The Behavior Analyst 1987, 10, 41–45 No. 1 (Spring)

Function-Altering Effects of Contingency-Specifying Stimuli

Henry Schlinger and Elbert Blakely
Western Michigan University

Contingengy-specifying stimuli (CSSs) can function differently than discriminative stimuli. Rather than evoking behavior due to a history of discrimination training, they alter the function of other stimuli and, therefore, the behavioral relations involving those stimuli. CSSs can alter the evocative function of discriminative stimuli, establishing operations, and conditional stimuli, as well as the efficacy of reinforcing and punishing stimuli and of stimuli that can function in second-order respondent conditioning. The concept of function-altering CSSs has implications for such areas of interest as stimulus equivalence, the terminology involving "rules" and "rule-governed behavior," and the way in which behavior analysts view the effects of such basic processes as reinforcement and punishment.

Key words: contingency-specifying stimuli, function-altering effects, verbal stimuli, rules

Behavior analysts have been increasingly interested in complex verbal stimuli that are "contingency-specifying." Such stimuli, which have also been termed "rules" or "instructions," are emerging as important explicanda of human behavior (Skinner, 1969, 1974) and as fruitful topics for research (e.g., Catania, Matthews, & Shimoff, 1982; Galizio, 1979; Hayes et. al., 1986; Shimoff, Catania, & Matthews, 1981; Vaughan, 1985). Although contingency-specifying stimuli (CSSs) have most often been classified as discriminative stimuli (SDs) (e.g., Galizio, 1979; Skinner, 1969), many CSSs seem to function differently. Specifically, they do not evoke (i.e., immediately strengthen) behavior as do SDs;[1] rather, they alter the function of other stimuli and, thus, the strength of relations among those stimuli and behavior. It is these "function-altering" effects that may be relevant to the complex verbal stimuli called rules, instructions, or relational-autoclitics, and that therefore make them worthy of explication.

In the present paper, we (a) briefly discuss the formal properties of CSSs; (b) classify some of the ways in which these stimuli can alter the functions of other stimuli; and, (c) describe several implications of this classificatory scheme.

FORMAL CHARACTERISTICS

Although this paper is essentially about unique functional characteristics of CSSs, these stimuli possess some formal properties that seem necessary (though not sufficient) for them to function as they do. As implied by the term, a CSS describes a contingency between antecedent stimuli (SDs and establishing operations [EOs]), behavior, and consequences (reinforcers and punishers), some combination of these three elements, or a contingency between two or more stimuli. Stimuli that identify only behavior, such as "Come here," do not meet the formal definition implied by "contingency specifying." Although these stimuli may evoke behavior as SDs or EOs, they do not appear to alter the functions of other stimuli directly. Thus, the function-altering effects of verbal stimuli seem constrained, in part, by their formal properties.

The authors extend their appreciation to Wayne Fuqua, Barbara Gault, Jack Michael, Ed Morris, Alan Poling, Paul Whitley, and Jayson Wilkenfield for their helpful comments on earlier versions of this paper. Reprints may be obtained from either author, Department of Psychology, Western Michigan University, Kalamazoo, Michigan, 49008.

[1] We acknowledge that there may be a lack of consensus regarding the defining features of SDs, particularly the evocative (immediate strengthening of behavior) element. Inclusion of this feature, however, is consistent with other treatments of stimulus control (e.g., Brownstein & Shull, 1985, p. 265; Martin & Pear, 1983, p. 115; Michael, 1980, p. 47; 1983, p. 21; Reynolds, 1975, p. 9; Rilling, 1977, p. 444; Sidman 1960, p. 350–352; Skinner, 1953, p. 107–108).

FUNCTION-ALTERING CHARACTERISTICS

Operant Relations

Discriminative relations. Contingency-specifying stimuli may alter the evocative function of discriminative stimuli either (a) by establishing a new discriminative relation between a stimulus and behavior, that is, by bringing a response under the discriminative (evocative) control of a previously neutral stimulus, or (b) by altering (either strengthening or weakening) an existing discriminative relation. For example, suppose a teacher tells her students to "Please go into the classroom when you see our visitor arrive." Although this CSS probably has several effects, we are interested only in its effects on the function of the stimulus described by the CSS (i.e., the arrival of the visitor). As a direct result of the CSS, and as evidence for its function-altering effect, the arrival of the visitor will now evoke the behavior of going into the classroom, whereas before, it may have evoked some other behavior (e.g., looking at the visitor), or no behavior at all. Moreover, this function-altering effect is evidenced whether the visitor arrives seconds later or hours later. The effect of the CSS is to bring the behavior of going into the classroom under the discriminative control of the visitor's arrival. The CSS does not evoke the behavior; the students do not go into the classroom immediately after the CSS is stated.

Note that if the visitor appeared either at the same time or immediately after the CSS was stated, the behavior would occur immediately. Thus, the CSS might appear to function as an SD. Two arguments can be made against this interpretation. First, when a CSS and the SD described by that CSS coincide in time, the evocative effects of the SD can be mistakenly assigned to the CSS. An experimental analysis is needed to separate their respective effects. Thus, temporally separating the arrival of the visitor and the CSS will demonstrate that the arrival of the visitor, not the CSS, evokes the behavior. As evidence, the students will go inside only when the visitor appears. This point is important for distinguishing the function-altering effects of CSSs from putative discriminative effects.

Assuming that we can separate the effects of the CSS from those of the stimulus it describes, a second argument can be made against classifying the CSS as an SD: Discriminative stimuli do not establish, or alter, discriminative relations; they are a part of such relations. Their control over behavior is evocative, not function-altering. In the present example, the CSS does not evoke going into the classroom. Instead, the arrival of the visitor evokes the behavior, a function engendered by the CSS.

Some might argue that a verbal stimulus that only specifies behavior might also alter discriminative (or motivative) relations. For example, suppose the teacher says only, "Go into the classroom." In most cases, such stimuli function as SDs or EOs and, therefore, evoke behavior. Their relation to behavior and consequences is the same as that of any SD or EO. Assume, though, that as a result of the command, we observe function-altering effects. We suggest that self-stated CSSs might produce these effects. For example, a student might say to him- or herself, "I will go into the classroom when I see the teacher go in." This CSS establishes the sight of the teacher going into the classroom as an SD for the same behavior in the student. Humans can produce verbal SDs and EOs that evoke their own behavior and, also, they can state CSSs that engender all of the function-altering effects that we describe in this paper.

More complex discriminative functions may be educed by instructions in human operant experiments. For example, suppose that an experimenter reads the following to each subject: "When the red light comes on, a quarter will be delivered after 10 lever presses. When the green light comes on, no quarters will be delivered for pressing the lever." As a result, the red light, as an SD, will evoke lever pressing; the green light, as an S-delta, will not evoke lever pressing. Thus, the CSS endows the red and green lights with discriminative functions that

mimic those under traditional discrimination training.

At this point, a terminological subtlety should be noted. When a CSS endows a stimulus with a "discriminative" effect, this effect only resembles that of an SD. Although the stimulus evokes behavior, it does not do so because in the past it has been correlated with reinforcement for that particular behavior. We nonetheless refer to the stimulus as "discriminative" as a way to emphasize that it will in the future be an element of an operant contingency.

Motivative relations. A CSS may also alter the evocative function of a motivative variable or establishing operation (see Michael, 1982 for a discussion of establishing operations), either (a) by establishing a new relation between a motivative variable and behavior, that is, by bringing a response under the evocative control of a previously neutral motivative variable, or, (b) by altering (either strengthening or weakening) an already-existing motivative relation. For example, assume that when children are water deprived, they ask for water. Next, they are advised that "When you are thirsty, push the button and you will get water." Although this CSS may produce several effects, we are interested only in its effects on the relation between the EO (water deprivation) and behavior described in the CSS (pushing the button). Assuming the CSS is effective as a function-altering event, button-pushing will vary in strength with water deprivation. As evidence for the altered motivative relation, water deprivation will now evoke pushing the button as well as asking for water.

Suppose, though, that a child is water deprived when the CSS occurs. The behavior will then immediately occur and appear to be evoked by the CSS as an SD. Again, two arguments can be made against this interpretation. First, temporally separating the EO and CSS will show that the EO, not the CSS, evokes button-pushing. Given this demonstration, a second argument can be made. In the present example, a new motivative relation was engendered by the CSS, an effect that is uncharacteristic of SDs. An SD does not bring behavior under the control of motivative variables, it only evokes behavior due to a history of discrimination training.

Some might assert that a verbal stimulus that only specifies behavior, for example, "Push the button," may also alter motivative (or discriminative) relations. As we argued earlier, such an effect may result from CSSs stated by the listener. For example, a child may say, "I have to push the button very fast to get water." In most cases, though, such non-contingency-specifying stimuli simply evoke behavior as SDs or as EOs and, therefore, require no special treatment.

Reinforcers and punishers. In addition to altering the functions of stimuli as SDs and EOs, CSSs can alter the reinforcing or punishing functions of stimuli. Contingency-specifying stimuli may endow a previously neutral stimulus with reinforcing or punishing properties or alter the efficacy of existing reinforcers or punishers. In human operant experiments, subjects are often instructed that points can be earned for a particular behavior and then exchanged later for prizes, money, etc. For example, in a recent experiment by Hayes et al. (1986), subjects were told the following:

> Occasionally the small round red light above the ready light will go on. When it does, a push on the middle button will advance the counter one point. Try to see how many points you can get. At the end of the experiment, the subject with the most points . . . will get $20. (p. 239)

If one assumes that the points actually strengthen the behavior that produces them, then their reinforcing efficacy seems established by the CSS. Thus, the behavior will be evoked upon the occurrence of the necessary discriminative conditions arranged in the experiment, in this case, the onset of "the small round red light," the control by which is also established by the CSS. Note that the CSS does not evoke button-pushing, although it may evoke some acknowledgment by the subject. Therefore, the CSS is not an SD for button-pushing; rather, it alters the reinforcing efficacy of the points.

Contingency-specifying stimuli may also alter the punishing functions of stim-

uli. Suppose the following is said to you upon hiring: "Bob is your supervisor. As such, he decides when you are eligible for pay raises. In making this decision, he considers your social behavior." A statement such as the above could alter the punishing (and reinforcing) effects of Bob's remarks. For example, suppose you tell a joke that Bob considers inappropriate. He then says, "I think your joke was in bad taste." Undoubtedly, the remark would function as a punisher and weaken joke-telling under similar circumstances, even more than might be expected prior to the CSS.

Respondent Relations

In addition to operant relations, CSSs can also alter the function of stimuli in respondent relations. One such effect is to alter the eliciting (evocative) effect of some stimulus. Consider the example, "When you hear a bell, you will feel a shock" (Skinner, 1957, p. 357). As a result of this CSS, the sound of the bell will evoke a constellation of autonomic nervous system responses (e.g., increases in heart rate and respiration) that are similar to, but perhaps weaker than those elicited by the shock or by the sound of the word "shock." As evidence for the function-altering effects of the CSS, the sound of the bell, which was previously neutral with respect to those particular autonomic responses, now evokes them. Note that if the bell is already ringing or quickly follows the CSS, the latter might appear to evoke arousal. If the two events are separated in time, though, the eliciting properties of the bell, independent of those of the CSS, will be apparent.

In addition to altering the evocative effect of the bell, the CSS has probably endowed the bell with the capacity to condition other stimuli with which it is correlated, in the manner of second-order conditioning. For example, a flash of light could be correlated with the bell and, as a result, the flash would elicit autonomic arousal. The CSS ". . . a flash of light will precede the onset of the bell . . ." would have a similar function-altering effect.

Range of Function-Altering Effects

Three points should be noted regarding the potential range of these function-altering effects of CSSs. First, "function-altering" implies no directionality. For example, the discriminative properties of a stimulus described by a CSS may be strengthened or weakened; likewise, the reinforcing or punishing efficacy of a stimulus may be increased or decreased.

Second, a given CSS may have many function-altering effects simultaneously. The CSS, "Each response will be followed by points and sometimes food delivery," will endow point deliveries with reinforcing effects and with eliciting properties appropriate to food delivery.

Third, the configuration of a CSS may be sufficiently complex that the effects of particular contingencies are mimicked (see Skinner, 1969, Ch. 6). For example, you might explain to your Spanish-speaking friend that "dog" and "cat" mean "perro" and "gato," respectively. As a result, "dog" and "cat" would acquire functions appropriate to "perro" and "gato," an outcome that resembles the effects of equivalence training. If, in a human operant experiment, the subjects were instructed that ". . . in red, every 50 lever presses will produce a quarter and in green, the first lever press after an average of one minute will produce the same . . . ," the resulting behavior may resemble the effects of extended training under a mult FR VI schedule.

IMPLICATIONS

The present paper has expanded the analysis of CSSs by positing a wide range of function-altering effects. Much of our analysis, though, is based on logic and on critical elements of basic principles of behavior (e.g., the definition of SD). Thus, the analysis could profit from empirical work. For example, researchers might study more closely the functions of stimuli described by CSSs. Moreover, they could investigate the histories that are necessary precursors to function-altering CSSs.

Function-altering effects of CSSs pro-

vide a possible mechanism for the similarities between "contingency-shaped" and "rule-governed" behavior (see Skinner, 1969, Ch. 6). Like CSSs, contingencies endow stimuli with particular functions that have obvious effects on behavior. For example, discrimination training endows stimuli with discriminative properties; correlations between stimuli endow neutral stimuli with reinforcing (or punishing) or eliciting properties. Thus, the similarity between contingencies and CSSs, in terms of their function-altering effects on stimuli, may account for the assumed similarity between the two classes of behavior.

The present analysis also has implications for how behavior analysts classify rules. As we stated previously, most behavior analysts classify rules as SDs. The present analysis of function-altering effects of CSSs, however, suggests a wider range of functions for rules. The result may be that behavior analysts will classify rules as function-altering CSSs rather than as SDs.

The function-altering analysis also relates to stimulus equivalence (see Sidman & Tailby, 1982). As already mentioned, the effected CSSs may mimic those of equivalence training. Contigency-specifying stimuli and equivalence training both alter the functions of other stimuli. These similar effects may suggest common underlying mechanisms and could, thus, aid behavior analysts in understanding both phenomena.

Finally, the concept of function-altering may be applied fruitfully to nonverbal stimuli. For example, in traditional accounts, reinforcers immediately follow behavior and increase responding. Consistent with the present analysis, one might argue that reinforcement brings behavior under evocative control of EOs and SDs. For example, after delivering food for key-pecking by a hungry pigeon, the rate of key-pecking will vary with food deprivation. In other words, the reinforcement contingency established a motivative relation between key-pecking and deprivation. Thus, the concept of "function-altering" might be a convenient, descriptive, and functional classification of all stimuli, verbal and nonverbal.

REFERENCES

Brownstein, A. J., & Shull, R. L. (1985). A rule for the use of the term, "rule-governed behavior." *The Behavior Analyst, 8,* 265–267.

Catania, A. C., Matthews, B. A., & Shimoff, E. (1982). Instructed versus shaped human verbal behavior: Interactions with nonverbal responding. *Journal of the Experimental Analysis of Behavior, 38,* 233–248.

Galizio, M. (1979). Contingency-shaped and rule-governed behavior: Instructional control of human loss avoidance. *Journal of the Experimental Analysis of Behavior, 31,* 53–70.

Hayes, S. C., Brownstein, A., Zettle, R. D., Rosenfarb, I., & Korn, Z. (1986). Rule-governed behavior and sensitivity to changing contingencies. *Journal of the Experimental Analysis of Behavior, 45,* 237–256.

Martin, G., & Pear, J. (1983). *Behavior modification: What it is and how to do it* (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Michael, J. (1980). On terms: The discriminative stimulus or SD. *The Behavior Analyst, 3,* 47–49.

Michael, J. (1982). Distinguishing between discriminative and motivational functions of stimuli. *Journal of the Experimental Analysis of Behavior, 37,* 149–155.

Michael, J. (1983). Evocative and repertoire altering effects of an environmental event. *VB News, 2,* 21–23.

Reynolds, G. S. (1975). *A primer of operant conditioning.* Glenview, Illinois: Scott, Foresman.

Rilling, M. (1977). Stimulus control and inhibitory processes. In W. K. Honig & J. E. R. Staddon (Eds.), *Handbook of operant behavior* (pp. 432–480). Englewood Cliffs, NJ: Prentice-Hall.

Shimoff, E., Catania, A. C., & Matthews, B. A. (1981). Uninstructed human responding: Sensitivity of low-rate performance to schedule contingencies. *Journal of the Experimental Analysis of Behavior, 36,* 207–220.

Sidman, M. (1960). *Tactics of scientific research.* New York: Basic Books.

Sidman, M., & Tailby, W. (1982). Conditional discrimination vs. matching-to-sample: An expansion of the testing paradigm. *Journal of the Experimental Analysis of Behavior, 37,* 5–24.

Skinner, B. F. (1953). *Science and human behavior.* New York: The Free Press.

Skinner, B. F. (1957). *Verbal behavior.* Englewood Cliffs, NJ: Prentice-Hall.

Skinner, B. F. (1969). *Contingencies of reinforcement: A theoretical analysis.* Englewood Cliffs, NJ: Prentice-Hall.

Skinner, B. F. (1974). *About behaviorism.* New York: Alfred A. Knopf.

Vaughan, M. E. (1985). Repeated acquisition in the analysis of rule-governed behavior. *Journal of the Experimental Analysis of Behavior, 44,* 175–184.