Behavior and Philosophy, *27*, 97-125 (1999). © Cambridge Center for Behavioral Studies

THE TWO SKINNERS, MODERN AND POSTMODERN

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ABSTRACT: Different accounts of Skinner's work are often in conflict. Some interpretations, for example, regard Skinner as a mechanist. Other interpretations regard Skinner as a selectionist. An alternative interpretation is to see Skinner as employing both views with changes in these views and their proportionate relations over time. To clarify these distinctions, it is helpful to see Skinner's work against the background of similar changes that have been taking place in Western Culture. An extended and overlapping shift in cultural values has occurred from modernism to postmodernism. Some key distinctions in this shift are that modernism emphasizes abstract simplicity, permanent necessity, and absolutely certain sources of truth. Postmodernism emphasizes complex and concrete contexts, probability, and explanations of change in terms of consequences. Skinner shows a similarly extended and overlapping shift over time that results in separate sets of responses which may be regarded as two sides or two selves of Skinner: one an organized collection of responses aligned with modernism, another an organized collection of responses aligned with postmodernism.

Key Words: determinism, mechanism, modernism, necessitarianism, probabilism, postmodernism, selectionism, Skinner

Some interpreters of Skinner, including behavior analysts who speak favorably of his views, have presented his theory as "essentially complete by 1935" (Herrnstein, 1972/1998, p. 73). Such a judgment of any scientist's theoretical work over time may be questioned (cf. Mayr, 1991, p. 111). In Skinner's case, the assumption that his theory was essentially uniform after the 1930s is particularly dubious in that there appear to be two dramatically different ways of interpreting Skinner on this basis. On the one hand, Skinner's views from the 1930s and afterwards are presented as fundamentally necessitarian or mechanistic in the tradition of S-R psychology. This position is supported when it is claimed that Skinner's operant is based on a fundamental if-then relation of necessity (e.g., Reese, 1986, pp. 170-171) and that radical behaviorism, which Skinner authored (Day, 1980, p. 206), asserts necessitarian determinism (e.g., O'Donohue, Callaghan, & Ruckstuhl, 1998, p. 317). On the other hand, other interpreters find that Skinner abandoned necessitarian S-R psychology in the 1930s for a

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probabilistic selectionism that remained fundamentally unchanged afterwards (cf. Palmer, 1998; Wiener, 1996, p. 168).

An alternative interpretation offered here is that Skinner presented conflicting necessitarian and selectionist views during and after the 1930s and that each of these views changed over an extended period of time. Following Skinner's suggestion, to the extent that these separate views are two integrated and organized systems of responses, they may be considered as two different selves. Skinner (1947) said, "[I]t is quite clear that more than one person, in the sense of an integrated and organized system of responses, exists within one skin" (p. 39). In respect to himself, Skinner (1967/1982) said, "[*Walden Two*] is pretty obviously a venture in self-therapy, in which I was struggling to reconcile two aspects of my own behavior represented by Burris and Frazier" (p. 26). In his published work, one side of Skinner advocated positions consistent with mechanistic necessity and another side of Skinner advocated positions consistent with probabilistic selection by consequences. The mix of these responses changed over time from proportionately more, and stronger, necessitarian and mechanistic responses to proportionately more, and stronger, probabilistic and selectionist ones. The contrast and changes over time in these two sides of Skinner has a parallel in more extensive changes in Western culture at large.

Although conflicts in Skinner's views such as to suggest two Skinners have been noted (e.g., Malone, 1987), the following makes the additional case that these conflicts appear as more systematically related against the background of the modern-postmodern distinction. This may not account for all the conflicts or delineate all the selves that may be found in Skinner. However, it should make Skinner's views and the variety of their interpretations more understandable.

From Modernism to Postmodernism

From the 17th Century to the 20th Century, modernism emphasized essential natures and timeless, universal certainty with expressions in mechanistic frameworks of necessary relations (cf. Cassirer, 1936/1956; Hacking, 1987; Toulmin, 1990). Chance and uncertainty were synonyms for ignorance. Change was granted only an illusory existence within the constancy of cyclical repetitions or within a fixed world formula of determinism. The characteristics of postmodernism are less easily identified, but a consideration of extended contexts, probabilism, and explanations in terms of consequences will be proposed as illustrating some of them. These changes appear to be interrelated to at least some extent. An explanation in terms of consequences seems naturally to include probabilism and extended contexts, just as inherent simplicity, permanent necessity, and absolutely certain sources of truth seem to go together and are difficult to discuss entirely separately.

In addition, while the postmodern views were developing, the modernist views were not simply declining. Some of the strongest manifestations of modernism occurred in the 1930s: In commenting on the parallels between the origins of modernism in the 1630s and what may be considered as the culmination of modernism in the 1930s, Toulmin (1990) said,

> The parallel between the 1630s and the 1930s requires one gloss. As developed in the 1920s and the 1930s, the myth of modernity and the dream of a fresh start did not replicate the 17th-century rationalist research program perfectly; nor did they reaffirm without change the model of formal exactitude that underlay 17th-century natural philosophy. Rather, the ideas of strict "rationality" modeled on formal logic, and of a universal "method" for developing new ideas in any field of natural science, were adopted in the 1920s and 1930s with *even greater* enthusiasm, and in an *even more extreme* form, than had been the case in the mid-17th century. (p. 159)

In the 1920s and 1930s these more extreme forms were also a widespread occurrence in the arts, including the spare modernist architecture of Mies van der Rohe and the twelve-tone music of Arnold Schoenberg, as well as the geometric and streamlined styling of modern art in general. It wasn't until after this culminating burst of modernism had died down that postmodernism, long in the making, became conspicuous and now appears to be applicable to a wide range of endeavors.

From the Underlying Intrinsically Simple to Complex Contexts

For some, postmodernism means little more than *not* modernism. For example, Toulmin (1982) said,

> Our own natural science today is no longer "modern" science. Instead (to borrow a useful phrase from Frederick Ferré) it is rapidly engaged in becoming "postmodern" science: the science of the "postmodern" world of "postnationalist" politics and "postindustrial" society—the world that has not yet discovered how to define itself in terms of what it *is*, but only in terms of what it has *just-now-ceased to be*. (p. 254)

Illustrating what this means, Toulmin (1990) provided an example of such a contrast:

> The axioms of Modernity assumed that the surface complexity of nature and humanity distracts us from an underlying Order, which is intrinsically simple and permanent. By now, however, physical scientists recognized as well as anyone that natural phenomena in fact embody an "intrinsically simple" order

> only to a limited degree: novel theories of physical, biological, or social disorder (or "chaos") allow us to balance the intellectual books. We may temporarily ("for the purposes of calculation") shelve the contexts of our problems, but, eventually, their complete resolution obliges us to put these calculations back into their larger human frame, with all its concrete features and complexities. (p. 201)

An extended consideration of contexts then is one of the features of postmodernism. Such a consideration includes advancing contextual relations rather than natural essences, theory-laden rather than simple facts (or simple given elements), and interpretive judgments by qualified experts rather than a confining reliance on decontextualized mechanistic objectivity (cf. Galison, 1990, 1998; Hanson, 1955).

From Permanent Necessity to Probability

Permanent necessity. Ernst Cassirer (1936/1956) found the Laplacean world formula epitomized what has come to be called modern as opposed to postmodern thought: "[The Laplacean formula] is nothing less than the complete expression, the pregnant summary, of that world view from which sprang the great philosophical systems of the seventeenth century, the system of classical rationalism" (p. 11). That summary formula expressed an existence that was necessary and permanent:

> Given for one instant an intelligence which could comprehend all the forces by which nature is animated and the respective situation of the beings who compose it—an intelligence sufficiently vast to submit these data to analysis—it would embrace in the same formula the movement of the greatest bodies of the universe and those of the lightest atom; for it, nothing would be uncertain and the future, as the past, would be present to its eyes. (Laplace 1814/1951, p. 4)

Conceptually, this formula functioned like an indestructible movie film of indefinite length with an incredible wide-screen view and absolutely precise predictability run forward or backward. Its permanent display could be seen at a glance by a supernatural being when the film was unrolled. But human beings could only observe the film partially when it was projected on a screen. The changes observed by a human audience were strictly an illusion. Everything was already fixed and necessarily determined.

This summary can be unpacked by examining the questionable assumptions in Leibniz's anticipation of Laplace's formula:

> That everything is brought forth through an established destiny is just as certain as that three times three is nine. For destiny consists in this, that everything is interconnected as in a chain and will as infallibly happen, before it

> happens, as it infallibly happened when it happened. . . . Now each cause has its specific effect which would be produced by it, if it were alone; when it is not alone there arises out of the concurrence a definite infallible effect . . . in accordance with the measure of the forces, and this is true not only when two or ten or a thousand, but even when infinitely many things work together, as indeed actually is the case in the world. Mathematics . . . can elucidate such things very nicely, for everything in nature is, as it were, laid off (abgezirkelt) in number, measure, and weight or force. If, for example, one sphere meets another sphere in free space and if their sizes and their paths and directions before collision are known, we can then foretell and calculate how they will rebound and what course they will take after the impact. Very simple laws are followed which also apply, no matter how many spheres are taken or whether objects are taken other than spheres. From this one sees then that everything proceeds mathematically—that, is infallibly—in the whole wide world, so that if someone could have a sufficient insight into the inner parts of things, and in addition had remembrance and intelligence enough to consider all the circumstances and to take them into account, he would be a prophet and would see the future in the present as in a mirror. (Cited in Cassirer, 1936/1956, pp. 11-12)

Leibniz equates the certainty of "everything brought forth through an established destiny" with the certainty of a mathematical statement. But such an equation cannot remove uncertainty: "All of mathematics was invented. Mathematics is a language, not a set of facts about the external world" (Rapoport, 1960, p. 297). Further, "Even mathematical statements . . . have a certain penumbra of ambiguity as they are usually stated . . . certain qualifications are likely to be tacitly assumed in every statement. It would simply take too long to make a statement irreproachably unambiguous" (Rapoport, 1960, p. 292). Leibniz also assumes that mathematics portrays empirical events exactly and unequivocally. But absolutely exact measures of empirical events have never been demonstrated. The measuring instrument will inevitably prove inexact at some point.

In addition, the transition that Leibniz makes from a conceptually simplified billiard-ball type of example to "everything . . . in the whole wide world" is an enormous overgeneralization. Take the billiard-ball example itself:

> What could be more deterministic than the motion of billiard balls on a billiard table? So straightforward and predictable did such a situation once appear that the term 'billiard-ball universe' was used as a byword for the deterministic mechanical world-view of Newton. . . . Leibniz used the example of such collisions as an exemplar of determinism. However, cue games like billiards and pool exhibit that extreme sensitivity and instability highlighted by Maxwell. . . . [Our irreducible infinitesimal uncertainty concerning its initial position] is so amplified by every collision with other balls and with the edges of the table that after only fifteen such encounters our irreducible infinitesimal uncertainty concerning its initial position will have grown as large as the size of the entire table. We can predict nothing at all about the ensuing motion of the ball on the table using Newton's laws of motion.

It is curious how long it took for the significance of these simple ideas to be appreciated. (Barrow, 1994, pp. 277-278)

In addition, the behaviors that Leibniz claimed for his spheres are unlikely to be found. In the empirical world, hard things commonly fracture or crumple when they collide; and soft things stick or mix together. The consequences of empirically observed collisions are not predictable in the way that Leibniz offered.

Overgeneralization also characterized Laplace's (1814/1951) classic account of determinism. Speaking of Laplace's confidence in absolutely precise predictions by a supernatural being, von Plato (1998) said:

> The [apparent] exactness of planetary motions was of course the practical reason for such confidence. But Laplace made a giant extrapolation from astronomy to the smallest parts of nature: 'The curve described by a simple molecule of air or vapor is regulated in a manner just as certain as the planetary orbits; the only difference between them is that which comes from our ignorance.' (p. 6). (p. 164)

The overgeneralization of apparent exactness to events with little appearance of exactness was not indicated by empirical evidence, but by a wishful assumption.

James Clerk Maxwell (1882/1969) suggested that scientists and philosophers were led into such overgeneralizations by selective observations—looking at stable rather than unstable systems:

> When the state of things is such that an infinitely small variation of the present state will alter only by an infinitely small quantity the state at some future time, the condition of the system, whether at rest or in motion, is said to be stable; but when an infinitely small variation in the present state may bring about a finite difference in the state of the system in a finite time, the condition of the system is said to be unstable.
>
> It is manifest that the existence of unstable conditions renders impossible the prediction of future events, if our knowledge of the present state is only approximate, and not accurate.
>
> It has been well pointed out by Professor Balfour Steward that physical stability is the characteristic of those systems from the contemplation of which determinists draw their arguments. (p. 440)

After giving examples of stable systems, including "the larger phenomena of the Solar System" (p. 442) and unstable systems, including "the rock loosened by frost and balanced on a singular point of the mountain-side" (p. 443), Maxwell concluded:

> If, therefore, those cultivators of physical science . . . are led . . . to the study of the singularities and instabilities, rather than the continuities and stabilities of things, the promotion of natural knowledge may tend to remove that prejudice in favor of determinism which seems to arise from assuming that the

> physical science of the future is a more magnified image of that of the past. (p. 444)

Maxwell's point is a simple one. If we generalize only from examples that fit our preconception and do not examine conflicting examples, we should not be surprised if we are led to an excessive and inaccurate overgeneralization.

Although tendencies to overgeneralize are widespread, they can be adjusted for. As we progressively differentiate, overgeneralizations disappear. Children, for example, may overgeneralize and call every animal a *dog* at first just as they may overgeneralize the addition of the *-ed* past tense form and say *doed* or *dided* for *did*. But they learn to discriminate. Adults also show a tendency to overgeneralize, but they too can learn discriminations:

> Undeniably, human beings have a habit of perceiving in Nature more regularities and patterns than really exist there, and of extrapolating unjustifiably without noticing the fact. . . . During the last twenty years, however, physicists have made progress as much by overthrowing bogus laws of Nature as by discovering new ones. Many quantities which were once believed to be unchanging have been found to possess tiny variations. Traditional conservation laws have been questioned; many apparent symmetries of Nature have turned out to be merely 'almost' symmetries upon closer scrutiny. . . . Paradoxically, chance lies at the root of most of the uniformities of the world we are familiar with. . . .(Barrow, 1994, pp. 296-297; also cf. Bain, 1870, on belief, pp. 12-13, 225, 607-608)

Assumptions of chance instead of determinism have turned out to be more workable, with less encouragement of overgeneralizations, than previously imagined.

Probability. Against the early background of determinism, any acceptance of chance or probabilism faced an uphill struggle, but it eventually happened. Hacking (1987) characterized *the taming of chance* and *the erosion of determinism* as "one of the most revolutionary changes in the history of the human mind" (p. 54).

> In 1800, we are in the deterministic world so aptly characterized by Laplace. By 1936 we are firmly in a world that is ultimately indeterministic. But the former label, the taming of chance, stands for the deeper thought, because determinism was eroded precisely by making chance manageable, intelligible, existent, and governed by laws of probability. Chance, which, for Hume, was "nothing real," was, for von Neumann, perhaps the only reality. (p. 52)

Hacking goes on to offer four stages in this transformation: "1. *The avalanche of printed numbers* (1820-1840)" in which "For the first time it was possible to perceive (seeming) regularities in facts about human behavior, and to model them by probabilistic laws" (pp. 52-53); "2. *Faith in the regularity of the numbers* (1835-1875). Once the numbers were there, probability laws could be investigated" (p.

53); "3. *The autonomy of statistical law* (1875-?). . . . By the 1890s we find the first serious philosophical statement of modern indeterminism. The author was the cantankerous C. S. Peirce, and at first hardly anyone took him very seriously" (p. 53); and "4. *Possible to actual indeterminism* (1892-1936). Here, for the first time (in my opinion) physics become central to the taming of chance and to the erosion of determinism. . .we have the quantum theory evolving" (p. 53; also cf. Hacking, 1975, 1990; Gigerenzer, Swijtink, Porter, Daston, Beatty, & Kruger, 1989). On this argument, the continuing and growing development of probabilistic accounts is a distinctive characteristic of postmodernism.

Illustrating the difficulty faced by anyone who initially used *chance* with any degree of acceptance, Darwin (1859/1964) apologized for his use of the term:

> I have hitherto sometimes spoken as if the variations—so common and multiform in organic beings under domestication, and in a lesser degree in those in a state of nature—had been due to chance. This, of course, is a wholly incorrect expression, but it serves to acknowledge plainly our ignorance of the cause of each particular variation. (p. 131)

On the other hand, despite this apology, Darwin (1871/1981) used the term *chance* widely in his work and at times as an irreducible element: "I had always perceived, that rare and strongly-marked deviations of structure . . . could seldom be preserved through natural selection, and that the preservation of even highly-beneficial variations would depend to a certain extent on chance" (p. 125). If Darwin accepted chance as ignorance, it was an ignorance that he saw as pervasive and for which he offered no prospect of complete elimination. An irreducible element of ignorance allows for only probabilistic explanations, which means that explanations in evolutionary biology may be causal but only probabilistically causal (cf. Hodge, 1987). This, of course, did not eliminate claims that a determinism of preexisting laws applied to evolution as well as to everything else (e.g., Huxley, 1869/1970, p. 110).

However, instead of a universe whose underlying reality is fixed and unchanging, an evolutionary universe may be posited where even the so-called laws of the universe have evolved and are currently evolving. In "A Guess at the Riddle," Peirce (1931-1963) affirmed that "Uniformities in the modes of action of things have come about by their taking habits" (1.409; also cf. 7.512-515). Peirce's "habits" extended not only to human behavior, but to all events in the universe. In surveying alternative views of the laws of nature, Whitehead (1933/1967) suggested what an evolutionary view should be:

> Thus the modern evolutionary view of the physical universe should conceive of the laws of nature as evolving concurrently with the things constituting the

> environment. Thus the conception of the Universe as evolving subject to fixed, eternal laws regulating all behavior should be abandoned. (p. 112)

Such views are more understandable today in the light of widely accepted cosmological theories that favor an evolutionary universe on the big-bang model over a comparatively stationary universe on the steady-state model (Kragh, 1996, p. 373); and the evolution of the laws of physics is now commonly regarded as a serious hypothesis to consider (e.g., Barrow, 1991, p. 37; Kragh, 1996, p. 96; Ferris, 1997, p. 173; Sheldrake, 1995, p. 188).

Differences between a cosmology that follows a fixed design and a probabilistic cosmology include their conceivable consequences, and one of these consequences is worth mentioning. Peirce (1894/1978) saw the acceptance of probabilism in support of toleration:

> The principle of toleration is intimately connected with the fundamental principle of science, for it can have no rational basis except the acknowledgment that nothing is absolutely certain. . . . What scientific men mean by "science" is not knowledge, but *investigation*. Now the scientific man will not shut off any question whatever as too sacred or too well known for further investigation, and therefore he must tolerate every opinion. (p. 22)

For Peirce, every belief has conceivable practical consequences of one kind or another, and toleration was one of the consequences for probabilism.

From Absolutely Certain Sources of Truth to Explanations in Terms of Consequences

Absolutely certain sources of truth. Although the assumption that truth was absolutely certain and eternal has a long tradition, it was never universal in Western culture. Aristotle and Epicurus accepted a role for chance; and Protagoras and Montaigne cast doubts on necessary truth. But a shift in favor of establishing permanently certain truth became prominent in modern times. Descartes sought to proceed from absolute certainty to absolute certainty. Once an absolute truth was established with certainty—characteristically an abstract principle—it could be used to establish other truths, like a deductive syllogism. In a sense the new truth was controlled by the antecedent old truth. Because Descartes was absolutely certain that he thought, he was absolutely certain that he existed. If Descartes was absolutely certain his ideas were clear and distinct, he was absolutely certain they were true. A deductive procedure for establishing certainty after certainty was to spread downward, as it were, to empirical events. When the empirical events were reached, however, they did not always conform to the predictions. Descartes, for instance, maintained that "regardless of its speed, a moving body cannot budge a stationary body of greater size" (Losee, 1972, p. 75), an assertion which Descartes could readily have disproved by firing a single bullet to strike a loose cannonball. From the 1630s on, Toulmin (1990) found: "All the protagonists of modern philosophy promoted theory, devalued practice, and insisted equally on the need to find foundations for knowledge that were clear, distinct, and certain" (pp. 69-70). The search was on to identify and propagate absolutely certain truth.

A belief in fundamental, and controlling, absolutes was also supported in politics. In 1736, a young Frederick the Great thought that the mechanistic philosophy should be emulated by rulers:

> As an able mechanic is not satisfied with looking at the outside of a watch, but opens it, and examines its springs and wheels, so an able politician exerts himself to understand the permanent principles of courts, the engines of the politics of each prince, and the sources of future events. He leaves nothing to chance; his transcendent mind foresees the future, and from the chain of causes penetrates even the most distant ages. (Cited in Mayr, 1986, p. 108)

Even if Frederick doubted whether such an ideal political order would ever exist (Mayr, 1986, p. 108), he probably saw advantages in his subjects' compliance if they accepted his emulation of such a model. Other authorities, governmental and religious, have found similar advantages in positing absolutely certain foundations in support of their pronouncements. In Mayr's (1986) summary,

> The principal features of this authoritarian conception of order are its insistence upon control by one authority and a centralist command structure. The central authority communicates with the subordinate members of the system through rigid cause-and-effect relationships that are unidirectional and do not provide for or appreciate return signals ("back talk" in an authoritarian usage, "feedback" in modern systems technology). (p. 120)

This absence of a role for feedback or consequences characterized classical mechanistic accounts; and authoritarian conceptions of order advanced antecedent sources of control in necessary, one-way relations or a series of such relations.

Religious institutions have long found appeals to unchanging antecedent sources attractive, and this attraction extends into the present. In *The New York Times* for October 16, 1998, Stanley (1998) reported on the 13th encyclical of Pope John Paul II, "Faith and Reason," accompanied by excerpts like the following:

> It is the nature of the human being to seek the truth. This search looks not only to the attainment of truths which are partial, empirical or scientific; nor is it only in individual acts of decision making that people seek the true good. Their search looks towards an ulterior truth which would explain the meaning of life.

> And it is therefore a search which can reach its end only in reaching the absolute. Thanks to the inherent capacities of thought, man is able to encounter and recognize a truth of this kind. Such a truth—vital and necessary as it is for life—is attained not only by way of reason but also through trusting acquiescence to other persons who can guarantee the authenticity and certainty of the truth itself. (p. A10)

The key claim here is that absolute truth can be reached "through trusting acquiescence to other persons who can guarantee the authenticity and certainty of the truth itself." Given widespread and longstanding doubts that absolute truth will ever be demonstrated, it is unlikely that many people will find they have discovered absolute truth through reason. The only remaining avenue to absolute truth then is trust in those who claim to guarantee it. One reason why the claims are to absolute truth is shown in a follow-up article in *The New York Times*, October 17, 1998, by Niebuhr (1998):

> "When philosophy is saying all truth claims are relative," Father Shanley said, then the challenge the church faces is that it becomes more difficult to teach that all believers should be bound by the decisions of church councils that took place in past centuries in Europe. (p. A4)

A statement is more likely to go unquestioned when people believe it is an absolutely necessary truth for all time. Administratively, absolute truth has at least short-term conveniences.

Explanations of change in terms of consequences. Accounts of self-regulation and change in terms of feedback systems have also been explicitly linked to postmodernism (Galison, 1994, pp. 258-259). Although feedback mechanisms have been in existence at least since the first half of the third century BC during the Hellenistic period (Mayr, 1970, p. 12), they did not serve as models for mechanistic accounts, and their conceptual explanation in terms of consequences was not widely applied to other areas of investigation until after James Watt's invention of the centrifugal governor in 1788. After that, Adam Smith, who knew Watt and visited his workshop, may have been influenced by this feedback mechanism in his economic theory of self-regulation (cf. Smith, 1776/1986, pp. 182-183).

Some evidence of the influences of Adam Smith and the concept of self-regulation may be seen in the papers submitted to the Linnaean Society in 1858 for establishing the codiscovery of natural selection by Darwin and Wallace (Barrett, 1977/1980, p. 3). Employing terms such as *profitable* and *economy*, Darwin (Barrett, 1977/1980) said, "I cannot doubt that during millions of generations individuals of a species will be occasionally born with some slight variation, profitable to some part of their economy (p. 9)." Although Darwin did not make a specific reference to man-made feedback devices, Wallace (Barrett, 1977/1980) did:

> We have also here an acting cause to account for that balance so often observed in nature—a deficiency in one set of organs always being compensated by an increased development of some others—powerful wings accompanying weak feet, or great velocity making up for the absence of defensive weapons; for it has been shown that all varieties in which an unbalanced deficiency occurred could not long continue their existence. The action of this principle is exactly like that of the centrifugal governor of the steam engine, which checks and corrects any irregularities almost before they become evident. . .(p. 18)

An account of the self-regulation of the steam engine governor is strikingly different from an account of a machine operating in a unidirectional sequence (cf. Bunge, 1979, pp. 154-156). One difference is that the steam engine governor adjusts for random variations that could destroy a unidirectional machine or render it ineffective. In addition, a consideration of amplifying (positive) feedback, in contrast to counteramplifying (negative) feedback, shows how large effects may readily follow from a selective accumulation of small differences (cf. Hanski, Pöyry, Pakkala & Kuussaari, 1995).

The feedback formulation is appropriately shown as a three-term contingency. For example, Bunge (1979, p. 154) shows a triangular graphic for the feedback loop that uses *input*, *output*, and *control* (in place of the term *feedback*) for the three terms. This three-term contingency is similar to Darwin's *conditions of life*, *variation*, and *selection*. It also resembles Skinner's three term-contingency of *setting*, *behavior*, and *consequences*. In all of these formulas, the relation between the first two terms is because of the third term, an AB-because-of-C relation. This appears to be the basic formulation for explaining change in terms of consequences.

The logic of feedback devices differs from the strict if-then, cause and effect analysis of mechanistic connections in other ways. In the logic of paired mechanistic connections, the effect is inevitable and final once its cause occurs (either in a single paired connection or a multiple series of paired connections); and it is often said that the effect is in the cause. In the logic of feedback devices, an effect continues so as to operate on a subsequent cause (which may be considered as being in the same class as the earlier cause). As Mayr (1986) put it for counter-amplifying (or negative) feedback, "The system is self-regulating because an effect automatically counteracts its own cause" (p. 177). For amplifying (or positive) feedback, the effect would enhance its cause. Explanations of change in terms of consequences to explain stable, self-regulating systems as well as unstable, amplifying systems are now widespread and commonplace.

Feedback theory and practice became particularly prominent and conspicuous in the twentieth century after the end of the Second World War:

> Practical control engineering made great progress during the Second World War, when each belligerent made efforts to gain superiority in this field. When after the war the secrecy was lifted, there suddenly became available (1) a mature technology of automatic control which had proven itself in dealing with the problems of radar, fire control, autopilots, guided missiles, and so on; (2) a theory that was universal and easy to manipulate; and (3) a staff of scientists and engineers who quickly spread this new knowledge, thus introducing the era of automation and cybernetics. (Mayr, 1970, 132)

It may be of interest to note that cybernetic devices using control by consequences to guide a missile to its target can achieve far more accuracy over a long distance than any antecedent control for firing a gun at a target over a similar distance.

The Early Conflict Between the Two Skinners

In the same early article that Skinner affirmed the importance of necessity in the reflex, Skinner (1931/1972) also supported a descriptive, pragmatic view in saying that "explanation is reduced to description and the notion of function substituted for that of causation" (p. 449). This reflected a Machian pragmatism that was in conflict with mechanistic necessity. Ernst Mach (1960), whom Skinner (1989, p. 122) credited as a source for his theoretical position in *The Behavior of Organisms*, saw an implacable conflict between the descriptive view he was advocating and the mechanistic tradition: "Purely mechanical phenomena do not exist . . . The mechanical theory of nature [may] for a time, have been of much value. But, upon the whole, it is an artificial conception" (p. 597). Mach faulted mechanistic cause and effect (pp. 580-581) and regarded Laplace's determinism as "a *mechanical mythology* in contrast to the *animistic* of the old religions. Both views contain undue and fantastical exaggerations of an incomplete perception" (p. 559). Skinner's pursuit of Machian functional description was at odds then with a mechanistic reflexology. In stating his early position, however, Skinner showed no awareness of a conflict, but Scharff (1982) noted it, saying "On the one hand, the study of behavior was to be entirely descriptive; on the other hand, it would supposedly retain the right to speak of necessary relations" (p. 47). If the relations in the contingencies of behavior are to be descriptive and if there is to be a consistent pursuit of functional description, the relations cannot be assumed a priori to be relations of necessity.

The Modern Skinner

From his early years, Skinner was prepared to follow the modernist necessitarian tradition of explanation. Skinner (1979) said, "I have always believed in some kind of determinism. I was very much a Presbyterian until late puberty, when I became an agnostic, and Presbyterians believe in predestination" (p. 47); and Skinner (1983/1984) said his belief in predestination carried over to his scientific career, "Much of my scientific position seems to have begun as Presbyterian theology, not too far removed from the congregational of Jonathan Edwards" (p. 403). When Skinner began his scientific career, he was well prepared for accepting a tradition of determinism that had been established in virtually every area of scientific endeavor, including the life sciences. Reflecting a strong continental tradition, Claude Bernard (1878/1974) claimed a rigorous determinism was being established in physiology: "it cannot be denied that present-day physiology follows a course which establishes more and more the rigorous determinism of the phenomena of life. It can be said that there is no longer any divergence among physiologists on this subject" (p. 42). Jacques Loeb brought the mechanistic ideal in physiology to the United States in 1891 and taught at the University of Chicago (Boakes, 1984, p. 145). "In my own work," said Loeb (1912/1964), "I have aimed to trace the complex reactions of animals back to simpler reactions like those of plants and finally to physico-chemical laws" (p. 58). For Loeb (1912/1964), prediction and control meant demonstrating "the force which unequivocally determines" and "discovering the laws according to which these forces act" (p. 36). The fundamental relation in such laws was necessity. For Pavlov (1927/1960), the reflex was a genuine scientific concept because it entailed necessity: "Our starting point has been Descartes' idea of the nervous reflex. This is a genuine scientific conception, since it implies necessity" (p. 7). Implying a similar underlying necessity, John Watson (1930/1970), one of Loeb's students at the University of Chicago, claimed that "the behaviorist is a strict determinist" (p. 183), and Skinner (1983/1984) said he was "a disciple of Watson" (p. 191).

Early in his professional writing, Skinner (1931/1972) affirmed his acceptance of a reflexological framework in which the cause and effect pattern of the reflex (if the stimulus, then the response) gave preeminent status to the antecedent causal stimulus: "The stimulus is an essential part of a mechanistic theory of behavior, whether the notion is arrived at through observation . . . or argued from physical necessity or mechanical analogy, as it was with Descartes" (p. 434). Skinner stressed the relation was one of necessity, "The reflex is important in the description of behavior because it is by definition a statement of the necessity of this relation [between behavior and its stimulus]" (p. 449). In addition, Skinner (1989, p. 122) credited the mechanist Loeb, as well as Mach, for his (Skinner's) theoretical position in *The Behavior of Organisms* (1938) along with crediting his work in the laboratories of W. J. Crozier, his dissertation supervisor and a disciple of Loeb (cf. Pauly, 1987, pp. 183-184).

Against this background, we can see why Skinner (1932; also see 1953, p. 112) saw little difficulty if observed functional descriptions appeared inconsistent with theoretical necessity:

> The inevitability of any reflex, the necessity of the relationships of any stimulus and response, rests ultimately upon observation: a response is observed to follow the administration of a stimulus and to be absent otherwise. But no reflex shows an absolute necessity of this sort. For example, the necessity is lacking during the absolute refractory phase and after complete fatigue. Necessity, moreover, implies a constant ratio of the values of stimulus and response, which is, nevertheless, seldom observed. No one will be likely to urge these exceptions against the validity of a reflex, for the conditions under which they are observed are almost always induced experimentally, with the result that the experimenter is provided with some means of accounting for an effect even before he has observed it. But such an appeal to a third variable (to a condition of the experiment, for example) will be fully satisfying only if the effect can be shown to be an exact function of the variable, and we ordinarily attempt to secure this satisfaction by demonstrating the nature of the function—for example, by discovering the "curve" for the refractory phase or for reflex fatigue. (p. 32)

Although no reflex shows absolute necessity, necessity can be posited when "the effect can be shown to be an exact function of" the third variable. When the relation of the third variable fails to show an exact function, this is presumably accounted for by further obscuring variables and so on indefinitely. Necessity rests upon suppositions that cannot be disproved by any experiment.

In the following, Skinner's modernist position will be characterized as necessitarian. Necessitarianism is broadly intended to capture the elements of decontextualized abstractions, permanent necessity, and antecedent sources of certainty in the modernist tradition. But it is also meant to indicate the central element of Skinner's modernism.

Necessity in Global Patterns

Skinner advanced global necessity well after the 1930s. He advanced the realization of a deterministic cosmogony through Frazier in Walden Two (1948/1962); a Laplacean-like determinism in 1947; and an S-R (or S-O-R) paradigm for organisms in general in 1956/1972. Skinner subsequently replaced or abandoned all of these positions even if all elements of necessitarianism did not completely disappear from all of his views.

The Design of Walden Two. Frazier created Walden Two as a relatively fixed design with features that would resist changes in that design. Frazier (Skinner, 1948/1962) explicitly characterized his design as having more to do with the Christian cosmogony of an omniscient God, who designed the universe as a whole, than with the unplanned universe of evolutionary theory:

> [T]here's no doubt whatever that Walden Two was planned in advance pretty much as it turned out to be. In many ways the actual creation of Walden Two was closer to the spirit of Christian cosmogony than the evolution of the world according to modern science. (p. 299)

As the designer of Walden Two, Frazier's role in analogy with Christian cosmogony was like that of a deity, a role Frazier deliberately cultivated on occasions when he imagined and behaved as though he were Christ. Similarly, as a perfectly designed universe would presumably run by itself, Frazier said in reference to Walden II, "Set it up right, and it will run by itself" (p. 234); and the active involvement of Frazier was no longer needed in running Walden Two. All the emphasis here is on the antecedents, on the plan that would produce the results. Such a formulation is an if-then, cause and effect alignment with an enlarged stimulus (the design of Walden Two) and response (the Walden Two activities). A similar formulation is found in creationist argument-from-design teleology. (To avoid any confusion, it should perhaps be noted that teleology, or explanations in terms of final causes, may occur in more than one sense: Darwin, 1859/1964, p. 439, opposed *final cause* in the sense of argument-from-design teleology, but Darwin, 1859/1964, p. 448, also favored *final cause* in the sense of Aristotelian means-end teleology.)

The link between Skinner's Walden Two design and his modernist views also bears some resemblance to the link between Bauhaus architecture and modernist philosophical views. Galison (1990) found that "The notion that technical innovation could alter the form of life lay deep in the political ideology of left-liberal modernism, especially in architecture" (p. 716), and Galison drew strong analogies between the philosophy of Wittgenstein's *Tractatus Logico-Philosophicus* (1922/1981) and Wittgenstein's architectural designs for the Wittgenstein house. Wittgenstein's philosophy of the *Tractatus* is not the same as Skinner's psychology of *Walden Two*, but both pursued an architectural engineering of simple, functional utility according to modernist values if not exactly the same modernist values.

Later, Skinner (1990a) rejected the idea that a world or culture could be planned ahead as he had suggested in *Walden Two*:

> A planned world was one of the casualties of evolutionary theory, and the belief that a life or a culture has evolved according to a plan is suffering the same fate. Too much of what will happen depends upon unforeseen variations and adventitious contingencies of selection. The future is largely a matter of chance... (p. 197)

Instead of relying on a predetermined design as a whole, Skinner now thought it was possible to improve practices in piecemeal ways. Skinner (1971) said, "Perhaps we cannot now design a successful culture as a whole, but we can design better practices in a piecemeal fashion" (p. 156), thereby suggesting the advantage of a more gradual evolution of a culture over time, with responsiveness to the consequences of changes, rather than designing a culture as a whole.

The 1947 Use of Necessity in Prediction. Skinner's most extreme statements in respect to the consequences of determinism occurred in 1947-1948 and not only through the role of Frazier. Skinner (1947) said, "[W]e 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. 299). Completely determined means strictly determined, and Skinner said that he looked forward to a time when theory would account for "the behavior of an individual in such a way that measurement would be feasible if he were the only individual on earth. This would be done by determining the values of certain constants in equations describing his behavior" (p. 39). Skinner approvingly anticipates the realization of a Laplacean-like determinism.

However, in his later years, Skinner (1990a, 1990b; also cf. Trudeau, 1990) placed the ultimate foundations for behavior in random variations. Skinner (Trudeau, 1990) said, "The origin of human behavior, like the origin of species, has got to be interpreted in terms of randomness and accident" (p. 2). In discussing the different kinds of variation and selection in natural selection, operant conditioning, and cultural evolution, Skinner (1990b) said the "variations are random and contingencies of selection accidental" (p. 1207). Determinism no longer has a foundational role in Skinner's selectionist behavior analysis.

The 1956 Use of Necessity in S-O-R Relations. Discussing the behaviors of organisms in general, Skinner (1956/1972) referred to what was in effect a comprehensive S-O-R diagram:

> Our organism emits the behavior we are to account for, as our dependent variable, at the right. To explain this, we appeal to certain external, generally

> observable, and possibly controllable hereditary and environmental conditions, as indicated at the left. These are the independent variables of which behavior is to be expressed as a function. Both input [stimuli] and output [responses] of such a system may be treated with the accepted dimensional systems of physics and biology. (p. 261)

This is a system of S-Rs with emitted behavior but no role for consequences. Skinner continued, “A complete set of such relations would permit us to predict and, insofar as the independent variables are under our control, to modify or generate behavior at will” (p. 261). This claim approaches the predictive power of world formula determinism. Skinner even suggested some retrodiction: “It would also permit us to interpret given instances of behavior by inferring plausible variables of which we lack direct information” (p. 261). Skinner’s final abandonment of necessitarian determinism as foundational for his behavior analysis came late (Moxley, 1997, 1998).

Necessity at Local Levels

Necessity to fill gaps. In the mechanistic tradition of the modernist approach, gaps in an account were abhorrent. Newton (1934) put it forcefully when he criticized action at a distance:

> That gravity should be innate, inherent, and essential to matter, so that one body may act upon another at a distance through a vacuum, without the mediation of any thing else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity, that I believe no man, who has in philosophical matters a competent faculty of thinking, can ever fall into. (p. 634)

Consistent with that view, Newton proposed a search for an intervening variable, an ethereal medium call the *ether*.

Similarly, for a time, Skinner claimed the existence of intervening variables such as the reflex reserve to fill what he thought would otherwise be gaps in his accounts. Eventually he abandoned this practice. In addition, Skinner originally would not tolerate any gaps, or delay, between behavior and its reinforcing consequences. But later, Skinner (1988) indicated there was always some delay in reinforcement for verbal behavior, “Verbal behavior is defined as behavior reinforced by the actions of listeners (or viewers), and the reinforcement is always slightly delayed” (p. 467). A delay between verbal behavior and its reinforcing consequences was not only permitted by Skinner, it was required. This also brought Skinner closer to Darwin. As Skinner (1989) noted, natural selection does not require contiguity between variation and selection "because the survival of the species is necessarily a deferred consequence" (p. 29).

Necessity in Educational Applications. In some of his educational recommendations, Skinner appeared to feel justified in making deductions from established principles to practice. A deduction involves an if-then relation of necessity in a one-way direction like cause and effect or stimulus and response. Skinner maintained such a deduction from principles against claims that this could not be done in education. For example, In *Talks to Teachers on Psychology*, William James (1899/1983) had said, "You make a great, a very great mistake, if you think that psychology, being the science of the mind's laws, is something from which you can deduce definite programs and schemes and methods of instruction for immediate schoolroom use" (p. 15). Skinner (1968) contradicted James and claimed that "the so-called experimental analysis of behavior has produced if not an art at least a technology of teaching from which one can indeed 'deduce programs and schemes and methods of instruction'" (p. 59). Deductions introduce logical necessity in if-then relations from assumptions. Skinner (1986, p. 106) saw programmed instruction as a product of such deduction. When American education failed to do much with the programmed instruction that he had advanced, Skinner (1987, p. 114) offered the "time lag" explanation between scientific discovery and technological application.

The time lag is the presumed gap between a scientific discovery and a technological derivation from that discovery. This gap is assumed to exist because technology is assumed to depend on science to discover what technology later applies. Skinner (1983/1984) had no difficulty in accepting the origins of science in technology: "Mach's *Science of Mechanics* naturally appealed to me by showing that science arose from craftsmanship" (p. 407). But Skinner seemed to accept a total reversal of roles once science arose. Skinner was not alone among the scientists of his day in assuming that technology depended upon science in a one-way direction (cf. De Sitter, 1932, pp. 136-137). However, it is more accurate to say that science derives knowledge from technology, and technology derives applications from science in an on-going two-way interaction (cf. Moxley, 1989). Over time, science has become more technology-like and technology has become more science-like; but it is difficult to find examples in which a technological application is a simple, direct derivation from a scientific discovery. Both technology and science make discoveries, and the discoveries are commonly advanced with each other's help. A two-way interaction between science and technology is the rule rather than the exception. Darwin's theory of natural selection was indebted to the sciences of geology and paleontology; but Darwin's account was also indebted to technological influences in the artificial selection of domesticated animals. In addition, the concept of self-regulation exemplified in the steam-engine governor, as we have seen, also seems to have played a role in the theory of natural selection jointly published by Darwin and Wallace.

Belief in the one-way dependency of technology upon science, however, supported Skinner's claim that effective educational applications can be a direct deduction from principles discovered by the laboratory scientist. In contrast to his laboratory work, Skinner did not publish data on his work with teaching machines and programmed instruction. Rather, he argued for the acceptance of programmed instruction largely on the basis that it deductively applied principles derived from the experimental analysis of behavior. In addition, Skinner's programmed instruction gave more prominence to stimulus control than to consequences.

This is not the only direction an applied behavior analysis can take. In contrast to Skinner's programmed instruction, Ogden Lindsley's precision teaching placed proportionately more emphasis on consequences in graphing responses. A mark on a graph is a consequence of a performance. Lindsley (1996) also pointed out the influence of applications on theory, illustrating the ongoing two-way relationship between science and technology.

> The myth that only laboratories can discover basic variables is not true. It is true that only the laboratories can *isolate* variables, but basic variables and procedures are often discovered in application. Fluency (Haughton, 1972; Starlin, 1970) and its products were discovered in application of the free operant in precision teaching [classrooms]. The Brelands [discovered] "targeting" with a target stick in shaping their show animals. (p. 219)

These points stand in opposition to the assumption that the relation between science and technology is a one-way deduction from science.

The Postmodern Skinner

Skinner's awareness of feedback systems, natural selection, and Peircean philosophy may all have had some influence in his development of his three-term contingency explanation in terms of consequences. Skinner (1981) allowed that some machines may show selection by consequences in saying, "Selection by consequences is a causal mode found only in living things, or in machines made by living things" (p. 501). Skinner (1953) also recognized: "The importance of feedback is clear. The organism must be stimulated by the consequences of its behavior if conditioning is to take place" (p. 67). Skinner, however, did not want the counteramplifying function of feedback in missile guidance to be equated with the way reinforcement increases probability (e.g., 1974, p. 56; 1983/1984, p. 129; 1988, p. 108).

Skinner's foremost appeal for explanations in terms of consequences, however, was to Darwin's natural selection, which employed three terms—the conditions of life, variation, and selection as key interrelated concepts throughout *The Origin of Species*. This was not far from Skinner's eventual formulation of setting, behavior, and consequences for his three-term contingency, and the term *selectionist* has been used to characterize both formulations. Skinner often referred to the analogies between Darwin's natural selection and operant behavior; and his reading of Darwin may have influenced the development of his later formulation of operant behavior. When Skinner replaced *discriminative stimulus* with *setting* in his three-term contingency, he brought the first term in that contingency much closer to Darwin's *conditions of life*.

Of other possible sources for a postmodern influence on Skinner, the most intriguing one is C. S. Peirce. There were several occasions on which Skinner could have been influenced by Peirce, if not directly then through the presentation of Peirce's views by others who were familiar with them. Skinner (1979/1984) mentioned his growing library, apparently by the late 1920s, included "*Chance, Love and Logic* by C. S. Peirce (recommended by Crozier for the chapter called 'Man's Glassy Essence')" (p. 41). This book also contained the essay, "How to Make Our Ideas Clear," which presented an early formulation of pragmatism. In addition, Skinner (e.g., 1979/1984, pp. 92, 151, 213, 281) had discussions with the pragmatist Quine, read *The Meaning of Meaning* by Ogden and Richards (1923/1989) in the early 1930s, and had a series of discussions with Richards. *The Meaning of Meaning* referred to pragmatism, expressed pragmatic views in a favorable way, and included selections from Peirce in Appendix D. Skinner (e.g., 1969, p. 170; 1979; 1979/1984, p. 41) only occasionally referred to Peirce, but Skinner (1979) found a high degree of similarity between Peirce's account of pragmatism and operant analysis:

> The totality of an idea or concept is the totality of its consequences or effects. The method of [Peirce] was to consider all the effects a concept might conceivably have on practical matters. The whole of our conception of an object or event is our conception of effects. That is very close, I think, to an operant analysis of the way in which we respond to stimuli. . . .[Peirce] was talking about knowledge shaped by consequences. That is, I think, the position we have arrived at experimentally; [Peirce] came to it from philosophical speculation. (p. 48)

Skinner was mistaken, however, if he thought that Peirce, who was employed as a scientist, did not have a strong scientific background. Skinner's accurate rendering of Peirce's position, including Peirce's pragmatic maxim to consider "all the effects a concept might conceivably have on practical matters," suggests Skinner may have given a careful reading to at least a portion of Peirce's essay "How to Make Our Ideas Clear."

The Three-term Contingency

In respect to his three-term contingency, Skinner moved from a dyadic configuration of terms, the configuration of choice for indicating necessary relations, to a triadic formulation and probabilistic relations. The new triadic formulation also shifted the explanation of a response from the antecedent stimulus in an S-R account to the consequence in an AB-because of-C account (the relation between antecedent conditions and behavior is because of consequences). He also replaced *discriminative stimulus* with *setting* as the first key term in his three-term contingency. Skinner's moves to include a much more complete context, probability, and an explanation in terms of consequences reveal key features of postmodernism.

From a dyadic to a triadic framework. In his early work, Skinner was at best considering an alternative three-term formulation for operant behavior while predominately presenting a four-term formulation of S-Rs (a pair of S-Rs). In "Two Types of Conditioned Reflex and a Pseudo-type," Skinner (1935/1972), presented Type I behavior, which would later (1937/1972) be called operant behavior, primarily as a pairing of S-R units in a linear chain of "S_0—R_0→S_1—R_1" (p. 479). However, on the next page, Skinner also presented Type I in the form of a three-term contingency: "S_0→R_0→S_1" (p. 480). In "A Reply to Konorski and Miller," where Skinner made the operant-respondent distinction for the first time, Skinner (1937/1972) referred to a two-term reflex for the operant, "the operant *(s—R)*" (p. 494) as well as to a three-term contingency diagram for the operant: "*s—flexion→food*" (p. 494). Presentations of alternative numbers of terms continued into *The Behavior of Organisms*, where Skinner (1938) primarily presents another paring of S-R's for the operant: "$s.R^0$→$S^1.R^1$" (p. 65) although he articulated a somewhat buried three-term contingency elsewhere: "Three terms must therefore be considered: a prior discriminative (S^D), the response (R^0), and the reinforcing stimulus (S^1). Their relation may be stated as follows: only in the presence of (S^D) is (R^0) followed by (S^1)" (p. 178). Skinner is undecided about the number of terms to use in portraying operant behavior. Only after the 1930s is it possible to see that Skinner definitely decided on three terms.

From necessary to probabilistic relations. Skinner (1938) also claimed the relations in the operant were "mechanical necessities of reinforcement" (p. 178);

and it is only after the 1930s that it is possible to clearly see that Skinner has decided in favor of probabilistic relations. Later, Skinner (e.g. 1969) described the three-term relations as “the contingencies of reinforcement” (p. 23). The shift from “necessities” to “contingencies” is revealing in that a certain and invariable *necessity* has historically been contrasted with a less than certain *contingency* (cf. Edwards, 1754/1982, pp. 15-23; Priestly, 1777/1977, pp. 7-19; Spinoza, 1677/1982, p. 51) although *contingency* is also used, as I have used it, to embrace both necessity and probability.

Emphasizing his break with the necessary relations of S-R psychology, Skinner (1966) distinguished the probability in an experimental analysis of behavior from the inexorable force in stimulus-response psychologies:

> The task of an experimental analysis is to discover all the variables of which probability of response is a function. . . . The position of an experimental analysis differs from that of traditional stimulus-response psychologies or conditioned reflex formulations in which the stimulus retains the character of an inexorable force. (p. 214)

An *inexorable force* reflected a necessity that Skinner replaced with probability. Control for Skinner (1973) no longer meant an assumed force or necessity but an observed change in probability: “Human behavior is controlled . . . by changing the environmental conditions of which it is a function. The control is probabilistic. The organism is not forced to behave in a given way; it is simply made more likely to do so” (p. 259). A probability relation—expressed as rate or frequency of occurrence of a response—was prominent in the operant and unlike the “determined” relation in the reflex:

> Rate of responding . . . could be said to show the probability that a response would be made at a given time. Nothing of the sort could be said of a reflex, where the stimulus determined whether or not a response was made. Probability simply did not fit the stimulus-response pattern. (Skinner, 1989, p. 124)

Probability was inherent in operant relations and in sharp contrast to the necessary relations inherent in stimulus-response formulations.

From discriminative stimulus to the setting. Further, although Skinner considered the relevance of some additional variables, such as the lever, for his operant unit in the 1930s, it would be misleading to construe them as equivalent to the variety of variables and relations that Skinner later identified for *Verbal Behavior* (1957) and for the complex collections of variables and their relations that he subsequently identified in the settings for human behavior. In addition, it was impossible in the 1930s to foresee the way Skinner would pursue an expansion of relevant antecedent variables.

For example, Sidman (1986, pp. 216-217) offered an expansion of contextual contingencies for reinforcement in terms of necessary relations. The use of necessary relations was consistent with Skinner's (1938) early description of operant behavior in terms of "the mechanical necessities of reinforcement" (p. 178). Sidman began with a response-consequence (R-C) relation of necessity as the fundamental relation in reinforcement: if the response, then the consequence. Sidman proposed that contextual variables should be considered as further relations of necessity that were added to this fundamental relation (if R1 then C1) in a nesting fashion: e.g., if S1 then (R1-C1), if S2 then (S1-(R1-C1)), if S3 then (S2 (S1-(R1-C1))) etc., giving three-term, four-term, five-term . . . and presumably N-term contingencies. In this contextual expansion, the additional contextual variables are additional discriminations in necessary relations.

Although this method expands the context of discriminations, it is far different from the expansion that Skinner pursued after the 1930s. In addition to introducing probabilistic relations, Skinner (1984/1988, p. 471; 1987, p. 201) expressed dissatisfaction with the single-variable term *discriminative stimulus* as the first term in his three-term contingency and replaced it with the *setting*, a term for including multiple variables (e.g., 1973, p. 257-258; 1984/1988, pp. 215 & 265; 1989, pp. 10, 13, 62-63, & 126; also cf. its use by Skinner in his interview with Segal, February 1988). In an extended sense, the setting could include relevant discriminations and any other relevant class of antecedent variables, such as establishing operations and variables of history and heredity.

The changes that Skinner made in his operant behavior (after it was originally presented in the 1930s) put the operant firmly in a probabilistic, selectionist orientation. Skinner's *setting*, *behavior*, and *consequences* were now much closer conceptually to Darwin's natural selection and Darwin's key terms of *conditions of life*, *variation*, and *selection*. Skinner's formulation was also closer to Peirce's (2.86) AB-because-of-C formulation for selectionism; e.g., the relation between the environment (A) and the animals adapted to it (B) is because of consequences (C) for previous AB relations (see Moxley, 1996). With his probabilistically developed three-term contingency, Skinner has implicitly refuted all claims of necessity: no claim of necessity can be more than probabilistic because all such claims are verbal behavior analyzable in terms of operant behavior, which is inherently probabilistic. The sweeping priority of probabilistic relations is also evident in Skinner's (1989) insistence, "The contingencies always come first" (p. 44); and these contingencies are probabilistic. Skinner highlighted his postmodern position in an epilogue to *Verbal Behavior* (1957): "A science of verbal behavior probably makes no provision for truth or certainty (though we cannot even be certain of the truth of that)" (p.

456), and Skinner (1983/1984) cautioned against accepting any truth as permanent: "Regard no practice as immutable. Change and be ready to change again. Accept no eternal verity. Experiment" (p. 346).

Conclusion

The cultural shift, or change in tendencies, from modernism to postmodernism has occurred more or less strongly in different areas, and this shift has occurred not only between authors at different times, but also within authors such as Wittgenstein and Skinner. The changes in Wittgenstein's views are easily noted because they can be seen in two prominently contrasting publications, Wittgenstein's *Tractatus Logico-Philosophicus* (1922/1981) and *Philosophical Investigations* (1953). The changes in an author such as Skinner are less easily noted because they are not sharply separated into two distinct periods of time. Skinner's modern and postmodern views overlap considerably, just as the historical developments of modernism and postmodernism overlap considerably, but the overall trend in Skinner's views is clearly postmodern just as the historical trend is postmodern. Skinner (1978, p. 119) said it had taken him a long time to get rid of the control from contingencies favoring S-R responses. These were the contingencies his modernist self responded to, and these responses continued to appear well after the 1930s. Skinner, the modernist, commonly had his say. But it was Skinner, the postmodernist, who increasingly said more of what was new and significant in Skinner's behaviorism.

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