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Contingencies, the Causal Texture of the Environment, and Behavioral Dispositions

Contingencias, la textura causal del ambiente y las disposiciones conductuales

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Abstract

Molar behaviorists have long recognized that behavior is affected by what Tolman and Brunswik (1933) called "the causal texture of the environment". Translating that recognition into an effective scientific system, however, has been a difficult task. For one thing, the "causal texture" consists of complex relations among events extended over time, and so the significant effects are often hard to detect. Also, it is often not obvious how the causal texture should be classified and measured so as to permit the discovery of an integrated set of fundamental environment-behavior relationships. An important contribution of contingency theory (e.g., Sidman, 1986) is in providing an integrated taxonomy of the environment's causal texture, thus making it possible to relate behavioral effects to the causal texture in a systematic way. Some of the behavioral effects are immediately apparent, but others are not. Some advantages may result from speaking of contingencies as affecting behavioral dispositions.

Key words: contingency, causal texture of the environment, behavioral dispositions, taxonomy of contingencies.

Resumen

Los conductistas molares han reconocido desde hace tiempo que la conducta se afecta por lo que Tolman y Brunswik (1933) llamaron "la textura causal del ambiente". Sin embargo, el materializar tal reconocimiento en un sistema científico efectivo, ha sido una tarea difícil. Por un lado, la "textura causal" consiste en relaciones complejas entre eventos que se extienden en el tiempo y por lo tanto, es

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frecuentemente difícil detectar los efectos significativos. Tampoco es evidente cómo clasificar y medir la textura causal, de tal forma que permita describir un conjunto integrado de relaciones fundamentales ambiente-conducta. Una contribución importante de la teoría de la contingencia (por ejemplo, Sidman, 1986) ha sido proveer una taxonomía integrada de la textura causal del ambiente, haciendo posible así relacionar de una manera sistemática efectos conductuales con la textura causal. Algunos de los efectos conductuales son aparentes inmediatamente pero otros no lo son. El hablar de las contingencias como maneras de afectar disposiciones conductuales, puede resultar ventajoso.

Palabras clave: contingencia, textura causal del ambiente, disposiciones conductuales, taxonomía de las contingencias.

I wish to make four points about contingencies. First, they are an important class of independent variables for behavior. Second, this kind of independent variable is easily overlooked. Third, a taxonomy of contingencies contributes to our systematic understanding of contingencies and their effects. And fourth, it may be useful to think about contingencies as altering behavioral dispositions rather than as altering behavior directly.

Contingencies as independent variables

In 1935 Tolman and Brunswik coined the phrase, *the causal texture of the environment*, to indicate that environmental events seldom occur randomly but instead occur in predictable relation to other environmental events and to aspects of an organism's behavior. Tolman and Brunswik were interested in the environment's causal texture because they thought it was at the root of the most important phenomena studied by psychologists, including learning and perception. If an organism is to function successfully in its environment, they reasoned, its behavior must be in harmony with the environment's causal texture. When an organism's behavior is not in harmony, the organism may be changed in some way. That is, the organism may "adjust," and those adjustments comprise the core subject matter of psychology. In Tolman and Brunswik's scientific program, then, the environment's causal texture is the independent variable (i.e., the cause) and the organism's adjustments comprise the dependent variable.

Behavior analysts rarely speak about the environment's *causal texture*. But they refer to the same kinds of facts when they speak about *contingencies*. A description of a contingency is a description of how the occurrence of one event (e.g., a pellet of food) depends upon the occurrence of other, prior events (e.g., a tone or a leverpress). It is a description, in other words, of how the environment works. It might be the case, for example, that a pellet of food will be presented to a rat immediately following a leverpress, but not otherwise. We say that the pellet is contingent on the leverpress. If a parent attends to a child whenever a child throws a tantrum but not otherwise, we would say that the parent's attention is contingent on the child's tantrum behavior. Contingencies can be considered independent variables because they can be specified and arranged independently of the actual occurrence of behavior (Hineline, 1990; Sidman, 1986; Weingarten & Mechner, 1966).

Tolman and Brunswik (1935) recognized another important fact about the environment. The "causal connections are always to some degree *equivocal*" (p. 44). In other words, the contingent relationships are probabilistic. "And it is...this very *equivocality*...in the causal 'representation' strands in the environment which lend to the psychological activities of organisms many of their most outstanding characteristics" (p. 44). Within the tradition of behavior analysis much of the research on contingencies has been concerned with the effects of intermittent, or probabilistic, contingencies.

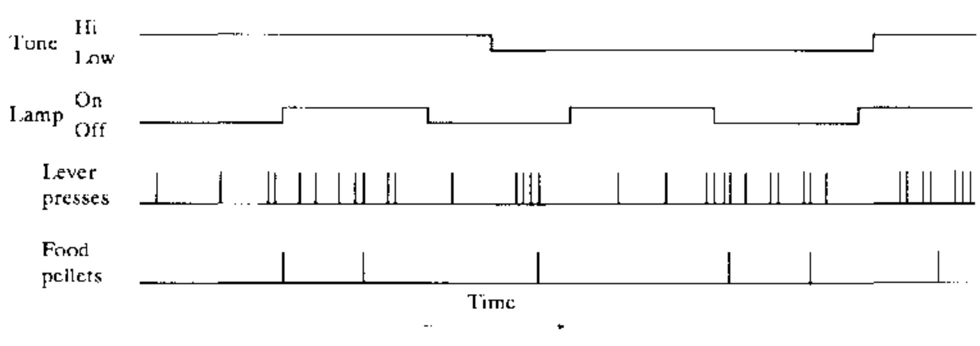
Contingencies are easily overlooked as independent variables

Skinner (1969) considered the question of why it took so long for psychologists to discover the significance of contingencies for determining behavior. One reason, Skinner suggested, is that the contingent relationships are extended over time and are probabilistic. That is, they are *molar* features of the environment rather than something that one can point to as occurring at this or that moment of time. As a result, contingencies tend to be inconspicuous (cf. Hineline, 1990). In contrast, stimuli can be said to occur at particular moments of time, and so the causal role of stimuli in evoking behavior (as in reflexes) was recognized early.

Contingencies are molar in the same sense that rhythm is a molar property of music. One cannot detect rhythm by considering only the individual notes because the term *rhythm* refers to the *pattern* of relationships among the individual notes. The pattern (i.e., the rhythm) is just as much a physical property of the music as the individual notes are; but the property that we call rhythm is, of its essence, molar in the sense of being extended over time and relational.

Skinner (1969, pp. 8-10) described an imaginary experimental procedure to illustrate how difficult it is to detect contingencies even under simplified laboratory conditions. I would like to do the same thing, and so I ask you to imagine the following fairly complex contingency (a conditional discrimination procedure). The subject is a food-deprived rat. It can occasionally obtain a food pellet by pressing a lever. Imagine that I tell you that the rat has been trained for several weeks under a particular procedure and that your task is to watch the rat for a while and try to figure out what the contingency is. Here is what you observe: You hear a high-pitched tone that remains on for about five minutes. During this time a lamp above the lever alternates about every two minutes between being lighted and being darkened, and you see that the rat presses the lever frequently when the lamp is lighted but seldom when the lamp is dark. Moreover, leverpreses occasionally are followed by food pellets when the lamp is lighted but never when the lamp is dark. After about five minutes, the high-pitched tone is replaced by a low-pitched tone, but the lamp continues to cycle on and off every two minutes or so. The first thing you notice is that there is a dramatic change in the frequency of leverpressing in the presence of the lighted and darkened lamp. Now the rat presses the lever at a high rate when the lamp is darkened and at a low rate when the lamp is lighted. Moreover, leverpressing now occasionally produces a food pellet when the lamp is off but never when the lamp is on. Figure 1 diagrams this procedure and its effect on the rate of responding.

Figure 1
Conditional Discrimination Procedure
(4-Term Contingency)



Schematic of a hypothetical conditional discrimination procedure (a four-term contingency).

The rat's behavior is clearly in harmony with the causal texture of its environment: The frequency of leverpressing increases and decreases in accordance with the likelihood that food pellets can be obtained by leverpressing. The point of the example, however, is to illustrate that you will have to watch this scenario attentively for a fairly long time before you will be able to identify the contingency and the rat's adjustment to it (the pattern of different response rates). Lever presses produce food only intermittently. And the important relationships among the tone, light, and the production of a food pellet by lever pressing comprise a molar *pattern* rather than an event that occurs at a particular point in time. To "see" the contingency (i.e., to see the causal texture), you need to observe at least one full cycle of the lamp in the presence of each of the two tones.

Eventually you probably will be able to figure out what the relevant contingency is that is responsible for the different rates of leverpressing. During the high-pitched tone, leverpressing has been reinforced by food pellets in the presence of the lighted lamp but not in the presence of the darkened lamp. Thus, the lighted lamp has come to function as a *discriminative* stimulus (S^D) for leverpressing; its presence increases the likelihood of leverpressing because leverpressing has been reinforced more frequently in its presence (S^D) than in its absence (S^Δ). The same process of differential reinforcement has occurred during the low-pitched tone except that the functions of the lighted versus darkened lamp were reversed. The tone (high pitched versus low pitched) is sometimes called an *instructional stimulus* in a conditional discrimination (Cumming & Berryman, 1965). It specifies which other stimuli (the lighted versus darkened lamp in this example) will function as discriminative stimuli for particular responses.

Consider some further complications. Imagine what it would be like if the tones were presented so quietly that the rat could hear them but you could not. From your perspective the environment would appear rather capricious, and the rapid adjustments in the rat's behavior would seem mysterious. Sometimes the rat would respond most rapidly in the presence of the lighted lamp and sometimes in the presence of the darkened lamp. But you would not be able to relate those changes in behavior to any feature of the environment except for the different frequencies of pellet delivery. Yet strangely, from your perspective, the rat's behavior would appear to change appropriately even before the rat has had the opportunity to sample the new frequencies of pellet delivery. Imagine, further, that the food delivery schedule is made so intermittent that no food is presented during the time that you are observing the procedure. That would make it even harder for you to relate the pattern of the rat's behavior to regularities in the environment, and so the rat's behavior would seem very puzzling indeed.

When you know the contingency, it is easy to see that the causes of the rat's behavior are in the environment. The immediate determiners of the rate of leverpressing include the pitch of the tone and the illumination of the lamp the discriminative and instructional stimuli. Those stimuli acquired their ability to influence the rate of leverpressing as a result of the rat's history of exposure to the contingencies involving those stimuli and differential reinforcement by food pellets.

If the contingencies are inconspicuous, however, it will not be apparent that the causes of the behavior are in the environment. And one may be tempted to invent special cognitive processes to account for the pattern of behavior (cf. Hineline, 1990).

If contingencies are hard to detect even in simplified laboratory arrangements, think how much more difficult it can be to detect them in everyday situations, where contingencies often are arranged by the social environment and where the contingent events are likely to be subtle. It is, perhaps, not surprising to see that it has taken a long time for behavioral scientists to recognize the important role that contingencies play in creating significant behavioral phenomena.

Taxonomy of contingencies

Although Tolman and Brunswik grasped the importance of the environment's causal texture as an independent variable, it is fair to say that they did not make much progress toward developing that insight into a systematic set of basic principles. The research that Tolman and his followers carried out (e.g., Tolman, 1932; Tolman & Krechevsky, 1933) often was designed to demonstrate that rats and other organisms were capable of remarkably flexible behavioral adjustments in response to changes in the causal texture of their environments. Such adjustments were aptly characterized as "purposeful" and "insightful." The point of this work was to show that the behavior of even so simple an organism as the rat could not be explained as a rigid response to a stimulus. Although it is unlikely that any theorist ever believed that behavior could be explained in such simple-minded stimulus-response (S-R) terms (Shimp, 1989; Zuriff, 1985), the demonstrations by Tolman and his followers nevertheless were interesting and dramatic.

But dramatic demonstrations make only limited contributions to the development of a coherent science. They tend to show merely that some interesting behavioral phenomenon either does or does not occur under a particular complex set of conditions rather than showing the kinds of orderly relationships between dimensions of the environment and behavior that can serve as the foundation of an effective science.

This is an area where behavior analytic research has made an especially important contribution. Behavior analysts have long been concerned not merely with demonstrating that contingencies have an effect on behavior but with identifying and classifying the significant features of contingencies and their behavioral effects so as to produce a systematic treatment. As Hineline (1990) described it:

> Behavior analysis is essentially the study, definition, and characterization of effective environments as arrayed over time, with "effective" defined by the dynamics of behavior. That is, in behavior-analytic theory the world is characterized through categories of transaction with behavior. Those categories do not consist of punctate, individual events; rather, they are sets of contingent relations or correlations between events or patterns of events over time. (p. 305)

The work is ongoing, and disagreement remains about what features of operant contingencies are most important for a general understanding of their effects. Some systems, for example, define contingencies in terms of the conditional probabilities of the contingent event given the occurrence and given the non-occurrence of a response (see Gibbon, Berryman, & Thompson, 1974, for a review, critique, and alternative formulation based on joint frequencies). Other systems emphasize relative rates of reinforcement for responses (Herrnstein, 1970; cf. Nevin, 1992). Still other systems define contingencies in terms of the dependency between relatively molar, temporally extended dimensions of reinforcement and behavior-for example, in terms of the degree to which rate of reinforcement depends on the rate of responding (Baum, 1973, 1989, in press; see also Catania & Keller, 1981, and Hineline, 1981). And, finally, it should be mentioned that some systems define contingency in terms of constraints imposed on the allocation of behavior (Hursh, 1980; Rachlin, Battalio, Kagal, & Green, 1981; Staddon, 1980, 1983; Timberlake, 1984).

Despite the differences among these (and other) systems, there is a common aim: to find the dimensions of contingencies that are responsible for significant behavioral effects ideally, dimensions that are generally applicable to environments both in and outside the laboratory. It should then be possible to express the behavioral effects as functions perhaps as continuous functions of the values along the dimensions of contingencies. Such a systematic treatment of these kinds of environment-behavior relationships would be a significant advance over the insightful, but incomplete, statement that behavioral effects are caused by exposure to the causal texture of the environment.

The work cited immediately above was concerned with identifying the effective dimensions of the most elementary kinds of contingency relationships that between a response and its consequence. Sidman (1986) has developed a more comprehensive taxonomy of operant contingencies an extension and elaboration of Skinner's (1938, 1953, 1969) system that encompasses more complex relations among stimuli and the reinforcement of behavior. It is hierarchically arranged, with more complex and molar levels of contingent relations subsuming simpler levels.

The levels of contingency relations are numbered according to the number of element types that must be considered to identify the contingency. A two-term contingency specifies the relation between a response and its consequence; a three-term contingency specifies that a discriminative stimulus signals the operation of a two-term contingency; a four-term contingency specifies that an instructional stimulus signals the operation of a three-term contingency; and so forth through five-term contingencies.

Figure 2 represents the conditional discrimination procedure described earlier (Figure 1) as a four-term contingency. The notation system is derived from that used by Sidman. It makes clear that the contingency is a molar pattern of response and stimulus relationships.

Sidman (1986, p. 242) spoke about these various levels of contingency relations as *environmental structures*, a term that seems to mean about the same thing as Tolman and Brunswik's *the causal texture of the environment*. Sidman's taxonomy thus provides a systematic approach to describing the environment's causal texture that can be applied generally. The test of its value is whether significant classes of behavioral effects can be found to correspond to the different levels of contingency. This is the topic of the next section.

Figure 2
Conditional Discrimination Procedure

4-Term	3-Term	2-Term
$S^{I}_{Hi\text{-}Tone}$	$S^{D}_{Lamp\ on}$	R_{LPress} – > S^{R}_{Food}
		R_{Other}–/– > S^{R}_{Food}
	$S^{\Lambda}_{Lamp\ off}$	R_{LPress}–/– > S^{R}_{Food}
		R_{Other}–/– > S^{R}_{Food}
$S^{I}_{Lo\text{-}Tone}$	$S^{\Delta}_{Lamp\ on}$	R_{LPress}–/– > S^{R}_{Food}
		R_{Other}–/– > S^{R}_{Food}
	$S^{D}_{Lamp\ off}$	R_{LPress} – > S^{R}_{Food}
		R_{Other}–/– > S^{R}_{Food}

R – > S^{R} = Response is followed by reinforcer
R–/– > S^{R} = Response is not followed by reinforcer
S^{D} = Discriminative stimulus (S–"dee")
S^{Δ} = S "delta"
S^{I} = Instructional Stimulus

A notation system for representing four-term contingencies (based on Sidman, 1986). The particular example is the conditional discrimination procedure shown in Fig. 1.

Contingencies as altering behavioral dispositions

Before discussing the behavioral effects of contingencies, I will need to say a little bit about *dispositional terms* because I will be suggesting shortly that contingencies create or alter behavioral dispositions instead of changing behavior directly. The classic discussion of dispositional terms is Ryle's treatment (Ryle, 1949; see also Baum, 1994; Harzem & Miles, 1978; Schnaitter, 1985; Zuriff, 1985).

Imagine a china cup sitting on a table. There are a number of things one can say about the cup: It is a certain color, size, and shape. One can also say that it is *brittle*. But describing the cup as brittle seems somehow different from describing it as, say, blue because the cup is not currently displaying the properties that the term brittle implies. It is not, for example, shattering; it is just sitting there. Indeed, it may never shatter. It almost seems as though the term brittle must be referring to some ghostly, unseen force or substance--especially when we say that the cup might shatter *because* it is brittle. But if that were the case, it would be hard to understand how people could ordinarily, and with such confidence, describe objects as brittle or not brittle.

One way to think about *brittle* is as a *dispositional term*. To call the cup brittle is simply to say that will act in particular ways under particular conditions. It will likely shatter if it is dropped, if it is tapped sharply, if it is subjected to a large and rapid change in temperature, and so forth. The term brittle is a short-hand summary a label for a set of entirely objective facts about the functioning of the cup. It is not some unseen entity or essence apart from those facts. We could, indeed, dispense with the term and simply list the conditions and their effects that the term brittle summarizes. But doing so would be cumbersome, especially because the list of instances can be very long. It is much more efficient to use the summary label. Other examples of such dispositional terms include soluble and elastic. To say that a ball is elastic is to say that it will bounce if it dropped on a hard surface, that it will return to its shape if it is squeezed, and so forth.

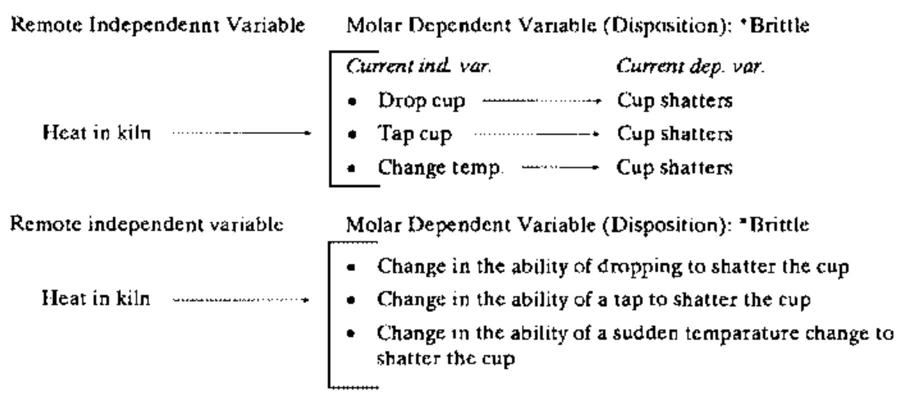
The term brittle, then, does not refer to an unseen cause of shattering in the sense that dropping or tapping might be said to be a cause. Nor does brittle refer to the molecular structure of the cup even though an understanding of the molecular structure might help us understand the cup's brittleness. We know that brittleness is not the molecular structure per se because we ordinarily and confidently call objects brittle (or not brittle) without having the slightest idea about the object's molecular structure. Again, brittle refers to what the cup will do under certain conditions.

We are often interested not merely in whether a dispositional term is appropriate as a description, but in the causes of the disposition. That is, we might ask how the cup came to be brittle. The answer might be that a piece of clay, shaped in the form of a cup, was heated in a kiln, which has changed the object from being plastic to being brittle. Before the cup was heated, a tap would have deformed it; afterwards, a tap will cause it to shatter. We can speak of exposure to the heat as an independent variable; the corresponding dependent variable would be the disposition the set of potential reactions to conditions that we summarize by the term brittle. The heating in the kiln does not directly, or immediately, cause the cup to shatter; indeed, the cup may survive for years if it is handled carefully. We can say, however, that the heating alters the ability of a tap to shatter the cup (or, equivalently, that it alters the susceptibility of the cup to being shattered by a tap).

The exposure to the heat no doubt changes the molecular structure of the clay, and understanding the nature of those changes might clarify the brittleness of the cup. But, again, the molecular changes are not the properties that lead us to speak of a change in brittleness, although the changes at the two levels may be correlated.

The following diagram (Figure 3) illustrates one way to think about dispositions and their causes. Exposing the cup to the heat can be considered the independent variable for the disposition. The disposition subsumes and summarizes a set of more local independent variable-dependent variable relationships, examples of which are listed. Thus, the disposition can be considered a molar dependent variable in contrast with shattering, which is a more molecular dependent variable. Two versions of the diagram are shown. The top one is more complete in showing the different levels of independent and dependent variables. The lower one is a bit simpler but summarizes the same facts. From either one it should be clear that the disposition is not some sort of unseen, mysterious force or entity on a par with tapping and dropping. It is nothing more than a summary label. We may not "see" brittleness when we speak of an object as brittle, but the facts that lead us to speak of the cup as brittle are entirely "seeable."

Figure 3



Brittleness as a disposition, and its cause. The list of instances comprising the disposition is illustrative rather than complete.

The point of discussing brittleness is to provide the groundwork for suggesting that exposing an organism to a contingency is analogous to exposing a clay cup to heat. Both may be said to alter the ability of other variables to produce some objective set of effects rather than evoking those effects directly. That is, both can be said to create or alter a disposition.

It is common to say that exposure to contingencies affects the likelihood, or the rate, of the operant. And that, indeed, is often a satisfactory description. The following sketch expresses this kind of direct functional (or causal) relation, with the arrow indicating the direction of influence:

Independent variable		*Dependent variable*
Exposure to contingency	⟶	Change in response rate

There are some problems, however, with viewing the contingency as having such a direct effect on response rate. Imagine that a rat's leverpress produces not just a single small pellet of food but a whole day's ration of perhaps 100 pellets given at once. The effect on leverpressing for some time after the rat has consumed the pellets probably will be a decrease in rate rather than an increase. If so, would this mean that the cluster of 100 pellets is not a reinforcer? Probably not. Food delivery has at least two effects on the behavior of a food-deprived organism: it can reinforce the response on which it was contingent, and it can also have a satiating effect. The lowered response rate in this example is not surprising: It simply reflects the fact that the rat is satiated. Satiation and deprivation are called *establishing operations* or *motivational operations* (Keller & Schoenfeld, 1950; Michael, 1982, 1993a, 1993b).

To demonstrate that there has been a reinforcement effect it should be sufficient merely to deprive the rat of food for a while and then put it back in the chamber. Leverpressing will most likely occur at a high rate or at least at a higher rate than before exposure to the contingency. A more general description of the behavioral effect, then, is that exposure to the contingency has enabled the level food deprivation to control the likelihood, or rate, of leverpressing.

A similar point can be made about the effects of exposing an organism to a three-term contingency (cf. Dinsmoor, 1995). One way to describe those effects is to say that exposure to the contingency has altered the ability of the third-term stimuli to influence the likelihood of the response specified in the contingency. That is, those stimuli are now able to function as S^Ds or S^Δs for particular responses. There is another effect as well: The stimulus that functions as an S^D for one response has probably also acquired the ability to function as a conditioned reinforcer for some other response.

These new abilities, or functions, of the stimuli may or may not be revealed in actual behavior just as the cup which has been made brittle may or may not actually shatter, depending on whether or not the precipitating conditions occur. To demonstrate the discriminative function of the stimuli, it is necessary to re-present the S^D and the S^Δ, after exposure to the contingency, and note that the likelihood of the response changes in a corresponding way. To demonstrate the conditioned reinforcing function, it is necessary to arrange a new contingency so that the organism can produce the stimulus by emitting some response different from the one in the original contingency. And then it is necessary to see that the likelihood of this new response increases as a result of its contingency (cf. Williams, 1994).

The diagrams in Figure 4 show these relationships in a form that parallels the conceptualization of brittleness and its cause in Figure 3.

Figure 4

Remote Independent Variable: Exposure to 3 term contingency →

Molar Dependent Variable (Disposition):
*Operant stimulus control;
*Discriminated operant

Current ind. var.	*Current desp. var.*
• Change establishing operation	Resp. rate changes
• Present/remove third-term stimulus (S^D/S^Δ)	Resp. rate changes
• Arrange contingency between new response and third-term stimulus	Increase rate of new response

Remote Independent Variable: Exposure to 3-term contingency →

Molar Dependent Variable (disposition):
*Operant stimulus control;
*Discriminated operant

- Change in the ability of an establishing operation to influence response rate
- Change in the ability of the thirt-term stimulus (S^D/S^Δ) to influence response rate
- Change in the ability of the third-term stimulus to function as a conditioned reinforcer for a different response.

Stimulus control (or discriminated operant) as a disposition, and its cause. The list of instances comprising the disposition is illustrative rather than complete.

Exposure to the three-term contingency is represented as a relatively remote independent variable whose effect is to alter the ability of other, more current independent variables (e.g., establishing operations, discriminative stimuli, and arranging additional contingencies) to influence the likelihood of particular responses. Thus, exposing an organism to a contingency, like exposing a piece of clay to heat, alters or creates a disposition.

The name we give to the disposition that results from exposure to a three-term contingency is *operant stimulus control* or *discriminated operant*. Representing the operant as a disposition emphasizes the point that the operant is a molar unit of behavior, defined in terms of environment-behavior functional relationships rather than in terms of response form (e.g., Skinner, 1957, p. 20-21).

There is precedent for regarding the behavioral effect of exposure to contingencies as altering the ability of other variables to influence the likelihood of responses. Michael (1993a; see also Glenn & Field, 1994), for example, has distinguished *evocative* effects of operations from *function-altering* effects. Establishing operations and discriminative stimuli alter the momentary likelihood of a response and so are considered evocative. They have become evocative as a result of exposure to contingencies; such exposure has altered their functioning[2].

A key point of Sidman's (1986) taxonomy was to develop a systematic way of representing fundamental classes of environment-behavior relationships. The exciting result of his analysis is that each level of contingency does, indeed, seem to produce distinctive types of fundamental behavioral effects. Although Sidman did not speak about these effects as dispositions, most of the ones he identified are disposition-like rather than direct, immediate changes in observed behavior. For example, Sidman emphasized the creation of a conditioned-reinforcement potential as a general effect of exposure to a three-term contingency.

Even more complex environment-behavior relations result from exposure to four-term contingencies. One such effect is *conditional stimulus control*. Another-at least with humans-is the set of relationships that are collectively called *stimulus equivalence*. That is, exposure to particular sets of four-term contingencies enables instructional and discriminative stimuli

2 There are, to be sure, other ways to speak about these facts. Instead of conceptualizing the effect of a remote independent variable as a changed disposition (or as an alteration of the function of more local variables), one could conceptualize the function of more local variables as acting jointly to affect response rate directly. Logically, the two conceptualizations seem equivalent, and so the choice of one over the other seems likely to depend on which one provers to be the more convenient for organizing the relevant environment-behavior relationships.

to function interchangeably under new arrangements of those stimuli to which the organism has not previously been exposed (see also Sidman, 1994)[3].

What emerges from Sidman's analysis is a hierarchical system for organizing environment-behavior relationships of different levels of complexity. These relationships are molar in the sense that the environmental variables are contingencies and the behavioral effects can be construed as dispositions. Inferences about internal mediating events are unnecessary (cf. also Hineline, 1990, 1992).

For Tolman (e.g., 1932), the behavioral effect of exposure to the causal texture of the environment was to confirm or change the organism's *hypotheses* (or *means-end readinesses*) about the environment's causal texture. On the surface, the term *hypothesis* sounds like a mentalistic term that has no place in a rigorous science of behavior. But Tolman insisted that *hypothesis* (and other such "cognitive" terms) were capable of rigorous behavioral definition (e.g., Tolman, 1932; Tolman & Krechevsky, 1933). Although Tolman did not speak about dispositions as such, it is fair to say that he used terms like *hypothesis* very much like a dispositional term (at least when he was being rigorous cf. Zuriff, 1985; Smith, 1986). That is, to speak of a rat as "having an hypothesis" about the layout of a maze is simply to say that the rat's behavior is likely to adjust in certain particular ways when aspects of the maze are changed (e.g., by blocking familiar routes) or when the deprivation or the reinforcer type is changed (Tolman & Krechevsky, 1933).

An important reason for using the term *hypothesis* was to emphasize that exposure to the causal texture of the environment produces a variety of behavioral possibilities rather than a rigid response. A disadvantage, however, is that terms like *hypothesis* carry everyday implications of reasoning and awareness. They may, therefore, imply more than the facts warrant. At the same time, they may be too limiting in the sense of not fully expressing the range of environment-behavior possibilities.

The behavior-analytic concept of the operant can likewise be conceptualized as a disposition, created by exposure to contingencies. The operant is thus a behavioral unit that is more like Tolman's concept of *hypothesis* (or

3 It should be noted that Sidman (1994, Chapt. 10) has made a strong case, based on evidence and logic, that the potential for the set of relations known as equivalence does not require exposure to four-term contingencies but instead can be established through exposure to three-term and even two-term contingencies. This possibility does not, however, contradict the point that "equivalence" is a disposition-like effect of exposure to contingencies.

means-end readiness) (cf. Levine, 1971) than like a rigid response to a stimulus such as might characterize a simple reflex. Exposure to contingencies, then, engenders a relatively molar unit of behavior the operant that is rich with potential[4].

The term, operant, is not part of ordinary language, and so it should be relatively free of constraints imposed by everyday understanding. But perhaps we have not fully exploited this freedom. Maybe there are behavioral implications of the operant and of other dispositional effects of contingencies that have not been fully investigated (Falk, 1994; Sidman, 1986). A systematic taxonomy of contingencies should help reveal these possibilities.

> Along with the ever more complex interactions between environmental structures and behavior that become accessible as the analytic unit expands, the very exposure of questions, conundrums, and paradoxes may be regarded as an additional virtue of the analytic procedures. The delineation of "obvious" next steps, and the clear exposure of lacunae in a systematic structure, are characteristics of the most advanced sciences. (Sidman, 1986, p. 242)

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4 It should be noted that none of the so-called S-R learning theoris conceptualized conditioned operant behavior as a simple response to a stimulus either. As a results of exposure to contigencies, a network of (mostly convert and hypothetical) S-R relations was assumed to develop, and this network gave operant behavior its distinctive flexible character (cf., Amsel & Rashotte, 1984; Guthrie, 1959; Miller, 1959).

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