASE OF OPERANT PSYCHOLOGY

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ABSTRACT: With S.S. Stevens, operationism became an important influence in psychology. In this paper I discuss the differences between Bridgman's and Stevens' proposals on operationism and the role that operational definitions play in scientific theory. I discuss how Stevens' notions of the basic act of discrimination and of the relation procedure–outcome influenced B.F. Skinner's criteria under which the main conceptual distinctions in operant psychology were formulated. The operational origin of the dichotomies between respondent and operant behavior, contingency-shaped and rule-governed behavior, private and public events, and verbal and nonverbal behavior are examined.
Key words: operational analysis, operational definitions, private–public events, operant–respondent behavior, contingency-shaped and rule-governed behavior

Since S.S. Stevens' emphasis on operational definitions in 1935, psychologists have incorporated this type of definition as an attempt to increase the objectivity of their theoretical and experimental efforts. Although operationalism as such is not explicitly acknowledged in present theoretical practice in psychology, Stevens' version of it still has an implicit, pervading influence. The customary practice of identifying processes with procedures or with the analogy of machine and models workings is not unrelated to operationism. In this paper I will examine the role of operational definitions in theorizing in psychology and the influence that operationism had on B.F. Skinner and the development of what is called today operant psychology.

First I examine Bridgman's and Stevens' proposals regarding operationism. Second, I discuss the way in which operationism influenced the construction of operant theory and its limitations, especially in regard to the identification of the empirical domain to be studied.

Operationism as Proposed by Bridgman and Stevens

In 1927 Bridgman published *The Logic of Modern Physics*. In this book he proposed the operational analysis (not the definition) of concepts in order to adapt the concepts of physics to the innovations resulting from Einstein's theory of

special relativity. In 1935 S.S. Stevens published *The Operational Definition of Psychological Concepts*, promoting the incorporation of Bridgman's operational analysis as a general methodology of science, in which psychology would have a prominent role. However, solid arguments distinguish between the proposals by Bridgman and Stevens and identify the actual influence exerted by S.S. Stevens upon B.F. Skinner and the way operant theory was developed.

Houts (1994) has summarized the relevance and context of Bridgman's operational analysis thus:

> First, it should not be forgotten that Bridgman developed operational analysis as his means to cope with the specific context of the conceptual revolutions brought about in physics at the turn of the century and into the first quarter century of modern physics. The major shift of thinking that Bridgman perceived and attempted to illustrate by repeated examples of analysis was a shift from taking concepts to refer to properties of objects to taking concepts to refer to activities of the physicist. In this sense, concepts such as length and velocity were achievements of humans acting on the world rather than signifiers of properties of the world. Concepts were therefore never fixed, but were instead subject to constant change as a function of new experimental and measurement procedures that humans devised to interact with the physical world. Second, human language use was itself subject to operational analysis, and the meaning of words was to be found, not in terms of the objects to which the words pointed, but instead to the conditions that occasioned the production of a particular word. Words could be shown without meaning when it could be shown that the only occasion for their use was to modify other words in an endless chain that failed to contact some concrete practical activity of the scientist. Third, Bridgman rejected the idea that the domains of logic and mathematics held some a priori truth criteria apart from their practical utility as rules for guiding action with respect to physical operations. Finally, each of these basic tenets of operational analysis were on Bridgman's view themselves reflexively subject to revision and change through further operational analysis. In other words, operational analysis was itself a relativistic enterprise constrained by the limits of human activity in relationship to the physical world. (pp. 111-112)

Bridgman (1927/1953) considered that Einstein's special relativity theory had profoundly changed the logic under which the concepts of physics were formulated. According to Bridgman, what Einstein did was change the criteria on which concepts were based by showing that the meaning of a concept was relative to the physical operations of the observer in determining its values and conditions of occurrence. According to Bridgman, terms such as "simultaneity" or "length" had different meanings depending upon the theoretical context under which observations were made. Bridgman concluded that Einstein highlighted that "the true meaning of a term is to be found by observing what a man does with it, not by what he says about it" (p. 37).

Bridgman was quite far from proposing rules for validating concepts or definitions, as customary practice in psychology has suggested. Bridgman commented that operational analysis was an "attitude" towards the use of concepts

in science, not a special theory about scientific concepts. Operational analysis stressed that the meaning of scientific terms had to do with the ways in which scientists used them, that is, with the operations, physical and linguistic, carried out during its applications. Bridgman (1927/1953) stated that:

> In general, we mean by any concept nothing more than a set of operations; **the concept is synonymous with the corresponding set of operations**. If the concept is physical, as of length, the operations are actual physical operations, namely, those by which length is measured; or if the concept is mental, as of mathematical continuity, the operations are mental operations, namely, those by which we determine whether a given aggregate of magnitudes is continuous. . . . We must demand that the set of operations equivalent to any concept be a unique set, for otherwise there are possibilities of ambiguity in practical applications which we cannot admit. (p. 36)

Bridgman's operational analysis explicitly acknowledged that concepts were inevitably linked to human experience and that they were equivalent to the actions involved in the formulation (or construction) and use of the corresponding terms. There are no "rules" for prescribing, selecting, or validating operations that identify the properties of objects or events to which concepts are applied. Concepts are equivalent to the practices in which they are employed. Because of this, the operational analysis of concepts is not related to criteria regarding the public verification of properties of events. Operational analysis does not deal with the objective–subjective or public–private dichotomies. Any concept may be operationally analyzed to the extent that we may observe the actions involved in its construction and use. Thus, Bridgman's analysis is akin to Gilbert Ryle's (1949) and Ludwig Wittgenstein's (1953) analyses of the meaning of words and expressions, contrary to frequent misunderstandings of operational analysis, as it is the case of Leahy's interpretation discussed by Grace:

> Certainly, Leahy (1980, p. 141) cannot be referring to Bridgman's operational analysis here ["operationism correctly fixes our eyes on the data, but at the cost of drawing them from what we do as scientists"]. In fact. . .the above quotation implies that "operationism" is the exact opposite of what Bridgman intended! For him, operational analysis was "an analysis into doings or happenings, in contrast to the more usual analysis into objects or static situations" (1959, p 522). He emphasized over and over again the importance of analyzing the activities of the scientist, to reflect on the nature of research and thus to improve it. (2001, p. 27)

On the other hand, S.S. Stevens (1935) advocated what he called *operationism* as a philosophy of science. Stevens adhered to a conception of truth by agreement. Hardcastle (1995) discusses Stevens' views on science by saying that:

> Individuals who disagree are ipso facto excluded from the community without regard to the truth of their claims or the character of their method, which for that matter are also a matter of agreement. "The 'true' value of a physical constant

. . ." Stevens wrote, "is true because physicists agree that it is true, and, if someone convinces physicists that the value is not true, it will thereafter be false. Of course each individual may think that he has his own private standards of truth. . . .The only difference is that the scientist's standards. . .conform to those of his associates (1936, p. 97). Consequently, science for Stevens is necessarily public. (p. 407)

According to Stevens, a procedure was required to define and validate concepts. Such a procedure consisted in appealing to the concrete operations that determined the concept. An operation was defined by denotation of the gross physical behavior performed in determining how a concept will be applied. Additionally, the definition should include an observable outcome of the operation. Both elements of the operation, denoting a procedure and observing a result, should be discriminated. Stevens (1935) regarded discrimination acts as the behavioral foundation of science:

> **Discrimination**, therefore, is the **sine qua non** of any and every operation, including that of denoting. In this sense discrimination is the fundamental operation of all science. (p. 324)

This tenet provided an interpretation of the methodology of science in which psychology would be the science testing and measuring the discriminatory capacities. Operationism, as Stevens' philosophical thesis, held that "every scientific concept must be accompanied by a rule for its application which is expressible solely in terms of acts of denotating and associated discriminations" (Hardcastle, 1995, pp. 408-409).

Stevens thought that operational definitions were needed to link semantic rules to objects. Definitions were conceived as semantic rules, disclosing an arbitrary convention concerning the use of words in relation to objects and events. Empirical definitions, as those used in psychology, were "invoked to relate words or symbols to objects or events" (Stevens, 1951, p. 16). Definitions, in fact, prescribed the correspondence between concepts (or words) and procedures related to the events and objects and their observed outcomes. From this perspective, operational definitions specified the procedures used and the outcomes observed when following such procedures and, to that extent, the concepts meaning consisted of a rule relating procedures with objects and outcomes. For Stevens (1951):

> It is generally accepted that semantic rules should be in the nature of operational definitions. . . .*Terms* have *applicability* to objects or events when the semantic rules governing their use satisfy operational criteria. The sentences or formulas created by combining these *semantically* significant terms into propositions are *empirically* significant (have truth value) when their assertions are confirmable by means of concrete operations. (p. 3)

The differences between Bridgman's and Stevens' conceptions are notorious. On the one hand, Bridgman, in contrast to Stevens, did not advocate a "truth"

dimension of propositions depending upon the meaning of concepts. Concepts consisted of words used in doing something, and their referents are precisely such doings, be they physical or linguistic (mental). According to Bridgman, then, it is not necessary to assume an explicit agreement in the form of rules of application that determine the truth value of terms' meanings. From this viewpoint, concepts are not true or false, but rather ambiguous or accurate. The public–private dimension postulated by Stevens in the discrimination acts of denoting and observing results is completely irrelevant. On the other hand, Bridgman, when talking of operational analysis, was not referring to rules or criteria for defining concepts. He was not talking about definitions but rather pointing to the operations (or physical and verbal actions) taking place when the concept is used, so operational analysis for Bridgman was necessarily descriptive, hence *a posteriori*.

In contrast, Stevens proposed operational definitions as criteria determining the validity of a concept and its application to the extent that it was correlated with a set of procedures and outcomes conceived as operations:

> A term denotes something only when there are concrete criteria for its applicability; and a proposition has empirical meaning only when the criteria of its truth or falsity consists of concrete operations which can be performed upon demand. (Stevens, 1963, p. 53)

According to Stevens, an operational definition always consisted of denoting (pointing or a gross physical behavior) and an observed result in the form of a discrimination. These differences between Steven's position and his own were clearly perceived by Bridgman, who disliked the fact that Stevens anchored operationism in basic acts of discrimination and public agreement. As quoted by Hardcastle (1995, p. 417), Bridgman commented to A.F. Bentley that:

> [Stevens] has talked with me at length about a couple of his papers before publication and professes to be most enthusiastic for "operational ideas". . .but I simply cannot make him see that his "public science" and "other one" stuff are just plain twisted. I have also discussed with him his "basic act of discrimination without making much impression. . ." (Bridgman to Bentley, 4 May 1936, Percy Bridgman Papers, Harvard University Archives, 4234.10)

Operational analysis for Bridgman was a matter of pragmatics, that is, of how words are used in the context of a theory or a research practice. In contrast, for Stevens, operational analysis was related to the denotation of objects and events, using definitions as criteria for the semantic correspondence between words and objects. While Bridgman thought of operational analysis in terms of pragmatics, Stevens conceived operationism as a matter of semantics.

Operational definitions and the operational analysis of concepts are two different things. Operational definitions consist of the specification of procedures and expected outcomes (procedures used for producing and measuring a phenomenon) as the necessary criteria for establishing that the terms defined are empirically meaningful. In contrast, the operational analysis of concepts involves

the *a posteriori* identification of the physical and/or verbal actions involved in formulating or applying a concept. Thus, operational analysis deals directly with the arguments, rationale, and criteria used in the construction and application of scientific concepts. Concepts are defined according to their use and to the circumstances in which they are applied, including concepts about procedures and operations. Because of this, and in order to avoid confusion regarding the use of the term "operational," operational analysis should be better called a "functional analysis of concepts."

Skinner and Operationism

Contrary to conventional wisdom, it was Stevens and not Bridgman who initially influenced B.F. Skinner's ideas about the meaning and validity of scientific concepts. Quoting Hardcastle (1995):

> Skinner praised Stevens operationism articles, writing of the first that it was "essentially what I have always supposed behaviorism to represent" (Skinner to Stevens, 16 June 1935, SSSP 2.10) and calling the second "a damn nice piece of work" and "the best statement of the behavioristic attitude toward subjective terms now in print" (Skinner to Stevens, n.d., SSSP, 2.10). (p. 418)

Skinner's sympathy for operational definitions might be related to his not always explicit conceptions about theory, valid knowledge, and the nature of scientific laws. His position regarding theory was, at best, ambiguous. In 1950, in his paper "Are Learning Theories Necessary?," Skinner was critical of all theories in which concepts did not correspond with the observational level of behavioral facts being classified or explained. In *Behaviorism at Fifty* (1963) Skinner argued against theories using mental concepts as intermediate causal stations between environmental events and behavior, claiming that private events (identified also with internal, subjective, and publicly nonobservable events) can be dealt with by a science of behavior. However, Skinner's opinion regarding theory was more negative than it is usually suspected. In an interview taped in 1990 and published later (Ribes, 1999a) Skinner stated that "data are independent of theory although theories determine the selection of data. That is one of the things I have against theories. . ." (p. 322) and ". . .many questions have not yet been answered, but I do not regard them as contradictions, especially because I have never been very much interested in theory" (p. 324).

Skinner's early reading of Bacon seemed to shape in him a strong technological attitude towards knowledge. Smith (1992) examined this influence of Bacon on Skinner:

> Bacon's (1620/1960) epochal declaration that "human knowledge and human power meet in one" (p. 39)—one of the Baconian principles that Skinner (1983) said governed his own life—is not a mere claim that contemplative knowledge can be put to human uses; rather it is the declaration of a different kind of knowing, in which the power of producing effects is not simply the by-product of knowledge, but rather the criterion of its soundness. With this declaration, the

age-old distinction of fact and artifact is broken down, and the artificial assumes, in a sense, more value than the natural. . .artifacts are preferred as being specially revealing of nature's ways. (p. 217)

Considering that Skinner (1953) thought that the goal of psychology as a science was the control and prediction of behavior, it is not surprising that operant methodology was directed toward the development of manipulative interventions related to the reproducibility of data. Data were considered to be important to the extent that they could be reproduced and replicated under explicit experimental operations (Sidman, 1960).

The technological and pragmatic attitudes of Skinner with regard to scientific knowledge were a fertile soil in which Stevens' ideas on operationism rooted and grew. The formulation of concepts based on procedural and measurement operations and their outcomes became the natural way of constructing a theory centered on the control and prediction of behavior. Although Skinner accepted that operations cannot be identified with events themselves (1963), concepts were developed as descriptions of operations and outcomes, both as manipulative or just observational interventions and recordings. This operational strategy was used by Skinner not only to coin the concepts that constituted the so-called "principles" or "laws" of behavior (Verplanck, 1954), it was also applied to the identification and classification of properties and events or phenomena. Terms such as "reinforcement," "extinction," "discrimination," "generalization," and "chaining" illustrate the theoretical functions given to concepts defined as operation–outcome relations.

The Analysis of Private Events

Despite these antecedents, several authors (Day, 1969; Moore, 1995; Zuriff, 1985) considered that the publication of "The Operational Analysis of Psychological Terms" by Skinner in 1945 represented a rupture with operationism, especially Stevens' version of it. I will try to show that this claim is incorrect and that, in fact, Skinner did not deal directly with operationism. Operationism, in both Bridgman's and Stevens' versions, was an epistemological proposal about scientific concepts. Skinner, in his interest in incorporating private events into an experimental analysis of behavior, grounded his position on their ontological status as physical events. Assuming that private events could be discriminated like any other physical event, Skinner spelled out the conditions required by a verbal community to identify (discriminate) them to teach a subject to discriminate private physical events in terms of a verbal self-report (*tact*). This proposal was very similar to Stevens' position, which did not deny the existence of private events but only claimed that in to study them scientifically the terms denoting them should be identified through public concrete operations.

In his paper on "The Operational Analysis of Psychological Terms" (1945/1961) Skinner began by acknowledging that the operational attitude in psychology is positive despite its shortcomings. At the same time, however, he seemed to identify operationism with Stevens' proposal regarding the truth value

of propositions, including concepts based upon discrimination and outcome operations. Nevertheless, Skinner misinterpreted the truth value of statements using nonverifiable terms with the issue of the existence or not of the things being included in such statements. From Stevens' suggestion that terms that could not be reduced to concrete operations were not meaningful to science, it was incorrect to conclude that the phenomena or events referred by such terms were nonexistent and, hence, could never be studied by science.

The core of argumentation by Skinner focused upon two issues, the truth value of observation based on public agreement and the ontological status of private events. This argumentation set the distinction between radical and methodological behaviorisms, a distinction that is questionable, at least in regard to its relevance for an epistemology of the science of behavior (Malcolm, 1971). Skinner claimed five things. First, that the world of events inside the skin, to the extent that is internal to the body is private, is subjective because only the owner of the body has access to what occurs inside him or her. Second, that private events correspond to what are called "mental" events. Third, that private events are physical events and, therefore, can be empirically analyzed with the methods of science despite not being publicly observable. Fourth, that the analysis of private events passes through the analysis of how the verbal community identifies their occurrence and reinforces the individual for properly reporting his or her private events in the form of a discriminated verbal operant (the self-descriptive tact). And, fifth, that private events are not causes of behavior.

Flanagan (1980), examining Skinner's operationism, remarks that "Skinner's behaviorism is not methodologically, but rather is ontologically or metaphysically, motivated. That is, it is motivated primarily by theses about *what there is* and the *way it is*, and not by any theses about the way psychologists should use their language. . ." (pp. 1-2). Skinner, in fact, did not refute operationism as an epistemological position. The ontological assertion related to the physicality of psychological events was not relevant to the program of operationism in any of its two versions. Stevens (1963) examined the shared goals of operationism and physicalism in translating psychological terms to a common physical language dealing with concrete operations, but this had to do with the empirical meaning of statements and propositions, not with metaphysical issues regarding the existence or not of different entities.

Regarding private events, Allen (1980) has convincingly shown that Bridgman acknowledged that expressions related to personal experiences were meaningful but insisted that these words and expressions had a special epistemological status; their meaning depended on who employed them. Bridgman commented:

> My solution is somewhat similar to that of Skinner in that I also recognize that the introspectional words are in a special class, but my solution differs from his in that instead of discarding these words altogether I retain many of them, but with a restricted meaning—These words are a subclass of the more general class of words the operational meaning of which depends on who it is that is performing the operations. (1959, p. 216)

Bridgman argued that when you have similar concepts corresponding to different operations (e.g., the case of length), their equivalence needs an empirical justification. When this is not possible, as in the case of words based only on introspection (e.g., "pain," "feeling," "consciousness") coinciding with Ryle's (1949) index words, Bridgman thinks that these words are a special subclass of relational words that should only be used in the first person, e.g., it is only I that am conscious, not you that are conscious, because conscious is a word that has been learned to use only in the first person. The meaning of relational words depends on who uses them. According to Ryle, index words indicate to the listener or reader the particular thing, episode, person, place, or moment referred to. "I," somehow, is a direct index word, and in this sense ". . .'I' is not an extra name for an extra being; it indicates when I say or write it, the same individual who can also be addressed by the proper name Gilbert Ryle" (1949, p. 188).

Malcolm (1971) also criticized Skinner's assumption that ascriptions of mental predicates to oneself and to other persons would be symmetrical in respect to verification. The verification of the utterance "I am excited" is different for the person experiencing excitement and for the one observing that person. Malcolm argues that

> If you did not believe that I am excited, I might try to convince *you* by making you note of how my hands are trembling. But I do not undertake to convince myself that I am excited by such an observation; or if I did, it would be a very untypical case. . . .In the normal case I do not say [I am angry] on the basis of the observation of *anything*. (p. 83)

Malcolm concluded that when first-person-singular present tense indicative sentences employing mental terms are used to make statements, reports, or descriptions, the speaker does not normally rely on behavioral criteria. Although we apply many mental concepts to other persons on the basis of behavioral criteria (i.e., on the basis of some physical change or utterance), we do not usually apply these concepts to ourselves on this basis.

The Operational Foundation of Classificatory Concepts in Operant Psychology

Skinner participated in a tradition in which operational terms were used not only to describe procedures and effective outcomes but also to account for similar outcomes when such operations were not explicitly developed (e.g., reinforcement history, stimulus control exerted by nonmanipulated properties of the environment, etc.). On the other hand, other terms were used for classificatory purposes and, therefore, to some extent terms intended to identify the functional properties of the events and phenomena included under such classifications.

The terms I will examine deal with the dichotomies between *operant* and *respondent* behaviors, *contingency-shaped* and *rule-governed* behaviors, *public* and *private* events, and *verbal* and *nonverbal* behaviors. It is my intention to show that these concepts are also operationally based concepts and that the criterion used

for their definition depended exclusively on observational limitations to identify the correlation of a stimulus event with a target response.

I will first examine the distinction between operant and respondent behavior and the underlying distinction between elicited and emitted behavior. Elicited behavior was defined by Skinner (1938) "when it can be shown that a given *part* of behavior may be induced at will (or according to certain laws [the laws of the reflex]) by a modification in part of the forces affecting the organism. . . .Only one property of the relation is usually invoked in the use of the term—the close coincidence of occurrence of stimulus and response. . ." (p. 9). In turn, in defining emitted behavior, Skinner stated that:

> An event may occur without any observed antecedent and still be dealt with adequately in a descriptive science. I do not mean that there are no originating forces in spontaneous behavior but simply that they are not located in the environment. We are not in a position to see them, and we have no need to. This kind of behavior might be said to be *emitted* by the organism. . . .An operant is an identifiable part of behavior of which it may be said, not that no stimulus can be found that will elicit it (there may be a respondent the response of which has the same topography), but that no correlated stimulus can be detected upon occasions when it is observed to occur. (pp. 20-21)

The classification and definition of behavior into two classes, respondent and operant, was based on a particular operational criterion: the detection by the observer of a stimulus eliciting a response. The identification and classification of behavior was not explicitly based upon criteria assuming specific properties and functions derived from observation or experimentation. Concepts classifying behavior were based on the observational limitations of the experimenter. If a correlation of a stimulus eliciting a response could be identified, then that behavior was considered to be elicited (or respondent). If no eliciting correlation could be observed (although it was assumed always to occur), then the behavior was emitted and a correlation could be imposed with a stimulus following the behavior. The correlation between a response and a subsequent stimulus could be identified and defined as an operant.

Skinner (1938) justified this strategy by saying that "so defined a reflex is not, of course, a theory. It is a fact. It is an analytical unit, which makes an investigation of behavior possible. . . .Many traditional difficulties are avoided by holding the definition at an operational level" (pp. 9-10). However, a classification of behavior, conceived as the formulation of a scientific domain (Shapere, 1974), should state some properties and functions of the behavior being classified. The events defined by Skinner, contrary to his statement, were not "facts" understood as given empirical referents. Skinner defined the empirical limitations of the observer in trying to identify the environmental or other variables functionally related to behavior and the possibility of explicitly manipulating their occurrence. In classifying a given part of behavior as a respondent or an operant, nothing was said about the properties of the behavior being identified. Rather, the labeling of a part of behavior in any of the two ways actually consisted in the description and

application of the observational criteria established the researcher. From my viewpoint, a classification of behavior properties built in terms of the operant–respondent distinction resulted in nothing more than a classification of the observer's limitations and procedures.

The distinction between contingency-shaped and rule-governed behavior was also based upon the observer's possibilities to identify or not a previous reinforcing stimulus as responsible for the occurrence of a new behavior. Skinner (1966, 1969), in his analysis of problem solving, established a difference between behaviors that are followed directly by consequences and behaviors that are evoked by contingency-related antecedent stimuli:

> The response which satisfies a complex set of contingencies, and thus solves a problem, may come about as the result of direct shaping by the contingencies (possibly with the help of deliberate or accidental programming) or it may be evoked by contingency-related stimuli constructed either by the problem solver himself or by others. The difference between rule-following and contingency-shaped behavior is obvious when instances are pretty clearly one or the other. (1966, p. 241)

> We refer to contingency-shaped behavior alone when we say that an organism behaves in a given way with a given probability because the **behavior has been followed by a given kind of consequence in the past**. We refer to behavior under the control of prior contingency-specifying stimuli when we say that an organism behaves in a given way because **it expects a similar consequence to follow in the future**. (1966, p. 243)

The need to distinguish between contingency-shaped and rule-governed behavior originated in two phenomena, both sharing a common feature: a new behavior occurred given an antecedent stimulus without the previous or immediate presentation of a consequence. The first phenomenon had to do with the studies on observational learning and modeling by Bandura and Walters (1963), which showed that new behaviors could be performed in a situation without being followed by consequences, just by exposing the subject to the behavior of a model. The second phenomenon was related to the emergence of new patterns of behavior when a problem-solving situation was presented. Although some of the behaviors involved in solving the problem could be already available in the subject's repertoire, the pattern itself consisted of a new behavior. Because this pattern of behavior had never been directly exposed to consequences, its acquisition had to be explained in terms other than those that accounted for normally contingency-shaped behavior.

The distinction between contingency-shaped and rule-governed behavior resulted from the observational difficulty of identifying the consequence (or reinforcer) that leads to the acquisition of a new response. The observational absence of a conspicuous shaping process and consequences prompted a concept based upon the identification of an antecedent event, most of the time an instruction or a model performing the behavior to be acquired. Because, in operant psychology, an antecedent stimulus becomes functional as a discriminative

stimulus only if it has been correlated with reinforcement, Skinner assumed that rules, as discriminative stimuli, reflected the history of reinforcement in presence of available discriminative stimuli, not the history of reinforcement of specific response classes. However, a careful examination of the logic of this distinction shows serious shortcomings (Ribes, 2000). My main argument is that the concepts of contingency-shaped and rule-governed behaviors only reflect the limitations of the observer regarding the "origins" of the behavior under analysis, not the suggested different functional properties of the behaviors distinguished in such a way.

A third classification was that between private and public events (Skinner, 1945/1961). This distinction was examined by Skinner to show that events that were nonobservable "to the other" (private events) could be identified and described under criteria subjected to public agreement, similar to those used in the identification and description of physical, observable events (public events). Private events were those events taking place under the skin. These events were accessible only to the skin-bearer. According to Skinner, private events had the same physical and functional properties as those that occurred outside the body. Emotions, feelings, pain, etc., independently of the terms used to talk about them, could be discriminated accurately when a contingency had been set up to do so by describing or naming them. Skinner, in the interview cited previously (Ribes, 1999a), said that ". . .the bodily states that we can observe and call emotions and feelings and states of mind all exist before we call them that" (p. 326). Skinner thought that the problem regarding private events was that the verbal response identifying a given stimulus by a speaker (as expressed by subjective terms) occurred in the absence of the same stimulus for the verbal community reinforcing the standard semantic use of such verbal response (a "tact" in technical terms). Except for its public unobservability, private events were thought to be there, waiting to be discriminated, named, and described under the reinforcement contingencies of a verbal community.

Skinner (1945/1961) proposed that the criteria defining operational definitions had to do with the criteria employed to reinforce the acquisition and maintenance of tacts by a verbal community. The tact was defined "as a verbal operant in which a response of given form is evoked (or at least strengthened) by a particular object or event or property of an object or event" (Skinner, 1957, pp. 81-82). In the case of tacting private events, Skinner pointed at two solutions to overcome their inferential character. One was related to the potential development of improved physiological techniques that could allow for the measurement of private events, although this would entail that the private event (e.g., pain) is what is being measured through a physiological device. Curiously enough, in proposing this solution Skinner *could* be identifying physiological and behavioral events, a position he had traditionally criticized. A second solution was to examine how the verbal community reinforced a tact *appropriately* correlated with its controlling stimulus properties.

In his paper on "The Operational Analysis of Psychological Terms" (1945/1961) and in *Verbal Behavior* (1957) Skinner identified four ways in which

a verbal community could have access to private stimuli and set the appropriate contingencies of reinforcement to generate verbal behavior in response to it. These ways consisted of four criteria that could be used to establish a specific verbal response that is "descriptive" of the conditions affecting an individual: (1) the reinforcement of the tact in the presence of a collateral response to the private stimulus (e.g., facial expressions), (2) the reinforcement of the tact correlated with a public regular accompaniment of the private stimulus (e.g., tissue damage), (3) the reinforcement of the tact in the presence of originally overt behaviors that become covert (e.g., movements and proprioceptive stimuli), and (4) the induction to private events of a response acquired and maintained in connection with public stimuli (e.g., metaphors about feelings).

Skinner argued that his analysis of private events set apart "the arid philosophy of 'truth by agreement'" from operationism. To him "the ultimate criterion for the goodness of a concept is not whether two people are brought into agreement, but whether the scientist who uses the concept can operate successfully upon his material-all by himself if need be" (1945/1961, pp. 284-285). However, it is not clear which is the fundamental difference between Skinner's operational analysis of private events and the one based upon the criteria of public verifiability. The four criteria proposed by Skinner to account for the establishment of proper discriminated verbal responses (tacts) to private events depend upon public cues reflecting the common agreement of the so-called verbal community. Private events are assumed to be *discriminated* in their properties by means of the contingencies arranged by the verbal community to make them public (or describe them) in the form of tacting behavior. In any case, private events remain hidden from the public observation of people other than the speaker under whose skin such events take place. What is the successful operation achieved by conceiving in this way the events taking place under the skin? As I have suggested previously (Ribes, 1982), the maintenance of the public–private distinction leads to serious conceptual mistakes. The analysis by Skinner about how we talk of private events has not only consolidated a questionable distinction between private and public events based upon their observability, it has also provided an operational justification about the existence of *psychological* (not mental) events (responses and stimuli) within the organism to the extent that private events might control observable behavior (Skinner, 1974). The identification of these internal events with physical events increases conceptual confusion by advocating a correspondence between physical properties of private events and the tacts describing them. Such an assumption gives to private events the status of *occurrences* equivalent to that attributed to stimulus changes in the environment (see, for instance, Ryle's 1949 analysis examining the category mistake of attributing the status of occurrences to dispositional terms).

Finally, the dichotomy between verbal and nonverbal behavior is also based upon an operational criterion. In this case, however, the nature of the operation is not observational. The distinction between both types of behavior depends on the agent providing consequences to operant behavior. In the case of nonverbal behavior, reinforcement is delivered through a mechanical device that can be

conceived of as a technical operation of the researcher or, more generally, as the kind of mechanisms that operate in nature when organisms act upon objects. Verbal behavior, in contrast, does not produce direct mechanical effects on the environment. Verbal behavior is identified because the mechanical operation of providing consequences is transferred to another individual. Verbal behavior is "behavior reinforced through the mediation of other persons" (Skinner, 1957, p. 2). The additional refinement specifying that the mediator of reinforcement has been especially conditioned to do so by a verbal community does not change the basic operational nature of the definition. The listener, to whom the role of mediating the reinforcer is attributed, becomes a surrogate for the mechanical device dispensing reinforcement. I have examined elsewhere (Ribes, 1996, 1999b) the logical and empirical problems derived from this definition: the misrepresentation of the verbal episode, the formulation of a highly questionable taxonomy of verbal behavior, the violation of definitions, and the frequent identification of internal contradictions in the classification and analysis of verbal "facts."

Summing up, an analysis of how some operant terms have been used shows that taxonomic concepts (e.g., operant–respondent, rule-governed, contingency-shaped, private–public, verbal–nonverbal) are only based on the limitations of the observation's operations required to identify one element of an assumed empirical relation: the eliciting stimulus, the reinforcer shaping a new response, the stimulus being tacted, or the mechanical effect of the response. Aside from any particular philosophical position, delimiting a scientific dominion solely by observationally-based criteria is theoretically weak.

Concluding Remark

Operant theory and radical behaviorism imply ontological assumptions about behavior as the construct that best represents the properties and nature of psychological phenomena. However, these assumptions (whatever they are) cannot tacitly be founded on or expressed only in the form of operational definitions. Operant concepts have been used as if they had multiple logical functions: they are used as terms denoting operations (procedures), events, processes, and outcomes (e.g., the terms "reinforcement and/or reinforcer," "discrimination and/or discriminative"). Although categories denoting operations are necessary in any science, they do not seem to be enough to deal with the classification, explanation, and prediction of behavior. Operational categories should be considered only as descriptions of procedures and criteria being used in experimental or observational interventions—but science seems to be something more than a self-description of the scientist's activities.

The scope of operational definitions is limited to the specification of procedures and outcomes related to observational and experimental operations. Operational definitions allow for generalized replication of procedures and data to the extent that they specify the operations used in the production and measurement of phenomena. In the case of operant psychology, the (not necessarily conscious) attempt to construct a system exclusively based upon operational definitions has

resulted in a simplistic account of behavior and in conceptual confusion. At best, nowadays operant theory fulfills the role of a conceptual scheme organizing technological operations, although the achievement of control does not seem to be correlated with the parallel achievement of prediction and theoretical understanding.

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