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ON B.F. SKINNER'S (IN)DETERMINISM

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Abstract: B. F. Skinner has committed himself to determinism at different points in his lifework. However, the Skinnerian scientific system is not based on fixed epistemological assumptions. This article aims to demonstrate that Skinnerian statements about determinism have different meanings, and some of them may also coincide with the opposite thesis of determinism (i.e., indeterminism). Concepts associated with determinism were examined within the three models of behavior proposed by Skinner (reflex, operant, and selection by consequences). This conceptual investigation showed that the formulations within the reflex model are consistent with determinism; those within the operant model are ambiguous as to their compatibility with deterministic and indeterministic scientific conceptions; and those within selection by consequences are aligned with scientific indeterminism. Skinner's repeated commitment to determinism should not lead behavior analysts to assume it is an uncontroversial "ism"; therefore, other interpretations of behavior analysis's fundamental postulates are possible.

Keywords: science; behavior analysis; determinism; indeterminism.

Determinism is considered one of the radical behaviorism assumptions, the philosophy of behavior analysis: "Determinism has long been a core assumption in many forms of behaviorism, including radical behaviorism" (Slife, Yanchar & Willians, 1999, p. 75). B. F. Skinner also declared himself as a determinist (Skinner, 1979/1984, p. 345), and committed to determinism at different stages of his work (e.g., Skinner, 1947/1999c, p. 319, 1953/2005, p. 6, 1968, p. 167, 1971/1976, p. 26, 1974, p. 54).

Often drawing on Skinner's conception of determinism, other behavior analysts have argued that behavior is a determinated phenomenon and that determinism is a cardinal premise of behavior analysis (e.g., Baum, 2005; Botomé, 1982; Carrara, 2004; Carvalho Neto, 2002; Chiesa, 1994; Fraley, 1994; Lanovaz, 2022; Strapasson & Dittrich, 2011; Tourinho, 2003). The deterministic interpretation has thus acquired a canonical feature. From this perspective, determinism is not in any way questioned; if anything, what is scrutinized is which formulation of determinism would best portray the desiderata of a science of behavior (see Slife, Yanchar, & Williams, 1999).

However, Skinner's scientific proposal is not grounded on fixed philosophical premises. Some studies have indicated, for instance, that Skinner's conceptions and models of behavior explanation have changed, shifting from positivist and mechanistic assumptions (Moxley, 2006) to those that are more consistent with pragmatism (Lattal & Laipple, 2003), contextualism (Morris, 1988) and selectionism (Hull et al., 2001; Moxley, 2004).

In view of the epistemological changes, it is plausible to hypothesize that Skinner's statements about determinism may have been affected, in some way, by these transformations. Even if Skinner reiterated his commitment to determinism in different periods of his academic practice, it is worth asking whether the statement that behavior is determined means the very same thing in the domain of these different philosophical principles. Starting from this assumption, this article aims to demonstrate that Skinnerian statements about determinism have different meanings, and some of them may also coincide with the opposite thesis of determinism (i.e., indeterminism).

To do so, I will present deterministic formulations and associated concepts in three different Skinnerian behavior models (reflex, operant, and selection by consequences). I will then compare the theoretical assumptions of such formulations with other understandings of determinism and indeterminism in the philosophy of science. When Skinnerian formulations of the determinism concept are examined under this framework, the seemingly uncontroversial character of the deterministic interpretation begins to be cast into question.

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I, therefore, conclude that Skinner's repeated commitment to determinism should not lead behavior analysts to assume that it is an "ism" that does not yet deserve to be debated. Not only is the discussion of determinism not "dead," but the deterministic interpretation may not be the most adequate to characterize all of Skinner's assumptions about behavior. Ignoring the epistemological changes in Skinnerian science and the debate in the philosophy of science may even overshadow possibilities for an indeterministic interpretation of the behavior analysis philosophical commitments.

Skinnerian deterministic formulations

In one of the most illuminating passages about his understanding of determinism, Skinner (1947/1999c) stated:

> To have a science of psychology at all, we must adopt the fundamental postulate that human behavior is a lawful datum, that it is undisturbed by the capricious acts of any free agent–in other words, that it is completely determined. (p. 319)

In the first part of the excerpt, Skinner depicted determinism as a necessary condition for doing science. In other words, the commitment to a deterministic conception is a prerequisite for classifying a given psychology proposal as scientific—if a given psychology is scientific, then it is deterministic, although the opposite is not true (e.g., psychoanalysis) (see Skinner 1971/1976, p. 26, 1974, p. 114). Furthermore, Skinner equated "determined" to "lawful." Thus, to say that behavior is determined means to say that it is a phenomenon that can be described by laws (lawful datum), from which it also follows that behavior is a regular or ordered fact (see Skinner, 1956/1999a, p. 130).

Skinner (1947/1999c) further stated that behavior is not just determined, "it is *completely* determined" (p. 319, emphasis added). As behavior is a lawful or determined phenomenon, its scientific explanation involves connecting a given type of event (response) in a regulated manner to other events (antecedent or consequent stimuli). However, the relations between responses and environmental variables do not always present themselves with the expected regularity; a response may occur without an explicit connection to another event, and the occurrence of an event (stimulus) may not be followed by the usual response. Thus, there are deviations or disruptions in these regularities, which appear in the form of spontaneity or whim. From a scientific deterministic perspective, the "spontaneous" character would disappear when these disruptions are explained; that is, when anomalous responses are understood as the effects of inconspicuous genetic or environmental causes.

In the case of a behavioral science (and not of genetics), the failure to demonstrate the dependency relationship of these "spontaneous" events with environmental stimuli would be an occasion for a free agent action, whose assumption would be antithetical to the pursuit of the regularities that underlie the laws of a science (Skinner, 1947/1999c). Therefore, it is assumed that all instances of responses, typical or not, would have a causal (or functional) dependency relationship with other events (Skinner, 1953/2005). The existence of disturbances, that is, of non-precedented responses to specific stimuli, or of stimuli not succeeded by expected responses, cannot therefore be attributed to "the capricious acts of any free agent," but to other events with which their dependency relationship needs to be demonstrated.

In short, the conceptual presumptions of the Skinnerian formulation of determinism indicate that: 1) determinism is a pre-condition for science, 2) every instance of response is the result of a causal law, and that 3) possible derangements in the ordering of the relations between stimuli and responses in a behavioral science do not amount to the action of a free agent, but the interference of physical causes that need to be identified.

Despite these conceptual implications, the Skinnerian view of determinism examined so far is still too broad (Skinner, 1947/1999c). If "determined" implies assuming that every instance of response is, conspicuously or not, causally and regularly connected with other (environmental) events, it is still necessary to elaborate what kind of regularity or causality characterizes this deterministic assumption. Begelman (1978) captured this point: "It remains an open question whether Skinner uses 'lawful' and 'determined' in the sense of the strict causal necessitation, or in a much looser way, closer

in meaning to those senses of the terms figuring in probabilistic accounts" (p. 14-15). Based on this, he concluded: "If so, his use of 'determined' cannot be regarded as unambiguous" (p. 15).

One way to carry out a conceptual refinement of the idea of determinism is to investigate Skinner's statements regarding terms, notions, or ideas he used to define the concept, such as regularity, causality, and behavior control. As this conceptual network is part of Skinner's scientific proposal, and since this proposition has changed throughout his work, there follows an examination of different explanations of regularity, and related terms, identified at times in Skinner's work in which different models of behavior prevail.

Three different formulations of regularity have been found in Skinnerian writings. The first is regularity as *necessity*, which appears when Skinner describes the relations between stimulus and response in the reflex model. Another concept is regularity as *probability*, which appears in a more systematic way when Skinner characterizes the operant model. A third meaning arises in the proposition of the model of selection by consequences, in which regularity is described in terms of *probabilistic selection* (non-necessitation causality) *of variations* (random).

Reflex model: Regularity as *necessity*

In the initial propositions of his scientific psychology in the 1930s, Skinner claimed that the concept of reflex was the most appropriate to refer to behavior as a scientific subject matter. The justification for this defense was as follows*:*

> The reflex is important in the description of behavior because it is by definition a statement of the *necessity* of this relationship. The demonstration of the necessity is ultimately a matter of observation: a given response is observed invariably to follow a given stimulus, or exceptions to this rule may be independently described. (Skinner, 1931/1999d, p. 433)

The "necessity" used by Skinner to describe the typical regularity of reflex relations can be elucidated by the notion of causal sufficiency, illustrated by the statement: *If A, then invariably B*. The concept of reflex specifies a relation between stimulus and response in which the stimulus represents a sufficient cause for the occurrence of the response: Given the stimulus, the response necessarily follows (invariably and unconditionally). However, the passage examined leaves open the possibility that a given stimulus is not a necessary condition for the occurrence of a given type of response. Even if the occurrence of a stimulus is succeeded by a response, the occurrence of a response may not have been preceded by that particular stimulus.

The final part of the quote, which reads "exceptions to this rule may be independently described," is also important to understand Skinner's formulation of scientific determinism. For Skinner, the typical invariability of the reflex could be empirically demonstrated. Nevertheless, the occurrence of exceptions to this observed invariability does not mean the action of a free agent or any metaphysical causal agent. Skinner resorted to third variables, such as the secondary laws of reflex, to explain any disturbances observed in the relationship between stimulus and response. For example, in cases where there is repetition of the same stimulus value and a corresponding decrease in response value, the third variable could be the number of elicitations of the response by the stimulus, which was designated *reflex fatigue*. Skinner restored the causal necessitation of the reflex relation with the secondary laws of reflex, which explained the variation of the correlation between stimulus and response as a function of third variables (see Skinner, 1931/1999d).

In refining his initial formulation of reflex, Skinner (1937/1999e) distinguished two types of reflex relation, Type I or Type R, and Type II or Type S, saying that "All conditioned reflexes of Type R are by definition operants and all of Type S, respondents" (Skinner, 1937/1999e, p. 467). One of the differences between these reflexes is that in the operant reflex, the response was not correlated with a conspicuous antecedent stimulus. Despite this, the Type R reflex did not invalidate the idea of a behavioral science based on the concept of reflex. According to Skinner, the apparent spontaneity in the operant reflex "does not mean that we cannot find a stimulus which elicits such behavior, but that no stimulus is operative at the time the behavior is observed" (Skinner, 1937/1999e, p. 467). At another time, Skinner (1938) reiterated the same assumption, stating that "they [operant reflexes] are obviously not subject to laws. But with strict control of all relevant operations, the kind of necessity which naturally characterizes simple reflexes seems to apply to general behavior" (p. 26).

Operant model: Regularity as *probability*

The concept of reflex was not able to support the proposal to scientifically explain the behavior of an organism as a whole. In the 1950s, Skinner (1953/2005) detached the operant from the notion of reflex, abandoning the premise that all behavior is reflex in nature. No longer being a reflex, the operant did not exhibit the necessity typical of the reflex, characterized by an invariable relation with antecedent stimuli.

Differently, in operant relations, responses are explained by their connection with consequent stimuli: "The term [operant] will be used both as an adjective (operant behavior) and as a noun to designate the behavior defined by a given consequence" (Skinner, 1953/2005, p. 65). This does not mean, however, that there are no connections with antecedent stimuli, but it is not an elicitation relationship, as in the reflex. Skinner insisted a lot on this differentiation; in the case of operant responses, "behavior of this sort [operant] may come under the control of stimuli, but the relation is not that of elicitation" (Skinner, 1953/2005, p. 64). He further specified that "stimulus and response occur in the same order as in the reflex, but this does not warrant the inclusion of both types in a single 'stimulus-response' formula" (Skinner, 1953/2005, p. 110); "operant behavior, in short, is emitted, rather than elicited. It must have this property if the notion of probability of response is to make sense" (Skinner, 1953/2005, p. 107).

Even if not elicited by environmental stimuli, it would be possible to do a science of operant behavior, as Skinner (1953/2005) claimed. Like respondent responses, operant responses are also regularly connected with stimuli. But Skinner employed the notion of probability rather than necessity to describe the regular relations between stimuli and responses in operant behavior. He said, for example, that in operant behavior "The discriminative stimulus does not elicit a response, it simply alters a probability of occurrence. The relation is flexible and continuously graded" (Skinner, 1953/2005, p. 110).

Unlike eliciting stimuli, environmental variables do not unequivocally fix the occurrence of a given type of operant response. Thus, antecedent and consequent stimuli do not function as sufficient causes, because both only alter the probability of occurrence of a given type of response. Before a given discriminative stimulus, for example, the operant response does not invariably follow, but is more likely to occur in the presence of that stimulus; "the response follows the stimulus in a more leisurely fashion, and it may be intense or feeble almost without respect to the intensity of the stimulus" (Skinner, 1953/2005, pp. 110-111). Similarly, reinforcing consequences increase the probability of occurrence of responses of the same operant class; ". . . consequences alter future probability" (Skinner, 1953/2005, p. 90). The "causal" dependence relationships between types of events in the operant is probabilistic, so that "our basic datum is not the occurrence of a given response as such, but the probability that it will occur at a given time" (Skinner, 1957, p. 55). Even being probabilistic, the regularities described in the operant allow prediction and control: "Both prediction and control are inherent in operant conditioning, but the notion is always probabilistic" (Skinner, 1974/1976, p. 226).

The probabilistic operant relation poses another challenge to Skinnerian science. If in the reflex the variability identified in the relationship between stimulus and response could be explained by resorting to the secondary laws of reflex, how can we interpret the flexible character of stimulus control in the operant without allowing margin for mentalistic explanations? After discriminative training, a given stimulus acquires a discriminative function, that is, a given response is more likely to occur in the presence of this stimulus, and the operant becomes discriminated. How to understand possible failures in this discriminative relationship, as in the situation where the discriminative stimulus is presented and the operant response does not happen, or the operant response happens even in the absence of this specific stimulus?

Skinner (1953/2005) reasoned that "the discriminative stimulus . . . shares its control with other variables, so that the inevitability of its effect cannot be easily demonstrated" (p. 112). Thus, in the case of the discriminative operant, the failure of stimulus control can be explained by using variables from the field of motivation and emotion. For example, someone can "see" the loved person in a crowd, even if the person is not present. The motivational operation of depriving social contact with the loved one may have increased the strength of previously reinforced responses in his or her presence, even though the discriminative stimulus (the loved person) for these responses is currently absent. On the other hand, the discriminative stimulus may be present, but the discriminative operant

response may not occur. Someone did not respond to the friend who said, "good afternoon" (verbal discriminative stimulus) because, on that day, the quarrel with the boss operated as strong aversive stimulus, generating an emotional state of anger, in which friendly responses had their strength of occurrence drastically and temporarily diminished (see Skinner, 1953/2005).

From a deterministic Skinnerian perspective, the occurrence of anomalous responses (e.g., seeing in the absence of the object seen, not greeting the friend) does not denote causal independence, nor is it the effect of mentalistic causes. The occurrence of such operant responses is supposed to relate to other physical variables. Skinner (1953/2005) elucidated the matter:

> When a discriminative stimulus has an effect upon the probability of a response, we see that the present environment is indeed relevant, but it is not easy to prove the inevitability of the control without an adequate account of the history of reinforcement and deprivation. (p. 112)

Skinner (1953/2005) shielded the operant from mentalistic explanations but left doubt whether probabilistic description of operant relations was only a temporary expedient in the face of methodological limitations in identifying the multiplicity of variables at play. While acknowledging that operant behavior has a "probabilistic nature" (Skinner, 1971/1976, p. 97), Skinner (1953/2005) suggested that once all the controlling variables in the discriminative operant have been taken into account, it would be possible to "force" the occurrence of the operant as in reflex: "But when all relevant variables have been taken into account, it is not difficult to guarantee the result – to force the discriminative operant as inexorably as the eliciting stimulus forces its response" (p. 112).

Similar reasoning holds true at other times. For example, Skinner (1968) emphasized that,

> There is always an element of mystery in the emission of any operant response. A stimulus never exercises complete control. It is effective only as part of a set of conditions, which build up to the point at which a response is emitted. There is a temporal leeway. (p. 137)

However, following the passage, he points out that even though it is not possible to say when exactly a behavior will occur, this does not mean that the behavior is "unlawful, but we lack the information needed to predict the moment of its occurrence with certainty" (Skinner 1968, p. 138). These assertions can lead one to question whether the probability in operant behavior describes a cognitive limitation rather than regularities that underlie laws, causality and, control that are substantively different from those of reflex.

Selection by consequences model: Regularity as *probabilistic selection of variations*

Skinner's scientific system had another significant change when he started to extend the principles of variation and selection from Darwinian evolutionary theory to explain the individual's behavior. Using the selectionist vocabulary, Skinner (1953/2005)[3] began to characterize the invariable relationship between stimuli and responses in unconditional reflexes, as well as the conditions responsible for the emergence of respondent conditioning as products of a history of variation and natural selection. Regarding reflexes, Skinner (1953/2005) stated: "Such biological advantages 'explain' reflexes in an evolutionary sense: individuals who are most likely to behave in these ways are presumably most likely to survive and to pass on the adaptive characteristic to their offspring" (p. 54). Similar reasoning applies to respondent conditioning:

> Since nature cannot predict . . . that an object with a particular appearance will be edible, the evolutionary process can only provide a mechanism by which the individual will acquire responses to particular features of a given environment after these have been encountered. (p. 55)

[3] There still needs to be consensus on when the analogies between behavioral and cultural selection and natural selection began in Skinner's work (Leão & Carvalho Neto, 2018). Somehow, Skinner (1953/2005) in *Science and Human Behavior* (*SHB*) had already sketched some parallels. It is a work that presents different formulations of behavior. Thus, *SHB* is used to illustrate the notion of regularity as a probability (previous section) and to show indications of selectionist regularity formulations.

In a Darwinian redescription, the conditions for the emergence of operant reinforcement also have an evolutionary origin (see Skinner, 1981, p. 501) and reinforcement itself is understood as a process of selection: "In certain respects, operant reinforcement resembles natural selection in evolutionary theory. Just as genetic characteristics arising as mutations are selected or discarded by their consequences, so new forms of behavior are selected or discarded by reinforcement" (Skinner, 1953/2005, p. 430). In this selectionist view, Skinner (1974/1976) compared the origin of operant behavior with the origin of species: "The origin of behavior is no different from the origin of species . . . There are many behavioral processes that generate 'mutations,' which are then subjected to the selective action of reinforcing contingencies" (p. 100).

Skinner (1971/1976) explained not only the behavior but also the evolution of cultures based on selection. As for analogies between species and culture, he stated, "a culture corresponds to a species. We describe it by listing many of its practices, just as we describe a species by listing many of its anatomical features" (p. 128), and that "the important thing about a culture so defined is that it evolves. A practice arises as a mutation, it affects the chance that the group will solve its problems, and if the group survives" (Skinner, 1974/1976, p. 203).

The parallels between the evolution of species, of behavior, and of cultures appear in different moments in Skinner's work but were systematized in what was eventually named selection by consequences (Skinner, 1981). According to Skinner (1981), selection by consequences is a causal mode different from classical mechanics:

> Selection by consequences is a causal mode found only in living things, or machines made by living things. . . In all three of these fields [species, behavior, and culture], it replaces explanations based on the causal modes of classical mechanics. (p. 501)

In push-pull mechanistic causality, the dependency relationship between events is described by means of a linear causal chain that admits no temporal gaps: The cause is an event that immediately precedes the effect, and acts as a force, "pushing" its occurrence; the effect, in turn, acts as the cause of the next event, and so on. In contrast, in the selection by consequences model, the environment does not "push or pull, it *selects*" (Skinner, 1971/1976, p. 22), and this selection is permeated by temporal gaps.

By involving a historical rather than mechanistic causality, in which the product is more conspicuous than the production process, the selection by consequences model further opens the flank for invoking a free agent and other mentalistic causes to fill temporal gaps. Skinner (1989) was aware of this possibility when he pointed out that "we feel the need for a creative god because we see the world but very little of the processes through which it came into existence, the product but not the production" (p. 27).

Skinner (1981) dismissed the notion of an initial cause and its mentalistic counterpart by rejecting the idea of a creative act responsible for the origin of species, cultures, and behavior. Thus, a species, a culture, and an individual behavior repertoire are not "caused" by a specific immediate antecedent event but are the product of a long and gradual process of selection (by consequences) of variants over time. This time lag can take thousands of years regarding the species, hundreds of years regarding culture, and the length of the individual's life history regarding behavioral repertoire (Skinner, 1981).

In addition to dismissing initial causes *à la* mechanistic causality, Skinner, like Darwin in the evolution of species, rejected final causes such as purpose or design as catalysts of evolutionary change (see Skinner, 1953/2005, p. 90). Skinner (1974/1976) resorted to the notion of mutation or random variation to abolish teleological explanation of evolution.

Random variations do not occur in response to prevailing environmental demands or to satisfy some adaptive purpose; in short, they describe a causal independence between variation and selection conditions. Even if there are environmental (e.g., radiation) and molecular causes for variation (e.g., crossing over), their occurrence is independent of selection conditions. Thus, as Skinner (1974/1976) reasoned, variation does not occur to better adapt the organism to the environment. For example, "a particular species does not have eyes in order that its members may see better," but because "certain members, undergoing variation, were able to see better and hence were more likely to transmit the variation" (Skinner, 1981, p. 503). The same reasoning was applied to the behavior and evolution of cultures (see Skinner, 1981).

Furthermore, with the notion of random variation, Skinner introduced the controversial concept of chance into the model of selection by consequences. He stated: "Since mutation is a random process and since most mutations are harmful rather than neutral or beneficial to the organism, it is evident that the occurrence of a variation is itself a matter of chance" (Skinner, 1974/1976, p. 57). Skinner (1974/1976) was aware that "chance" was a "taboo," especially for deterministic theories:

> Another deterministic system, psychoanalysis, has initiated another age in which chance is taboo; for the strict Freudian, no one can forget an appointment or call a person by the wrong name or make a slip of the tongue by chance (p. 114)

and that "we may not like to credit any aspect of a successful painting to chance" (Skinner, 1970b/1999, p. 349).

The controversial point is that the concept of chance describes the very notion of independence between events or situations (or conditions of variation and selection). If scientific explanation is traditionally characterized by the demonstration of causal dependence relations between events, *chance* specifies the limits of scientific explanation. Even so, Skinner placed the "chance" in the heart of the variation-selection system, which drives evolution: The "meeting" between certain variations and certain life conditions is, in principle, accidental. Thus, the eventual selection of evolutionarily significant variations resulting from this encounter is entirely contingent and not necessary (see Skinner, 1974/1976, p. 114).

The appeal to chance is even more evident when Skinner dispels the ghost of the creative mind of the origin of new behaviors from a selectionist perspective. Something that, until then, had not been achieved by traditional behaviorism, as Skinner reasoned (1974/1976): "It was an insoluble problem for stimulus-response psychology because if behavior were nothing but responses to stimuli, the stimuli might be novel but not the behavior" (pp. 113-114). Skinner (1968) admitted the occurrence of the authentic novelty when he declared that "certainly new forms of human behavior have come into existence. Very little of the extraordinary repertoire of modern man was exhibited by his ancestors, say, 25,000 years ago" (p. 179), and that "each of the responses composing that repertoire must have occurred at least once when it was not being transmitted as part of a culture. Where could it have come from if not from a creative mind?" (p. 179). In the behaviorist system, the variation, diversity, or novelty verified in the human behavioral repertoire could not come from a creative mind. The Skinnerian answer to this question was not, therefore, mentalistic; but rather selectionist: "New responses are generated by accidental arrangements of variables as unforeseeable as the accidental arrangements of molecules or genes" (Skinner, 1968, p. 180). Therefore, unlike what happened in the reflex and operant models, in selection by consequences, mentalistic explanations (i.e., a creative mind) were eliminated by resorting not only to environmental (and genetic) variables, but also to chance.

The use of *chance*, however, in no way threatens science. In the first place, behavior is still understood as a lawful datum: There are responses (respondent and operant) that happen regularly in a relationship of dependency with the environment (and with genes). As is known, it is the role of a science of behavior to empirically demonstrate and describe these regularities by laws or concepts, also guaranteeing prediction. The difference is that in selectionism it is admitted that not every occurrence of a new response is an instance of a causal law. In other words, a new response may result from an encounter *by chance* between variation and selection conditions and not caused by a new antecedent stimulus. Chance and regularity are united in the selection by consequences model.

Second, the possibility to control behavior is also safeguarded, even though this notion was also redescribed in terms of variation and selection (see Skinner, 1981, p. 504). With the notion of random variation, Skinner moved away from a teleological notion of planning, but he tried to "tame" chance by combining it with a secular notion of designing: "The role of chance may be taken over, and extended, by deliberate design" and it is "possible not only to take advantage of accidents, following Pasteur's well-known dictum, but to produce them" (Skinner, 1968, p. 180).

The reasoning behind this attempt to domesticate chance seems to be the following: If the evolution of behavior and culture, as well as that of species, occurs by selection on variations, and if variations are the material of selection, then if one wants to accelerate this process of behavioral or cultural change, one must mimic chance. Because chance describes disjunctions or independence

between events or situations, mimicking chance would be precisely to arrange conditions in which the control of behavior by the environment would become less rigid and precise: "Mutations may be made more probable by making the control of a medium less precise or by encouraging disturbances" (Skinner, 1970b/1999, p. 349). Random encounters can be maximized by "loosening" the dependency relations between responses and specific stimuli, and with this, the probability that original responses will occur increases (Skinner, 1968).

With a "planned diversification," Skinner envisioned, for example, the possibility of a technology of teaching aimed at promoting creative individuals. Although original behavior cannot be taught, the teacher can teach the student intellectual self-management techniques, with which the learner can manipulate the environment in a way that increases the occurrence of behavioral variations (see Skinner, 1968, pp. 178-184). Mimicking the chance, cultural planners can give a specific direction to the evolution of cultures, catalyzing the occurrence of variations in cultural practices and arranging social contingencies that favor the selection of those aligned with the survival of cultures (see Skinner, 1971/1976).

Through selectionism, Skinner (1981) dismissed the notion of the initiating agent but did not bequeath a passive human being; it is possible to intervene in the selection process of species, behavior, and cultures actively and deliberately by inserting variations in genes, behaviors, and practices. Human beings can then "control" their own genetics, their own behavior, and their own destiny, "but it does not do so in the sense in which the term control is used in classical mechanics. It does not for the very reason that living things are not machines: selection by consequences makes the difference" (Skinner 1981, p. 504).

If the recognition of chance does not prevent the Skinnerian selectionist model from reaching the scientific aims of explanation, prediction, and control, it remains to be seen if this system can still be considered deterministic. Until then, for Skinner, "determined" is interchangeable with lawful, caused, and controlled; in selection by consequences these terms acquire different meanings from those verified in reflex and operant. In the selectionist model, "lawful" denotes regularity coordinated with chance; "caused," in turn, designates a causal model different from classical mechanics (variation and selection over time), and "control" can mean inserting variations in the environment in order to accelerate behavioral or cultural evolution.

Even with all these changes in the way of characterizing his scientific system in selectionism, Skinner seems to have insisted on the determinist designation (see Skinner 1968, p. 171, 1974/1976, p. 114). The analysis of the notions of regularity (and its correlates such as causation and control) done so far shows that determinism not only acquires very different meanings in Skinner, but also takes on a meaning so broad that it loses its heuristic value of differentiating the Skinnerian scientific system from other proposals of psychology. If 'determined' means conceiving the phenomenon to be investigated as regular, ordered, caused, controlled, and all this can denote necessity, probability, and even the participation of chance, what, then, would be a non-deterministic psychology?

I will show that some meanings of determinism identified in Skinner's text and in the behavior-analytic literature coincide with indeterministic scientific formulations in the philosophy of science. Given this possibility, Skinner's assumption that determinism is a prerequisite for doing science needs to be revised.

Formulations of determinism and indeterminism in the philosophy of science

As examined so far, Skinner (1947/1999c) identified determinism with the assumption that events are regular, caused, or controlled. This identification is also echoed in the specialized literature (e.g., Baum, 2005; Chiesa, 1994). However, the wording of the Skinnerian formulation of determinism is too broad, for it is not specified in what kind of regularity, causality, or control would be at stake in such a statement. Furthermore, looking more closely at Skinner's formulations of behavior as a scientific subject matter, it is possible to identify different frameworks for behavioral regularity.

To shed light on these different formulations, some understandings of scientific determinism and indeterminism in the philosophy of science will be highlighted. Based on them, it is possible to reinterpret the kind of regularity or causality that typifies some Skinnerian claims about behavior as deterministic or indeterministic.

Determinism

The generic nature of the Skinnerian notion of determinism contrasts with classical philosophical acceptations of the term in which so-called deterministic regularities are made explicit (e.g., Laplace, 1814/1951; Mill, 1843/1979; Einstein et al., 1935). For some authors, such as Earman (1986), William James' definition is a good illustration of the typical regularity of determinism:

> What does determinism profess? It professes that those parts of the universe already laid down absolutely appoint and decree what the other parts shall be. The future has no ambiguous possibilities bidden in its womb; the part we call the present is compatible with only one totality. Any other future complement than the one fixed from eternity is impossible. The whole is in each and every part and welds it with the rest into an absolute unity, an iron block, in which there can be no equivocation or shadow of turning. (James cited by Earman, 1986, pp. 4-5)

The Jamesian definition shows that the notion of deterministic regularity is characterized by the notion of sufficient causality. From this perspective, to say that an event is determined is the same as saying that its occurrence is an inexorable effect of a cause. Therefore, *classical* determinism is the claim that all events are regularly connected with other events (understanding "regularly" as sufficient causality, at least). In other words, every occurrence of an event is an instance of a causal law.

As already examined, the only formulation of regularity in Skinner that aligns with this classical definition of determinism is the one that designated the reflex (Skinner, 1931/1999d), or the S-type reflex (Skinner, 1937/1999e), according to which, given the occurrence of the stimulus the response invariably followed. The notion of determinism based on sufficient causality is verified in the behavior-analytic literature (Botomé 1982; Fraley, 1994; Vorsteg, 1974, Theophanus, 1985). For example, Vorsteg (1974) says: "By a causal law I mean a true statement to the effect that whenever conditions of kind F occur, conditions of kind G invariably occur" (p. 109), and that "*determinism* is the thesis that *every* item of behavior is an instance of a causal law" (p. 110). Fraley (1994) also employs the notion of sufficient causality to characterize determinism: "Determinism is the thesis that, given the conditions surrounding an event, nothing else but it could happen" (p. 71). But unlike Skinner (1931/1999d, 1937/1999e), some behavior analysts regard this meaning of determinism to define not only the reflex but also the operant (Botomé, 1982; Fraley, 1994).

Determinism and probability

Given the relationship between classical determinism and sufficient causality, denying this type of causality would imply denying determinism. Non-sufficient causality would then describe that the occurrence of the cause does not unambiguously fix the occurrence of the effect, as in probabilistic causality: "The central idea behind probabilistic theories of causality is that causes increase the probability of their effects; an effect may still occur in the absence of a cause or may fail to occur in its presence" (Hitchcok, 2021).

At least in the case of the operant, Skinner (1953/2005, 1971/1976) subscribed to a non-sufficient or probabilistic causality. However, there are attempts to preserve determinism even while assuming probabilistic causality. A revealing example of this strategy is the notion of "probabilistic determinism" (see Botomé, 1982; Carrara, 2004; Carvalho Neto, 2002; Tourinho, 2003), applied to mark a difference with absolute determinism; "the idea of causal determinism . . . always refers, in the behavioral analysis supported by radical behaviorism, to a probabilistic determinism and not to an absolute determinism" (Carrara, 2004, p. 39). As behavior is determined by a myriad of causes whose complete knowledge eludes behavior analysts, what is left for them is to deal with "probabilistic determinism" (Tourinho, 2003, p. 38). In this form of determinism, probability describes a cognitive limitation: "It is impossible to deal with all the variables of which a behavior is a function; . . . one can only increase or reduce the probability of a behavior but not determine it in an absolute way" (Tourinho, p. 38).

By characterizing the notion of probability as a cognitive limitation, the notion of probabilistic determinism does not completely rule out absolute determinism. Laplace (1814/1951) embraced the notion of probability in his deterministic system by reasoning that it portrays a human limitation in divining all causes: "Probability is relative, partly to our ignorance, partly to our knowledge" (p. 06). A similar sense was endorsed by Mill (1882/2009), when he said that "we must remember that the

probability of an event is not a quality of the event itself, but a mere name for the degree of ground which we, or someone else, have for expecting it" (p. 659). For him, a supporter of determinism,

> Every event is in itself certain, not probable; if we knew all, we should either know positively that it will happen, or positively that it will not. But its probability to us means the degree of expectation of its occurrence, which we are warranted in entertaining by our present evidence. (p. 660)

There are, therefore, formulations of "absolute" determinism that embrace the notion of probability: It is admitted that every occurrence of events is an effect of sufficient (or necessary and sufficient) causes, and failures in this inexorability are described in terms of probability. Probabilistic descriptions would be a temporary expedient because of the difficulties in identifying sufficient causes. Given this possibility, the notion of probabilistic determinism would not necessarily be an alternative to absolute determinism, but only a way to make absolute determinism compatible with the notion of probability (Laurenti, 2008).

The possibility of combination between classical determinism and probability was suggested by Skinner (1931/1999d) when he justified possible differences between S-type and R-type reflexes in terms of cognitive limitations. If, at first, every reflex relation was characterized by relations of necessity, the apparent spontaneity of the so-called operant reflex was due to the non-identification of an eliciting stimulus. Something similar is verified when Skinner (1953/2005, p. 112) stated that once all the controlling variables were detected, it would be possible to force the discriminated operant as inexorably as the eliciting stimulus does in the responding behavior.

Faced with the abandonment of sufficient causality in describing the typical regularities of operant behavior, a different interpretative route is to appeal not to other types of determinism (e.g., probabilistic determinism) but to formulations of scientific indeterminism.

Indeterminism

Indeterminism is not incompatible with science, as Earman elucidated (1986): ". . . from the many examples studied we know that denying determinism does not push us over the edge of the lawful and into the abyss of the utterly chaotic and non-lawful" (p. 243). In few words, "determinism vs. non-lawful behavior" is a "false dichotomy" (p. 243). Popper (1965/1975) highlighted this point related to physical indeterminism. If determinism states that the occurrence of all events is an instance of a deterministic causal law, the denial of this assumption (i.e., indeterminism) does not mean to claim that no event is regularly connected with another, but that at least one is not. Popper defined indeterminism as "the doctrine that *not all* events in the physical world are predetermined with absolute precision, in all their infinitesimal details" and "it is compatible with practically any degree of regularity you like, and it does not, therefore, entail the view that there are 'events without causes'" (p. 220).

Therefore, scientific indeterminism does not deny causality, but rather that all events are caused by sufficient causes. Hacking (1990/2004) argued that "the erosion of determinism is not the creation of disorder and ignorance" (p. 2). Because of this, other formulations of causality, such as probabilistic causality, are reconcilable with indeterminism, as Hitchcock (2021) points out: "Since probabilistic theories of causation require only that a cause raise the probability of its effect, these theories are compatible with indeterminism" (s.p.). If probabilistic causality is compatible with scientific indeterminism, and if probabilistic causality seems to typify operant behavior, then, Skinner's (1957, 1969) scientific system could include indeterministic formulations.

Besides rejecting sufficient causality, other elements lead to an indeterminist interpretation of the philosophical assumptions of behavior analysis. The insertion of "chance" in a scientific system is also a form of rejection of determinism. Peirce (1892) already anticipated this corollary with his critique of the doctrine of universal necessity: "It cannot, I conceive, be maintained that we are in any better position than this in regard to the presence of the element of chance or spontaneous departures from law in nature" (p. 329). Furthermore, he argued that,

> those observations which are generally adduced in favor of mechanical causation simply prove that there is an element of regularity in nature, and have no bearing whatever upon the question of whether such regularity is exact and universal, or not. (s.p.)

Thus, he rounded off the argument by saying: "Try to verify any law of nature, and you will find that the more precise your observations, the more certain they will be to show irregular departures from the law" (p. 329).

The criticism of determinism has also echoed in evolutionary biology, but not without resistance. Recurring to "chance" as an evolutionary factor was once treated as an unnecessary appeal because "the physical scientists were still deterministic in their outlook, and so indeterministic a process as natural selection was simply not acceptable to them" (Mayr, 2004, p. 111). On the other hand, it was precisely "the refutation of strict determinism and of the possibility of absolute prediction freed the way for the study of variation and of chance phenomena, so important in biology" (Mayr, p. 27). In Darwinism "chance" coexists with regularity, but this is not a retelling of the classical philosophical pairing of necessity and chance. For Mayr, at least, chance plays a role not only in the occurrence of variation, but also in selection:

> At this first step [variation], everything is chance, everything is randomness. The second step of selection is the fate of the new zygote from its formation to its successful reproduction. At this step, selection is the dominant factor even though chance still plays a considerable role. (p. 136)

The regularities that characterize the selection process are not of necessity; they are probabilistic (Mayr, 2004).

Skinner's statements about the processes of variation and selection are also compatible with indeterministic formulations that admit the possibility of novelty and random variation. As already indicated, Skinner (1968) admitted the occurrence of novelty (Skinner, 1968, p. 179), and that "it is in the nature of behavior, as it is in the nature of a genetic trait, that there are variations, and that new behavior and new genomes emerge when variations are selected by their consequences" (Skinner, 1989, p. 129). He also recognized that variations can happen by chance: "Variations are random and contingencies of selection accidental" (Skinner, 1990, p. 1207); and that "if there is freedom, it is to be found in the randomness of variations. If new forms of behavior are created, they are created by selection" (p. 1208).

The Skinnerian scientific system exhibits at least two characteristics compatible with indeterministic scientific formulations: Probabilistic causality and the insertion of chance in a scientific system. In the literature of the area, there are few indeterministic interpretations based on these elements (e.g., Moxley, 1997, 1999, 2007). According to Moxley (2007), "Skinner accepted randomness and spontaneity for here-and-now reality in his three-term contingency of antecedent conditions, behavior, and consequences," and that "in his final positions, Skinner showed no support for scientific determinism or for any other form of determinism" (p. 72). Other interpretations have also criticized deterministic views in behavior-analytic field (e.g., Begelman, 1978; Neuringer, 1991; Theophanous, 1975; Vorsteg, 1974). Thus, determinism is not necessary to do science, as Skinner claimed, because there are indeterministic sciences, including potentially behavior analysis.

Conclusion

B. F. Skinner declared that behavior is determined, thereby saying that it is a lawful datum (Skinner, 1947/1999c). This broad formulation covers the entire scientific field, as he suggested when postulating determinism as a prerequisite for doing science. Furthermore, with such a generic characterization, hardly any proposal for psychology would not be covered by the notion of determinism, and the defense of determinism in psychology or behavior analysis would not seem a necessary endeavor (cf. Dittrich, 2009; Strapasson & Dittrich, 2011). The theoretical relations presupposed by Skinner and endorsed by many behavior analysts may imply that the determinist interpretation is uncontroversial. However, determinism is not unequivocal in the philosophy of science, nor does it seem to be in Skinner's scientific system.

When modifications in the epistemological assumptions of the different behavior models (reflex, operant, and selection by consequences) are considered, Skinner's deterministic assumption does not mean the same thing throughout his work. Examining his statements about regularity and causality

within these models, indicated that distinct notions were at play, some of which are compatible with deterministic formulations in the philosophy of science and others with indeterministic ones.

Conceptions of regularity, compatible with determinism appear mainly in the reflex model when Skinner emphasized the notion of causal sufficiency to characterize the inexorability of reflex relations. Affinities with determinism also emerge when the probabilistic feature of the operant is described as a cognitive limitation of sufficient causes. On the other hand, there are statements about the probabilistic nature of the operant consistent with scientific indeterminism, such as those indicating another type of relationship between environment and responses, which is not encompassed by the typical invariability of reflex, even if implicitly. In the selection by consequences model, the notion of probabilistic regularities results from the selection (by consequences) of random variations. In this third sense, random responses, if selected, may give rise to behavioral regularities (individual repertoire) and cultural regularities (cultural practices); descriptions of regularities that are close to indeterministic conceptions in the philosophy of science.

Considering these results, is Skinner a determinist or an indeterminist? Skinner was a determinist and an indeterminist, not at the same time, of course. However, rather than stating whether Skinner is a determinist, the conceptual scrutiny of determinism brings to light issues underlying this debate, such as models of behavior and science, conceptions of regularity, laws, and causality. A discussion that was, for some time, encouraged by few behavior analysts and now deserves to be revisited, especially in a context in which several behaviorist proposals proliferated, many of them claiming an original aspect to the Skinnerian version (see, Zilio & Carrara, 2021).

Questioning the deterministic perspective brings back the debate on a classic theme. It also gives a fresh perspective to behavior analysis itself, showing that it is an epistemologically multi-layered model of scientific psychology capable of interacting with deterministic and indeterministic proposals of science. In that case, it is essential to know which path is being followed by behavior analysts (Skinnerian or not) and to speculate on the probable implications for the survival of this science.

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