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Representing Personal Determinants in Causal Structures

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The present commentary addresses the substantive issues raised by Staddon's (1984) alternative models of causality. Staddon presented an expanded behavioristic model of causation. In his model, behavior is portrayed as under the dual control of current external stimuli and past stimulus inputs. The major question at issue is not the formalizability of causal processes, but whether cognitive determinants of behavior are reducible to past stimulus inputs in causal structures. Evidence indicates that the residuum of past stimuli cannot serve as an adequate proxy for cognitive processes, which largely involve propositional knowledge and cognitive operations on what one knows.

Staddon (1984) is displeased with what he alleges to be my formalization of causal structures. The article in the *American Psychologist,* to which he refers (Bandura, 1978), was not devoted to formal modeling of different patterns of causation. Rather, it centered on the properties and functions of self-regulation by means of internal standards and on how such a self-system is both product and producer of influences. Acknowledging at the outset that the self-system is embedded in a network of reciprocal causation, the article briefly described three alternative conceptions of interaction—among behavior, cognitive and other personal factors, and environmental factors—that have been proposed at one time or another. In two of these conceptions, influences relating to behavior flow in only one direction. They depict behavior as the by-product of a person–situation interaction, but behavior itself is not an interacting determinant in the transaction. In the conception of triadic reciprocity, the three sets of factors all operate interactively as determinants of each other.[1]

In triadic reciprocal causation, the mutual influences and their effects do not occur at the same instant in the likeness of a simultaneous holistic interaction (Bandura, 1983). They work their mutual effects sequentially over variable courses of time. Nor does reciprocality mean symmetry in the strength of bidirectional influences. Staddon is incorrect when he states that triadic reciprocity is a combination of the other two models, in which influences flow only unidirectionally from person and environment to behavior. There is no way one can merge the two models, each of which includes only one-way causation with regard to behavior, and come up with a model in which behavior is involved in two-way causation (Figure 1). The first two models may be considered special cases of the third.

Staddon would have readers believe that I oppose formalism. I not only hold no such view, but I have difficulty imagining why anyone would be against formal articulation of conceptual models. Given adequate theoretical specification of determinants and the processes by which they produce their effects, obviously formal models can be fruitfully used to represent and test causal processes. One can point to formalizations based on deficient theoretical specifications of determinants or on inadequate measures of them that have not added to our understanding. But that is the fault of theory, not formalism. Equations cannot rescue deficient theory.

In the article to which Staddon refers (Bandura, 1978), I question whether self-regulation of behavior through self-reactive influence can be reduced to reflexive mechanics in which feedback signals are compared to a criterion and, if incongruity exists, the organism is automatically redirected on the correct path. Thought often overrides the effects of immediate feedback, and how events are construed even affects whether the self-reactive system will become engaged in a particular endeavor. These higher control functions are usually

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[1] The article under discussion includes a schematization of the relations between the three classes of determinants in triadic reciprocal causation. A formal predictive model was not presented because that was not the purpose of the article. The composite figure also includes Lewin's (1936) frequently discussed representation of the sources of behavior, $B = f(P, E)$, as an alternative model of causation. This "equation," which Staddon finds wanting, was never proposed by Lewin as the formalization of his conceptual scheme.

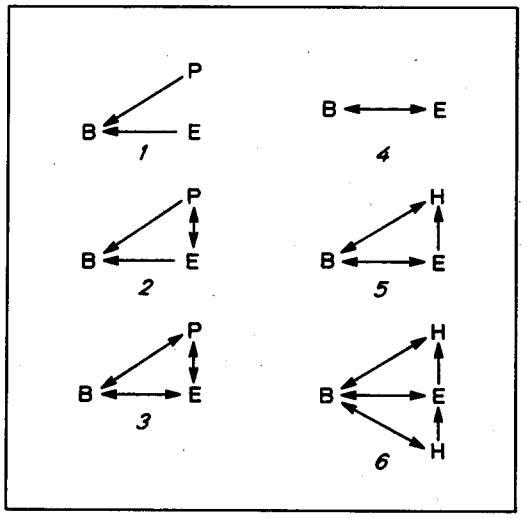

Figure 1. Schematization of alternative causal structures. (*B* signifies behavior, *P* the cognitive and other personal determinants, *E* the external environment, and *H* the history of environmental inputs. Conceptual Models 1–3 come from "The Self-System in Reciprocal Determinism" by Albert Bandura, *American Psychologist,* 1978, *33,* p. 345. Copyright 1978 by the American Psychological Association, Inc. Adapted by permission. Models 4–6 are the causal structures proposed in "Social Learning Theory and the Dynamics of Interaction" by J. E. R. Staddon, *Psychological Review, 91,* p. 503. Copyright 1984 by the American Psychological Association, Inc. Adapted by permission.)

subsumed by an executive control system in multilevel cybernetic analogues. To say that conceptions of self-regulation must explain how higher cognitive control systems operate does not mean, as Staddon alleged, that cognitive control cannot be formalized in causal structures, or that one must abandon the conventional conception of causality that events produce effects. I also noted that information-processing theories generally neglect the role of self-reflective thought in human functioning. This in no way implies that thoughts about one's own thoughts cannot be incorporated in formal models. Questions about aspects of conceptual models should not be misconstrued as rejection of formal models.

Because causal processes are obviously formalizable, the issue of interest is the adequacy of the formalism that is proposed. A causal factor requires time to exert its influence. Therefore, a formal model must include temporal lags in explaining causal effects. The choice of the unit time lag (e.g., 5 s, 1 min, 1 hour, 1 day) should correspond to the time needed for the particular causal factor to exert itself. Different unit time lags yield different estimates of the strength of a particular influence. If the length of the selected time unit is too short or too long, the estimates may be quite misleading.

Let us examine how Staddon's formalism deals with this necessary feature of any formal model. The first four equations contain no lags between causal events. Indeed, Staddon acknowledges in Footnote 2 that the equations should have included lags. Because of the absence of this necessary feature in the equations, one can place little confidence in any derivations from them (e.g., that all models involving two entities, such as organism and environment, reduce to Model 4). These comments about the deficiencies of the formalism embodied in the first four equations in no way imply that a better formalism cannot be devised. Staddon gives an example in Footnote 3.

Because the utility of formalism is not in dispute and there is consensus that the influence between behavior and the environment flows bidirectionally, the remaining issue in contention concerns the properties and function of internal determinants in the broader network of reciprocal causation. It is these substantive issues raised by Staddon's alternative models of causality, rather than the issue of formalism, that requires comment.

Staddon presents an alternative causal model that he regards as a less arbitrary way of characterizing causal interactions. In his basic Model 4, shown in Figure 1, the causal structure is stripped down to a transaction between behavior and environmental stimuli: Behavior ↔ Stimuli. This basic causal model is then enlarged by adding past stimulus inputs as the second source of control.

Let us first examine the basic model. For years, control by contingencies of reinforcement was advocated as the most fruitful model of causation. Behavior was supposedly cued by the stimuli that precede it and was shaped and controlled by the reinforcing stimuli that follow it. However, all too often, behavior is not much affected by its immediate antecedents or consequences (Estes, 1971). Because antecedent stimuli do not account all that well for the form behavior takes and immediate outcomes do not necessarily strengthen the behavior after it appears, proponents of the contingency model of causation assign an increased explanatory role to the residuum of past contingencies. In Staddon's enlarged Model (5), behavior is under the dual control of current external stimuli and the past environmental inputs (Figure 1). Staddon presents this model of causality as the *new formalism,* which presumably has the virtue of fully representing personal determinants of behavior in terms of measurable stimulus inputs. The new formalism looks a lot like traditional behaviorism fitted with a register of past contingencies.

Viewed from the cognitive perspective, people

are not simply reactors to external stimuli or steered by implants of past stimuli. In transactions with the environment, people draw on their knowledge and cognitive skills to generate courses of action to suit particular purposes, and they regulate their behavior on the basis of where they think their actions are likely to lead and what they may eventually produce (Ericsson & Simon, 1980). Forethought can enhance, neutralize, or override the impact of external stimuli.

Staddon's formalism rests on the view that because internal determinants are unmeasurable, if they are to be included in causal structures, they should be represented by measurable stimulus inputs. In the example he cites (p. 504), expectation is indexed by "past history of punished behavior." Past environmental inputs similarly represent "self-reaction," "self-control," and other "internal variables." Postulated internal determinants should be tied to measurable indices of their properties, but there is reason to question whether past contingencies are the best indicants to use for this purpose.

Cognitive processes are not publicly observable, but they do have indicants through which they can be known indirectly. The indicants of thought are separate from the behavior to be explained. Verbal probes provide one indirect means of studying the relationship between thought and action. Evidence from diverse lines of research reveals functional relationships between indirectly gauged thought and subsequent behavior (Ericcson & Simon, 1980). Even in simple operant tasks, human behavior can be better predicted from measures of people's beliefs about the basis on which their behavior is reinforced than from the actual contingent inputs they have experienced (Brewer, 1974). Thought probes, of course, are not confined to verbal indicants. Nonverbal probes also provide indirect ways of measuring what people know, as when physical symbols are used to convey understanding of the structure and meaning of events.

It is a truism that people are affected by their past experiences. The issues in contention are whether transactions with the environment create internal determinants unidirectionally or bidirectionally, and whether human behavior is steered by implanted stimulus inputs or regulated, in part, by thought processes that involve cognitive operations on propositional knowledge. Personal determinants arising from past experiences are not simply preserved replicas of previous environmental contingencies. Rather, the representation of the past involves constructive processes. Stimulus events are filtered through personal meanings and biases and are cognitively transformed into propositional knowledge (Anderson, 1983; Anderson & Bower, 1973; Neisser, 1967, 1976). The cognitively processed residuums can differ markedly from the stimulus inputs. By their actions, people partly contribute to the nature of their experiences as well as process them for memory representation. Thus, people serve as partial authors not only of their experiences but of their memory of their experiences. Researchers are working within the cognitive framework to clarify how historical determinants operate by analyzing how stimulus events are perceived and how the personally edited information is coded for memory representation and is acted on by cognitive operations to guide judgment and action.

Staddon's expanded Model 5 shows a unidirectional flow of influence from environmental stimuli to personal factors indexed as history of contingencies, but personal factors have no effect on the environment unless responses are emitted. This important causal link is included in the model of triadic reciprocity, which does not disembody internal determinants from the person presiding over them and from his or her physical characteristics. People evoke different reactions from their social environment, apart from their behavior, simply as a result of their physical characteristics, such as their age, size, race, sex, and physical attractiveness (Snyder, 1981). People similarly activate different reactions depending on symbols of role and status. Thus, by their observable characteristics people can affect their social environment before they say or do anything. The social reactions so elicited, in turn, affect recipients' conceptions of themselves and others in ways that either strengthen or reduce the environmental bias.

Staddon regards the three alternative models of interaction that I described as an arbitrary selection from a possibly larger set. The choice was certainly selective, but far from arbitrary. The models he added are formed by deleting one or more causal links from the triadic model. His Model 4, $R \leftrightarrow E$, is but a segment of the more complex network of reciprocal causation in the triadic model. The causal structure of his Model 5 is essentially the triadic model with the $P \rightarrow E$ link deleted and with the personal determinant confined to past environmental inputs. Because listing every possible incomplete model of causality would be a pointless exercise, omitting them hardly represents an arbitrary selection process.

In creating Model 6, designed to represent dyadic interaction, Staddon adds a second component of the partially truncated model. This model is difficult to interpret because the specification of the adult's causal structure in the text is at odds with the schematic form. In the schematization of causal structures, the history of inputs interacts in a peculiarly different way in the two participants. Whereas the child's expectation is unidirectionally shaped by the environment, the parent's expecta-

tion unidirectionally shapes the environment. However, the account in the text states that the parent's expectation depends on the environment. If this missing link is added to the schematized structure, then the parent's causal structure in Model 6 becomes equivalent to the triadic reciprocality of Model 3.

Staddon presents Model 6 and the accompanying equations as the best way of modeling differential regulation of aggression referred to in my earlier article (Bandura, 1978). The example concerns reciprocal aggressive behavior in parent–child interactions. In disordered families, punishment is just as likely to produce mutual escalation of aggression as to reduce it (Patterson, 1976). Staddon assumes that punishment reduces aggression, whereas a major part of the data to be explained is why punishment escalates aggression. A formal model is more likely to survive the test of reality if the assumptions on which it is based are not at odds with the actual phenomenon it purports to explain. Unfortunately, Staddon provides no evidence that his formalism produces results that fit what is observed.

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