AUTOMATIC REINFORCEMENT: AN IMPORTANT BUT IGNORED CONCEPT

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I. INTRODUCTION: NATURE OF THE PROBLEM AND A POTENTIAL SOLUTION

The consequences of any behavioral phenomenon must have a place in a complete description of the event. Indeed, many learning theorists contend that consequences are essential for establishing and maintaining all learned behavior (respondent or classically conditioned behavior being a general exception). Other theorists, however, argue that there are a number of occasions when behavior changes in strength or form in the absence of any obvious consequence. The fields of psycholinguistics and cognitive psychology, for example, are replete with studies said to demonstrate that reinforcement theory is incomplete if not inaccurate (Bandura, 1971; Chomsky, 1959; de Villiers & de Villiers, 1978; Piaget, 1951).

Studies on language acquisition illustrate this point (e.g., Brown & Hanlon, 1970). In a typical study, parents' interactions with their children are recorded for extended periods of time. It is found that, over time, children gradually begin to utter correctly constructed sentences — adjectives before nouns, for example — despite the lack of any obvious external reinforcement for correct word order. Thus, according to psycholinguists and cognitive psychologists, the acquisition of grammatical behavior cannot be due to reinforcement, but rather to a structure within the organism

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[2]I thank Professor B.F. Skinner for his time in discussing with me the concept of automatic reinforcement and for his valuable written comments on this paper. A special thank you goes to Professor Gerald Zuriff for his critical reading of both this paper and an earlier draft. His many insightful comments helped me "discover what I had to say," and from that, what I shouldn't.

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phylogenetically selected for just such a purpose. Similarly, the behavior of children is not, in any obvious sense, reinforced in any systematic fashion because it conforms to a regional dialect, yet they usually acquire dialects similar to those of the adults in their environment. If reinforcement is not at work, what is? Even more problematic is the analysis of thinking and problem solving. How is this kind of behavior reinforced? The lack of any immediate external consequence has again led people to the reification of cognitive structures or higher mental processes in explaining complex human behavior (Bandura, 1971; Neisser, 1976; Piaget, 1951).

Can behavior analysts do any better? Are we compelled to accept hypothetical constructs as explanations, or can we find a more parsimonious explanation in existing laws of behavior? Perhaps we cannot wholly avoid metaphor, but a less extended metaphor seems preferable to many current theoretical analyses.

The concept of "automatic reinforcement" may provide just such an alternative. B.F. Skinner makes much use of it in his various writings, particularly those concerned with verbal behavior and with intellectual self-management. The term appears close to 100 times in *Science and Human Behavior, Verbal Behavior, The Analysis of Behavior* (with J.G. Holland), *Contingencies of Reinforcement, Technology of Teaching,* and *About Behaviorism*.[4] "Automatic" does not appear to function as a technical modifier, like "conditioned," "unconditioned," or "intermittent."[5] (It is not indexed in any of his writings, and in the programmed text, *The Analysis of Behavior,* it appears in frames but never as an answer for any frame.[6]) Apparently it is used in the ordinary sense of not requiring mediation by another person. It is used merely to emphasize the relevance of reinforcement in cases where it might be easily overlooked. That is, it counteracts any tendency to restrict the concept of reinforcement to those occasions upon which it has been deliberately arranged by another person or group.

Skinner's usage clearly avoids the implication of a technical term; nevertheless, the concept plays a critical role in his analysis of human behavior, verbal and nonverbal. Yet, surprisingly, few other writers in the behavioral area make any use of the term. Possibly other behaviorists are unaware of this type of reinforcement, or take it for granted in even the most complex cases. They may also deliberately avoid it because it is possibly circular or inferential. A more likely possibility is that other behavioral writers have not shown Skinner's willingness to speculate about the types of complex human behavior that often seem to require the concept.

In any case, Skinner's extensive use of "automatic reinforcement" justifies a closer look. What are the conditions under which it occurs? Can they be classified in any useful way? Section II of this paper attempts to answer these questions. In Section III, criticisms of Skinner's usage are considered, and finally, Section IV surveys the heuristic value of automatic reinforcement. In summary, the paper as a whole is an attempt to describe and clarify the role of automatic reinforcement in Skinner's writings in order to determine its importance in furthering the analysis of complex human behavior.

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[4]Interested readers are encouraged to write to the first author for a complete citation list.

[5]A point that was first raised by Paul Whitley.

[6]A point that was brought to our attention by Norman Petersen.

II. The Circumstances of Automatic Reinforcement

In the most general sense, automatic reinforcement is reinforcement that is not mediated by the deliberate action of another person — "deliberate" in the sense of action taken because of the consequences for the other person. It is a "natural" result of behavior when it operates upon the behaver's own body or the surrounding world.[7] In general, the reinforcement may be conditioned or unconditioned, positive or negative. Moreover, the behavior reinforced automatically may be verbal or nonverbal.

To illustrate the ubiquitous nature of automatic reinforcement in Skinner's writing, we have found it instructive to classify the examples as consisting of either perceiving, producing, or problem-solving behavior. In addition, we have subdivided this classification according to whether such behavior operates on the behaver directly — not requiring environmental support — or operating on the behaver via the external environment. Although these divisions are by no means pure, they have provided us with a means of ordering a myriad of examples.

We will first consider examples of perceiving, producing and problem-solving behavior which involve only automatic-positive reinforcement. Examples involving "automatic"-negative reinforcement and "automatic" punishment will be treated separately to avoid unnecessary confusion.

A. The behavior of perceiving

The fewest examples of automatic reinforcement taken from Skinner's writings fall under the heading of perceptual behavior operating on the environment. For example, "The dog lover is automatically reinforced when he sees dogs" (1969 p. 252). The reinforcement is automatic — "seeing" is the natural result of "looking at."

Perceptual behavior may also operate on the behaver directly and derive automatic reinforcement. "[We can assume] that when a visual object is automatically reinforcing, the behavior of seeing it may become so strong that it occurs in the absence of the object" (1968, p. 125). At a later date, Skinner states: "The whole world of fantasy is perceptual behavior which is automatically reinforcing . . . " (1974, p. 141). In both cases, reinforcement does not depend on the mediation by another person; hence, it is automatic.

B. The behavior of producing.

In the case of perceptual behavior (e.g., listening to, looking at, feeling of) the behaver engages in minimal action. There are other cases, however, where the behaver must engage in some activity prior to "perceiving" the reinforcing stimulus. Such examples involve what we term "the behavior of producing." It may be useful to view the distinction between these two classes of behavior — perceiving and producing — as the difference between the feeling of something and the act of doing something to

[7] MacCorquodale (1969) makes the following point in describing the concept: "It would be a mistake to paraphrase automatic self-reinforcement by saying that such behavior 'reinforces itself.' It generates stimulus *consequences* that would be reinforcing if they originated from another source, and does not reinforce itself any more than any other behavior does." (p. 835)

feel it, and the difference between listening to and the act of doing something to hear, and so on.

Automatic reinforcement derived from the behavior of producing makes up the majority of examples found in Skinner's work. "The student may be automatically reinforced as he picks out a familiar tune on the piano even though he has not recently heard it" (1968, p. 209). And in *Contingencies of Reinforcement,* Skinner states: ". . . when a craftsman spends a week in completing a given object, each of the parts produced during the week is likely to be automatically reinforcing because of its place in the completed object" (1969, p. 18). The reinforcement in both of these examples is automatic — it is a direct result of one's own behavior, and does not involve another person.

Additional examples occur in analyzing the educational process. "The better the child can discriminate 'like' patterns, the more precise the automatic differential reinforcement of his drawing behavior" (1961, Set 24, frame 33). Also, in learning how to write "the important reinforcers are largely automatic: a sentence comes out right, it says something interesting, it fits another sentence. If these automatic reinforcers are powerful enough, the student may continue to write and improve his writing even though he receives few if any comments" (p. 160). "Money, grades, and honors must be husbanded carefully, but the automatic reinforcement of being right and moving forward are inexhaustible" (1968, p. 158).

In all of these cases the producing response operates on the surrounding world and is strengthened through automatic reinforcement. The largest sub-group, however, consists of producing responses which operate on the behaver directly. It may also be the most interesting because it includes behavior often thought of as involving "higher mental processes." "There are many automatic reinforcements from the effect of the behavior upon the speaker himself" (1957, p. 86). And at a later point Skinner states: "Insofar as he automatically reinforces himself, he must be regarded as an audience affecting the strength of relevant parts of his behavior" (p. 179). In fact, in *Verbal Behavior* he states: ". . . thinking is behaving which automatically affects the behaver and is reinforcing because it does so" (p. 438).[8] "Moreover, automatic reinforcement may play a role in the process of editing" (1957, p. 380), and "'knowing that you know'" (1968, p. 156).

C. The behavior of problem solving.

In Skinner's system, the behavior of perceiving and/or producing a reinforcing stimulus is automatically reinforced by the presence of the reinforcing stimulus. In addition, a discriminative stimulus, which is a component of an already established contingency, may function as automatic reinforcement. That is, producing a change in the environment so that a previously successful response can occur may be automatically reinforcing.[9] In *Contingencies of Reinforcement,* Skinner states: "The behavior

[8]It should be noted that Skinner rejects this definition of "thinking" later in the same chapter not because it is inaccurate, but because it is too narrow.

[9]The distinction we are making between the behavior of producing and the behavior of problem solving is perhaps a tenuous one. However, for the purposes of this paper it seems useful to acknowledge not only the role of automatic reinforcement as an "end in itself," but also its role as a "means to an end."

observed when a man solves a problem is distinguished by the fact that it changes another part of his behavior and is reinforced and strengthened when it does so." Presumably he is referring to automatic reinforcement, for at an early date he states: "Another source of automatic reinforcement is seen in 'problem solving,' when the speaker generates stimuli to supplement other behavior already in his repertoire" (1957, p. 442). In this same passage he proceeds to give several examples of behavior maintained by automatic reinforcement: "He prompts and probes his own behavior, as in recalling a half-forgotten name . . . ;" "Scientific behavior 'pays-off' even when the scientist is talking to himself;" "calculating the odds at poker . . . counting a number of objects . . . using a watch . . . and using special mnemonics or algorithms in the construction of new verbal behavior." In all of these cases the problem solver is operating either on the body directly or on the surrounding world and deriving reinforcement as a result.

Thus far, only examples of automatic-*positive* reinforcement have been considered, but Skinner also relies on automatic-*negative* reinforcement in clarifying his analysis of punishment. We must therefore consider —

D. The special role of automatic reinforcement in understanding the effect of punishment.

In *Science and Human Behavior* (1953), punishment is not defined by its effect on behavior, but rather in terms of the operations involved. By defining reinforcement in terms of the presentation of a positive or the withdrawal of a negative reinforcer, Skinner then asks: "What is the effect of withdrawing a positive reinforcer or presenting a negative?" (p. 185). He then proceeds to analyze in some detail three effects of punishment: (1) the immediate effect — "and not necessarily followed by any change in behavior upon later occasions" — is the elicitation of responses that are incompatible with the punished response; (2) under similar circumstances in the future, one's own behavior "may supply conditioned [aversive] stimuli which . . . evoke opposed emotional responses" (p. 186-187); and (3) most important, and most relevant to this paper, the aversive stimulation generated in (1) and (2) may serve as a negative reinforcer and "any behavior which reduces this conditioned aversive stimulation will be reinforced" (p. 188). Although the term automatic reinforcement is not used here, the underlying process is nevertheless present, for in *Verbal Behavior* he provides many examples of this third effect of punishment with frequent reference to the automatically reinforcing effect of reducing conditioned-aversive stimulation. When considering the production of verbal behavior and, specifically, why verbal behavior may be rejected, Skinner acknowledges the role of punishment by emphasizing the role of automatic-negative reinforcement.

> . . . punishment does not directly weaken behavior; it merely strengthens incompatible forms. A child acquires an obscene [verbal] response at school, emits it in his home, and is punished. The effect is not to reduce the probability of that response, but to make it, as well as the circumstances under which it is likely to be emitted, a conditioned aversive stimulus. When the response is again strengthened to the point of emission, it generates aversive stimulation.

> . . . This special consequence alters the apparent strength of the verbal operant, but it has another distinguishable effect in generating a kind of behavior conveniently called rejection. Rejecting a response reduces the conditioned aversive stimulation generated by it and is reinforced because it does so. (1957, p. 371)

For example, "If, as the result of his own No!, the child ceases to behave in the specified way, he may be automatically reinforced by the reduction of conditioned aversive stimulation" (1957, pp. 323-324).

These examples not only clarify Skinner's interpretation of punishment but of automatic-negative reinforcement as well. It is now possible to consider one final use of the term "automatic."

E. Automatic punishment

Given the above discussion, it is easy to appreciate the role of automatic punishment. Here Skinner is referring to the first two effects of punishment, in which the aversive stimulation is generated by a punishing stimulus or by the very behavior itself, with both having an immediate suppresssive effect.

> Verbal behavior may be automatically self-punishing. The names of disliked persons and responses appropriate to embarrassing, dangerous, or gruesome episodes generate punishing consequences in the process of being emitted. (1957, p. 375)

And at another point Skinner states:

> The individual is strongly disposed to engage in behavior which achieves such reinforcements as sexual contact or the infliction of damage upon others. These kinds of behavior, however, are precisely the sort most likely to be punished. As a result the individual not only does not overtly engage in such behavior, he cannot engage in it covertly or see himself engaging in it covertly without automatic aversive self-stimulation. (1953, pp. 293-294)

III. Theoretical Issues and Criticisms Raised by the Concept

It is clear that automatic reinforcement[10] plays a major role in Skinner's analysis of complex human behavior. The notion of reinforcement arising from one's own behavior enabled Skinner to extend an operant analysis to behavior that appeared to lack conspicuous reinforcement — not however, without criticism (Chomsky, 1959; Hayes, 1977) or confusion (Skinner, 1977).[11]

[10]For purposes of clarity and ease in writing, we again mention only automatic reinforcement, but the same points are relevant to automatic punishment. This will also be the case in the next Section.

[11]Skinner sometimes uses the expression "self-reinforcement" in writing about automatic reinforcement (e.g., *Verbal Behavior*, p. 164). More recently, the term "self-reinforcement" has come to refer to a self-management goal, for example, "giving" oneself a new item of clothing when one finishes writing a term paper. Skinner never intends this usage in any of his references to automatic reinforcement. In fact, he is quite skeptical of the "reinforcing" effect of such a practice and discussed the difficulty of this type of self-control in *Science and Human Behavior* (pp. 237-239). Thus, criticisms of this "non-Skinnerian" form of "self-reinforcement" are not dealt with in this paper.

A. The problem of interpretation.

Explanations of behavior in terms of automatic reinforcement have been questioned. It is argued that, given a strong belief that most behavior is generated and maintained by reinforcement, one is led to "invent" a source of reinforcement when it is not obvious. The issue does not arise in experimentation, where stimuli can be described in physical terms and their effect on behavior reliably determined (MacCorquodale, 1970). However, in interpretive analyses the presumed controlling variables have not been or cannot be manipulated.

To move beyond interpretation, and demonstrate a true functional relation, certain methodological criteria must be met. Schnaitter (1978) lists six: 1) specification of a response in such a way that instances of it can be reliably identified; 2) specification of a stimulus in such a way that its occurrence can be reliably determined; 3) measurement of a baseline response rate, meeting some specified criterion; 4) arrangement of a contingency between (1) and (2) with rate of response meeting a second criterion of stability; 5) abolishment of the contingency and its reestablishment in such a way as to demonstrate that the change in response rate is a function of the changing contingency; and finally, 6) the rate-controlling properties of the contingent response-stimulus relation are determined by an additional third variable (e.g., food deprivation). He concludes by stating:

> These commitments are ideals that, on balance, optimize prediction and control, but they are often compromised in various ways in the pursuit of particular behavioral analyses. When such compromises are made, however, the analysis may later be questioned. (p. 6)

Is the use of automatic reinforcement, then, a compromise? To answer this question, the variables in question must be manipulated in such a way as to show a functional relation between the behavior and its product.

The fact that little systematic research has been conducted to test the notion of automatic reinforcement does not imply that it is impossible (Note 1). Consider the example: "The dog lover is automatically reinforced when seeing dogs" (Skinner, 1969, p. 252). First, the response "looking at dogs" could be identified as turning pages in a book on dogs, with the reinforcing stimulus, a picture of "dogs," appearing on each page. After obtaining a baseline on rate of responses (e.g., the number of pages turned in *Science*), a contingency could then be arranged between the above specified stimulus and response. The contingency could then be broken so that turning pages did not result in "seeing dogs," with the contingency reestablished at some later time. Finally, the "deprivation state" could be manipulated so that, for example, the subject was kept from seeing dogs for several days prior to the experiment, or required to spend five days in a kennel prior to the experiment, to test the reinforcing value of "seeing dogs."

Thus, certain examples in Skinner's writings do seem legitimate according to the criteria listed by Schnaitter — namely, those cases where the behaver operates on the surrounding world. However, other examples do not lend themselves to the same experimentation — namely, those cases where the behaver acts directly on the body.

Under these conditions it is virtually impossible to sever the behavior from its product, and thus impossible to manipulate the variable of which the behavior is considered a function. This methodological impass has lead critics to argue that the concept of automatic reinforcement is useless because it is circular and unobservable. Both of these related issues deserve attention.

A circular statement is one in which the cause given for some event is inferred from the very event that it is said to explain. In this context, the response product serving as automatic reinforcement must be inferred from its effect on behavior rather than defined by a universal property independent of its effect. It is double-jeopardy when we speculate about unobserved reinforcement for unobserved behavior (e.g., thinking). But to hesitate in extending to a level that is unobservable the process by which some stimulus-change takes on conditioned reinforcing value would leave large gaps in an account of human behavior. No one questions studies showing how observable stimulus-changes, once neutral, take on reinforcing value because of their association with other reinforcement. The issue is whether we can speculate about a similar process at a level barring inter-observer reliability. Skinner's position on this matter, given almost four decades ago, seems to be the most cogent:

> 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. What matters to Robinson Crusoe is not whether he is agreeing with himself but whether he is getting anywhere with his control over nature. Agreement is not the key to workability. On the contrary, it is the other way around. (1945 p. 285)

Thus, if the function of interpretation is to encourage further extensions of behavioral analysis by providing a plausible account within the behavioral framework, and hence, to generate further experimental, technical, and theoretical developments, then the notion of "automatic" reinforcement would seem to be valuable.

> As in other sciences, we often lack the information necessary for prediction and control and must be satisfied with interpretation, but our interpretations will have the support of the prediction and control which have been possible under other conditions. (Skinner, 1974, p. 176)

B. Is Skinner Self-Contradictory?[12]

Skinner's position on response products which serve as reinforcing stimuli has been, to some people, inconsistent. The confusion arises as a result of Skinner's response to Herrnstein's (1977) article, "The Evolution of Behaviorism." Herrnstein argued that behavior may be followed by consumable objects external to the organism (e.g., food) or reinforcing stimuli arising from the behavior itself (e.g., sex). The latter, he contends, have been overlooked by most behaviorists. That is, Skinnerians assume behavior is "hedonically neutral." He provides a number of examples to illustrate the role of "behavior's intrinsic power to reinforce" (p. 601).

[12]We thank Roger Schnaitter for suggesting this sub-heading title.

> When a response is to any degree self-reinforcing, to that degree it ceases to be arbitrary. Its form is then dictated by built-in contingencies of reinforcement, not easily shaped by a behavioral engineer. (p. 601)
>
> When a predator stalks its prey, the reinforcer seems to involve stalking and capturing. The mouse as food reinforcer precipitates out at some later point in its encounter with a cat. Prior to that, the mouse probably provides the occasion for reinforcers embodied in the cat's own behavior. (p. 600)

In his reply, Skinner (1977) took issue with such an analysis. He argued that one need not explain behavior in terms of self-reinforcement when it is "clearly traceable to natural selection" (p. 1011).

> The stalking behavior of a cat appears to be largely inherited, though the topography no doubt changes under reinforcement as a mouse is stalked.
>
> Herrnstein wants to explain all the behavior as due to self-reinforcement — reinforcement not by the reactions of the mouse but by the very behavior itself. (p. 1011)

Skinner (1966) contends that:

> Parts of the behavior of an organism concerned with the internal economy, as in respiration or digestion, have always been accepted as "inherited," and there is no reason why some responses to the external environment should not also come ready-made in the same sense. (p. 1205)

He adds that we now know a great deal about shaping behavior and can be fairly sure that certain behavior, namely behavior traceable to phylogenic contingencies, occurs too fast and is too complex to be generated by contingencies of reinforcement.

Thus, Skinner is *not* arguing against the notion that behavior can be learned and maintained through automatic reinforcement. In the example above Skinner suggests that the mouse plays a critical role in determining the specific topography of the cat's behavior (e.g., whether it turns right or left, moves forward or backward, and so on). Given the mouse, there is no need to suppose that the cat is providing its own reinforcement; the mouse is providing plenty. But this does not weaken the role of innate behavior; the contingencies of reinforcement merely supplement such behavior. Both phylogenic and ontogenic contingencies may and often do interact. In cases where behavior is not, however, traceable to phylogenic contingencies, and there are no environmental changes occurring as a function of the behavior, it is not unreasonable to look to the stimuli arising from the behavior for the reinforcing consequences. It is under these conditions that Skinner makes reference to automatic reinforcement.

IV. The Heuristic Value of Automatic Reinforcement

A dictionary of modern thought published in England defines "operant conditioning" as: "A form of conditioning in which behavior is controlled through systematic manipulation of the consequences of previous behavior."[13] Why "systematic manipu-

[13]We thank B.F. Skinner for bringing this definition to our attention.

lation"? Is this not a little like defining "respiration" as a "procedure in which the oxygen concentration of a person's body is controlled through the systematic manipulation of the quantity of air entering the lungs"? Operant conditioning, like respiration, goes on continuously as long as the organism is in contact with the environment.

Part of that environment is composed of other people who are necessarily modifying the behavior of others. But behavior occurs and is modified in the absence of other people as well. The modification of non-verbal behavior causes no difficulty because the reinforcement is the result of, and is in a direct relation to, the action taken. The reinforcement is usually not mediated. But verbal behavior has no natural, mechanical strengthening effect. Verbal behavior, by its very definition, requires mediated reinforcement; an audience is a necessary condition. When the reinforcement is mediated by someone else, it is often contrived (cf. the educational system). But when, as a function of learning how to speak as well as listen, we begin to talk to ourselves and react to this verbal behavior, the consequences are necessarily automatic.

The implications of such a self-contained system are extraordinary. On the one hand, for example, people could derive automatic reinforcement from self-deception, unrealistic fantasies, or autistic behavior. On the other, people could derive automatic reinforcement for keen thinking, complicated problem solving, and so on. Such a system of reinforcement takes advantage of the fact that each person is their own best audience.

This paper began by asking: Can behaviorists do any better than cognitive psychologists in analyzing complex human behavior? After reviewing the examples of automatic reinforcement provided by Skinner in his many writings, we believe the answer is "yes." By incorporating the concept of automatic reinforcement, complex human behavior not generating conspicuous environmental changes can now be analyzed. Indeed, it may be the main type of reinforcement used in interpreting "higher mental processes." Moreover, it encourages looking for subtle forms of non-contrived reinforcement; we no longer need to ask who is arranging the reinforcement.

If complex verbal behavior is initially a function of contrived reinforcement and only through a rich conditioning history comes under the control of automatic reinforcement, then Skinner has provided a pragmatic framework to begin to study, analyze, and teach the behavior most difficult in understanding and developing. The analysis may be speculative, but it is nevertheless aimed at the right target, and automatic consequences may be an essential aspect of the interpretation.

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