Separating Discriminative and Function-Altering Effects of Verbal Stimuli

Henry D. Schlinger, Jr.
Western New England College

Ever since Skinner's first discussion of rule-governed behavior, behavior analysts have continued to define rules, either explicitly or implicitly, as verbal discriminative stimuli. Consequently, it is not difficult to find, in the literature on rule-governed behavior, references to stimulus control, antecedent control, or to rules occasioning behavior. However, some verbal stimuli have effects on behavior that are not easily described as discriminative. Such stimuli don't evoke behavior as discriminative stimuli, but rather alter the functions of other stimuli in a manner analogous to operant and respondent conditioning. Hence, this type of control has been called *function altering*. Any known stimulus function (e.g., evocative, or [conditioned] reinforcing or punishing functions) can apparently be altered by such function-altering stimuli. Describing these stimuli as discriminative stimuli obscures their possible function-altering effects and consequently may retard inquiry into them. This paper encourages behavior analysts to begin separating the discriminative and function-altering effects of verbal stimuli and suggests that by doing so, behavior analysts may better understand what may be most unique about these stimuli. Results from several experiments, especially those in which children served as subjects, are analyzed. Finally, some speculations are offered concerning the genesis of function-altering stimuli.

Key words: rules, rule-governed behavior, function-altering stimuli, contingency-specifying stimuli, discriminative stimuli

Several recent papers (Blakely & Schlinger, 1987; Schlinger, 1990; Schlinger & Blakely, 1987) have argued that if the term *rule* is used by behavior analysts to refer simply to verbal stimuli¹ with discriminative effects, then an unnecessary special status has been accorded the term. In other words, if what we speak of as "rules" are nothing more than verbal discriminative stimuli (S^Ds), then a special term (*rule*) seems unnecessary, especially because a special term may be interpreted as a technical one (Brownstein & Shull, 1985). Moreover, investigation into the effects of rules would also be unnecessary, because there is al-

ready an extensive literature on stimulus control; the assumption is that verbal S^Ds are presumably no different than non-verbal S^Ds. These papers have also argued that the function of some verbal stimuli is not easily classified as discriminative, and, if we discover that these stimuli serve unique functions, then perhaps the term *rule*, if it is used at all, should be reserved for these events (Blakely & Schlinger, 1987; Schlinger, 1990). The stimuli in question don't evoke behavior as S^Ds. Rather, they alter the behavioral functions of other events and, hence, are called *function altering*. Cerutti (1989) suggested that rule-governed behavior is difficult to define because there is no "set of common features that may define a functionally distinct category" (p. 261), but once stimuli with discriminative effects are separated from stimuli with function-altering effects, the latter may constitute such a functionally distinct category. In fact, the effects of such stimuli, called *function-altering stimuli* (FASs), can be shown to be analogous to the effects of respondent and operant conditioning. The present paper will describe some of the general implications of a function-altering interpre-

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Correspondence concerning this article should be addressed to Henry D. Schlinger, Jr., Department of Psychology, Box 2227, Western New England College, Springfield, MA 01119.

¹ In the present paper, the term *verbal stimuli* refers simply to the stimulus products of an individual's verbal behavior.

tation of stimuli with a specific emphasis on the study of rule-governed behavior in children. The first step is to distinguish between stimuli that are discriminative and those that are function altering.

DISTINGUISHING DISCRIMINATIVE FROM FUNCTION-ALTERING EFFECTS OF VERBAL STIMULI

Discriminative Effects of (Verbal) Stimuli

According to Michael (1980), a discriminative stimulus is a stimulus that evokes a response because that response has been more successful in the presence than in the absence of the stimulus. The term *evoke* is synonymous with *stimulus control* and refers to increasing the momentary frequency of a response (an operant) by a stimulus with this training history² (Michael, 1980). However, behavior analysts should be cautious about classifying stimuli as S^Ds just because they precede behavior and seem to be functionally related to it. Consider the following instruction: "When the bell rings, stand up and walk out of the room." Although the statement does precede the behavior of actually standing up and walking out of the room, and is obviously functionally related to it, it does not *necessarily* qualify as an S^D; that is, it may not possess all of the characteristics of stimuli that we speak of as S^Ds. There are two reasons. The first is that the behavior is not properly considered to be evoked (i.e., momentarily strengthened) by the statement. Even "set the occasion" doesn't sound right; that is, it doesn't seem appropriate to say that the statement set the occasion for standing up and leaving the room. Rather, it is the sound of the bell that evokes (or occasions) the behavior.

The second reason that the statement

may not properly be interpreted as an S^D is that we cannot be sure that the statement has been used in the discrimination training that we normally associate with stimuli we call S^Ds. Finally, tempted though we may be to ascribe S^D properties to the bell, that may not be correct either, because the bell acquired its evocative functions as a result of the statement and not because of a direct history of differential reinforcement. Some have suggested that a direct history is not necessary for a stimulus to still be considered an S^D (Cerutti, 1989). In support of this position, Cerutti and others (e.g., Catania, Matthews, & Shimoff, 1990) argue that rules exploit "generalized classes that can be recombined in novel instructions that produce novel complex responses" (Cerutti, 1989, p. 261). This statement may be true, but it doesn't necessarily mean that we should describe the rule's function as a discriminative one. Although we may debate whether the bell should be considered an S^D for standing up and walking out of the room, the question of whether to classify the statement as the S^D for the behavior is more difficult. The behavior is not reinforced in the presence of the statement nor is reinforcement more readily available in the presence of the statement, and the statement doesn't evoke the behavior. At the present time, there doesn't appear to be any data-based justification for altering the definitional requirements of the S^D to fit discrepant human situations (Schlinger, Blakely, Fillhard, & Poling, 1991).

In addition to the problems of incorrectly assigning discriminative properties to events that are likely not S^Ds, several other potential problems with assigning special status to verbal S^Ds arise. As already stated, a special term for verbal S^Ds seems unnecessary, especially if the effects of such events are no different from those of nonverbal S^Ds. If verbal S^Ds do not differ in principle from nonverbal S^Ds, then special research into the effects of such stimuli is also unnecessary. We already possess a significant body of knowledge concerning the effects of S^Ds, and whether they are verbal or not seems irrelevant.

² Stimulus control also includes the effects of stimuli correlated with extinction (or punishment), traditionally called S-deltas, which would have the effect of decreasing the momentary frequency of behavior.

Function-Altering Effects of (Verbal) Stimuli

The term *function altering* is used to refer to environmental operations that alter the behavioral functions of other stimuli (Schlinger & Blakely, 1987). Because of the ubiquity of the function-altering nature of certain environmental operations, it appears that function-altering operations (FAOs) may represent a fundamental process underlying what we traditionally speak of as learning. For example, the following operations all change stimulus function: (a) respondent operations (e.g., respondent conditioning, respondent extinction); (b) operant operations (e.g., operant conditioning, operant extinction, punishment, discrimination training, conditional discrimination training); (c) the operations that produce conditioned reinforcers and punishers; (d) matching to sample; (e) schedule-induced operations; (f) various verbal operations (e.g., observational learning, verbal stimuli [rules]); and other environmental operations (e.g., imprinting). Moreover, effects such as overshadowing, blocking, latent inhibition, sensory preconditioning, and semantic generalization are all examples of the function-altering nature of environmental operations.

Consider basic operant conditioning. In operant conditioning, reinforcers do not simply increase the frequency of the behavior they follow. Reinforcement brings behavior under the evocative control of establishing operations (EOs), and S^Ds if differential training is involved. Thus, reinforcement as a function-altering process alters the function of the motivational variable (and the S^D if there is one) to evoke the behavior that produced the reinforcer. For example, if lever presses are followed by food in a food-deprived rat, the effect is to establish the evocative function of food deprivation. This relation could be more clearly evidenced by placing a satiated animal in the chamber and then, if it were possible, to immediately instate food deprivation. The effect would be to evoke (i.e., increase the momentary frequency of) be-

havior that in the past has been successful, namely, lever pressing. Likewise, discrimination training alters the evocative functions of some stimulus, and, thus, brings behavior under the joint control of an EO and that stimulus.

In respondent conditioning, the procedure of correlating stimuli alters the function of neutral stimuli (NSs) to be conditional stimuli (CSs), and another type of stimulus-stimulus correlation alters NSs to function as conditioned reinforcers (or punishers). The matching-to-sample procedure used in stimulus equivalence research is also a function-altering operation. In fact, as already implied above, any operation that results in the transfer of stimulus function is properly described as function altering. Verbal interactions are replete with such FAOs.

The most important point for the present discussion is this: Just as verbal stimuli can be discriminative and, therefore, can mirror the effects of nonverbal discriminative stimuli, verbal stimuli can also be function altering and, therefore, can mimic the nonverbal FAOs of operant and respondent conditioning. The difference, of course, is that verbal S^Ds may be functionally no different than nonverbal S^Ds, whereas verbal FASs are very likely to be different from the nonverbal contingencies they mimic. In fact, Skinner (1966) was presumably concerned with these issues when he first approached the issue of rule-governed behavior. Actually, Skinner had described the unique function-altering effects of verbal stimuli much earlier in his book, *Verbal Behavior* (1957), in a section aptly titled "Conditioning the Behavior of the Listener" (p. 357), which hints at what may be most interesting about verbal stimuli, that is, that they can mimic the effects of operant and respondent processes. Nevertheless, when Skinner formalized the distinction between rule-governed and contingency-shaped behavior, he probably erred by describing the function of these verbal stimuli as S^Ds, although such an interpretation is understandable (cf. Cerutti, 1989).

The necessary and sufficient properties

of stimuli that make them verbal FASs are not clear. Elsewhere it has been argued that such stimuli most likely possess certain formal properties (Schlinger, 1990; Schlinger & Blakely, 1987). Simply stated, it was suggested that such stimuli must specify the events to be related; in other words, to borrow a term from Skinner (1969), they must be *contingency-specifying stimuli* (CSSs). In other words, a function-altering CSS must name at least two events (e.g., two stimuli, or an antecedent stimulus and a response, or a response and a consequence, etc.). Of course, three (or more) events may also be included, typically a stimulus, a response, and a consequence. When formally defined, most instances of verbal statements that produce function-altering effects may be said to be contingency specifying only in the sense that the formal verbal unit contains at least two terms. However, not all verbal FASs need contain two or more terms. In sophisticated listeners it is common for a single word to have function-altering effects. For example, if someone is about to eat some food and someone else says, "poison," this alters the evocative function of the sight of the food in the sense that it decreases the momentary probability of the behavior of putting it in the mouth. Some might suggest that there is an implicit CSS in the word "poison" (e.g., "If you eat this food you will get very sick"). However, such a suggestion begs the question concerning the function of the verbal stimulus. Thus, irrespective of the form of the verbal stimulus, if it is function altering then we may speak of it as a rule.

Verbal FASs can alter several behavioral functions, including (a) the evocative functions of stimuli that mimic the evocative effects of discriminative and motivational events, (b) the evocative functions of stimuli that mimic respondent conditional stimuli, and (c) the reinforcing or punishing functions of stimuli that mimic the same effects that result from nonverbal procedures.

Given this brief description of discriminative and function-altering effects of verbal stimuli, we may now move on to

examine how one may attempt to separate their respective effects in experiments on rule-governed behavior.

A Function-Altering Versus Discrimination Interpretation of "Rules"

Suggesting that some verbal stimuli have function-altering effects is one thing; demonstrating those effects is another. Such a demonstration is especially difficult when attempting to separate discriminative from function-altering effects. An even more difficult task is to try to convince behavior analysts that a discrimination theory of rules (e.g., Cerutti, 1989) may be inadequate to explain all of the effects of verbal stimuli. Consider the following example: "When you come to a red light put on the brakes by pressing the pedal on the left." Now, if such a statement controls the appropriate behavior, classifying it as an S^D seems natural. According to Malott (1989), an S^D is a stimulus in the presence of which a particular behavioral contingency is more likely to be operative. However, it is difficult to find in this example a behavioral contingency occurring in the presence of a stimulus that we can then call an S^D . If we use Michael's (1983) definition of the S^D and include an evocative (or occasioning) requirement, then there would have to be a momentary increase in the probability of the behavior controlled by the rule (Michael, 1983). Although we might be able to make a case for the red light as the S^D for pressing the pedal, making a case for the statement as the S^D is more difficult.

Separating discriminative from function-altering effects of rules becomes even trickier when a CSS is stated and alters the function of some event that is already present, such that the relevant behavior immediately occurs. In these situations the temporal proximity between the CSS and the behavior it specifies makes it appear that the CSS evoked the behavior, thus strengthening an S^D interpretation. Consider the following instruction, taken from Ayllon and Azrin's (1964) study with mental patients, which compared

reinforcement with instructions for picking up eating utensils: "Please pick up your knife, fork, and spoon, and you have a choice of extra milk, coffee, cigarettes, or candy." Does this statement function as a discriminative or a function-altering CSS? In other words, does the CSS evoke the relevant behavior only because of a history, even generalized, of discrimination training, or does the CSS alter the function of the sight of the utensils? In this case, the utensils were presumably within sight of the patient at the time of the instruction. So, was picking-up behavior evoked by the combination of the statement and the sight of the utensils (as a conditional S^D), or did the CSS alter the evocative (S^D -like) function of the utensils? Obviously, it is extremely difficult to tell. Of course, there is always the possibility that the CSS may have both effects simultaneously. In fact, it is only when there is greater temporal separation between a CSS and the specified behavior that we may more clearly point out its function-altering effects. This does not mean that function-altering effects occur only after long temporal delays. Some behavior analysts would still appeal to a discrimination theory to explain such relationships, irrespective of the temporal delay (e.g., Cerutti, 1989). However, as was recently pointed out, there is also some disagreement among behavior analysts concerning the necessary and sufficient defining properties of S^D s (Schlinger et al., 1991).

Fortunately, the best evidence against a discrimination interpretation of FASS comes from examples of CSSs that affect behavior but that don't seem explainable in terms of a discrimination interpretation. As stated previously, verbal stimuli can alter respondent-like stimulus functions, including those that endow previously neutral stimuli with reinforcing or punishing effects. In *Verbal Behavior*, Skinner (1957) offered the example, "When you hear the bell you will feel a shock." Now, when the bell rings how do we account for increases in the subject's GSR and heart rate? Certainly not in terms of operant stimulus control by the statement. In this example the bell evokes

GSR and heart rate *as if* it had been correlated with the shock in a respondent conditioning procedure. The question is this: How did the bell acquire such evocative functions? The answer seems clearly to implicate the CSS, but not as an S^D . The human operant literature is replete with examples of CSSs that seem to endow various stimuli (e.g., lights and sounds) with potential reinforcing or punishing properties. For example, in a study with young children using a repeated-acquisition design, Vaughan (1985) stated, among other things, that, "Sometimes you will hear a nice sound for pressing a button, but at other times you will hear a loud buzzer telling you that you have pushed the wrong button" (p. 177). In another example, Danforth, Chase, Dolan, and Joyce (1990) stated to college students who served as subjects, "Each time you make a correct response a beeper will sound" (p. 99). Finally, in a study by Matthews, Shimoff, Catania, and Sagvolden (1977), college students read the following "instructions": "Each point is worth 0.1¢. For example, if you earn 2,000 points, you will be paid \$2.00" (p. 455). In each of these cases, different stimulus changes—points and sounds in the Vaughan (1985) experiment, sounds in the Danforth et al. (1990) experiment, and points in the Matthews et al. (1977) study—were endowed by the CSSs with reinforcing (or punishing) properties. These changes in stimulus functions could easily be tested by comparing performance on a simple task before and after the stated CSS. It is difficult to imagine how a discrimination interpretation could explain these effects.

Following from the logic that CSSs can alter respondent-like evocative and reinforcing or punishing functions of stimuli, we are led to conclude that S^D -like evocative functions can also be altered. For example, Vaughan (1985) instructed her children, "Do not begin pushing buttons until the panel lights come on" (p. 178). In addition, some of the subjects in the Matthews et al. (1977) study read, "Whenever the RED LIGHTS beside the counter are on, each press on the RED BUTTON will add one point to your to-

tal" (p. 455). Vaughan's instruction specifies stimuli and responses (panel lights and button presses), whereas the instruction of Matthews et al. specifies a three-term contingency—red lights (and the red button), button presses, and points. In both cases, however, appropriate responding was brought under the control of the relevant stimulus as a result of the CSS or, said another way, the CSS endowed the relevant stimuli with evocative (S^D -like) functions. Of course, some might still argue that the statements are S^D s for the behavior. However, there are more straightforward examples of discriminative (instructional) control. For example, in the Matthews et al. (1977) study, the last line of the instruction card read, "Put on the headphones now . . .," which presumably evoked the appropriate behavior as a (conditional) S^D (or possibly as an EO). The next part of the instruction, however, read ". . . and do not remove them until the end of the session" (p. 455). This CSS controls behavior by altering the stimuli that signal the end of the session such that they evoke the behavior of removing the headphones, and is thus function altering.

SOME IMPLICATIONS OF FAILING TO DISTINGUISH BETWEEN DISCRIMINATIVE AND FUNCTION-ALTERING CONTROL

Now that we have differentiated discriminative from function-altering effects, further discussion is possible of the implications of failing to make the distinction, especially in research involving the control of behavior by verbal events.

Semantic Implications: The Language of Rule-Governed Behavior

The first implication of failing to distinguish between discriminative and function-altering effects of verbal stimuli concerns how behavior analysts talk about verbal events. First, in many instances behavior analysts have fallen into the (cognitive) trap of talking about rules as structural entities. For instance, Ma-

lott (1989) distinguishes between contingencies that are direct-acting and those that are not direct-acting. Direct-acting contingencies involve effective behavioral outcomes (consequences) for the causal response, whereas indirect-acting contingencies involve outcomes that are not effective for the causal response; in other words the behavioral outcome is too delayed, too improbable, or too small to be effective. For example, the improved health resulting from a low-fat diet is too delayed to reinforce the behavior of eating healthy food. Obviously, direct-acting contingencies control behavior through known laws of conditioning, but what about indirect-acting contingencies? They are defined on the basis of structural rather than functional characteristics; that is, they involve outcomes that do not function as effective behavioral consequences. So what behavioral function do they have? It is difficult to imagine, because indirect-acting contingencies by definition do not act. Nevertheless, Malott (1989) distinguishes between rules that specify direct-acting versus indirect-acting contingencies and, moreover, between rules that are complete versus incomplete. But again, these are structural and not functional distinctions. And what about the function of rules? Of course, indirect-acting (or "remote," see Michael, 1986) contingencies are interesting precisely because at times they do seem to affect behavior. A discrimination (or motivation) interpretation, however, would seem to fall short in explaining how such long spatio-temporal gaps can be mediated. Of course, we could always bridge the gap with cognitive—mediational—analyses. The present paper argues that perhaps one, indeed the only, way that such indirect-acting "rules" might affect behavior is by altering the behavioral functions of the events specified by the rules.

A second semantic problem with behavior analysts' treatment of stimuli called rules is that in many instances when behavior analysts have taken a functional approach to rule-governed behavior, they have confused discriminative and func-

tion-altering effects, usually by failing to correctly identify function-altering effects. The result, as might be expected, is that the language of discrimination (or motivation) is used to describe function-altering processes. For example, behavior analysts have defined rules variously as "antecedent verbal stimuli" (e.g., Catania et al., 1990; Hayes, 1986)—a structural definition—or as a "verbal description of a contingency" (Braam & Malott, 1990)—another structural definition. And although the function of these antecedent verbal stimuli that describe contingencies is rarely specified, it is frequently implied as being discriminative. For example, Catania et al. (1990) describe rule-governed performances as "occasioned," the same term used to refer to control by S^Ds. Presumably rules are S^Ds that "occasion" the performances. Braam and Malott (1990) define rule-governed behavior as behavior under the control of a rule. But they define a rule as a "verbal description of a contingency." What kind of control is implied? Interestingly, they suggest that rules function as establishing operations. In both cases, however, rule control would have to be seen as evocative and not as function altering; that is, the rule evokes the relevant behavior *as a part* of a (direct-acting) contingency of reinforcement like any other S^D or EO. Behavior analysts should not make the mistake of assuming that there are essential properties of rules that distinguish them from other stimuli (see Palmer & Donahoe, 1992). The position of the present paper is that verbal stimuli must be classified according to their function, and if some verbal stimuli are no different than their nonverbal counterparts, they should not be distinguished with a special term (see also Blakely & Schlinger, 1987; Schlinger, 1990).

Finally, another semantic byproduct of a discrimination interpretation of rules is the use of lay-cognitive terminology such as "rule following," "following instructions," "rule compliance," or "obeying rules." These and other ways of describing rule-governed behavior are organism based and not environment based and,

hence, they open the door to cognitive interpretations.

Methodological Implications: The Function(s) of Instructions

The methodological implications of failing to distinguish between discriminative and function-altering effects of verbal stimuli are related to the semantic implications. In other words, the ways in which behavior analysts talk about the verbal stimuli they speak of as rules have determined the types of research into their effects. As stated earlier, behavior analysts typically interpret rules (or instructions) as S^Ds. Consider the term *instruction*. For several researchers, an instructional stimulus is one that is correlated with reinforcement for correct responding or, in other words, a discriminative stimulus. For example, in repeated-acquisition experiments, Boren and Devine (1968), Vaughan (1985), and Danforth et al. (1990) all programmed stimuli that accompanied each correct response in the chain. In the studies by Boren and Devine (1968) and Vaughan (1985), a light appeared above the correct response, and for Danforth et al. (1990) either a small dot or the phrase, "This one is correct," accompanied correct responses. Although the effects of these "instructions" on behavior are interesting, if the effects are only discriminative, then it is doubtful that we learned much that is new about any unique functions of "instructions" or, according to the present interpretation, about rule-governed behavior.

In much of the human operant research, the specific function of instructions has not been considered. In fact, in many studies the instructions are defined more by their structural properties, such as whether the instructions specify deadlines or immediate or delayed consequences (e.g., Braam & Malott, 1990). Their function is usually considered in a more global fashion in terms of whether their presence has *any* effect on responding. Sometimes the effect of interest is whether the presence of instructions is

related to human performances that deviate from those of nonhumans under similar schedules (e.g., Baron & Galizio, 1983). At other times, the effect of interest is how the specific nature of the instructions is related to the rate and patterning of behavior (e.g., Buskist, Bennett, & Miller, 1981). As already stated, instructions in human operant experiments frequently have both discriminative *and* function-altering effects. Of course, one of the points of the present paper is to suggest that separating these two functions may lead behavior analysts to a more complete understanding of the ways in which verbal stimuli affect behavior.

STUDIES ON RULE-GOVERNED BEHAVIOR IN CHILDREN

One way of better understanding the behavioral effects of verbal stimuli and their genesis is to use very young language-learning children as subjects. Investigations into the control of children's behavior by so-called rules or instructions, however, are rare. In fact, most such studies, when they exist, were usually conducted under some other guise. For example, consider the research into so-called "say-do" correspondence training. Correspondence training, by definition, concerns the relation between what a person says he or she will do and whether he or she actually does it; that is, the extent to which the two correspond. Although studies on correspondence training do not directly examine the genesis of control by verbal stimuli, they do shed light on some problems that might be helpful in disentangling their discriminative from their function-altering effects. Some researchers (e.g., Deacon & Konarski, 1987) have speculated that the correspondence behaviors may occur not because the child promises to do the behavior but because the child construes his or her own "rule," for example, "In order to get the toy, I must do what I say I will do." As Baer, Detrich, and Weninger (1988) point out, such an interpretation "implies that the verbalization by the subject is functionally unnecessary to the performance of the target behavior . . . because the rule can be generated and

followed in the absence of verbalizations by the subject" (p. 346). There are, however, problems with this interpretation, not the least of which is the problem of inferring a subject's covert verbal behavior as a causal variable. Moreover, the two studies in which such rule-governed behavior was implicated involved mentally retarded subjects and 4-year-old children, respectively. Whether either group was sophisticated enough verbally to construct such rules is not clear (cf. Mistr, 1992; Pouthas, Droit, Jacquet, & Wearden, 1990). For the present argument, we must ask whether it is really necessary to make such inferences in order to provide a functional account of the behavior. One possibility is that the experimenters' initial instruction and/or verbal feedback may be the variable controlling the child's behavior (Baer et al., 1988). In fact, using a multiple baseline across toy-play behaviors, Baer et al. showed with preschool children that there were no consistent differences in the children's target behaviors between conditions with only the experimenters' instruction and those with the child's verbalization. This result provides support for the suggestion that the child's verbalization may not be functionally related to the target behavior. The possibility that the experimenters' instruction was the critical variable suggests a function-altering interpretation. Thus, the CSS, "Today you need to play with the puzzle if you want to get a treat," might have altered the evocative functions of the sight of the puzzle when the child finally saw it. This process mimics the effects of operant discrimination training. Consider, by contrast, whether the sight of the puzzle would have evoked playing behavior in the absence of the CSS. Of course, it is possible, as it is in all instances of function-altering control, that the child simply repeated (cognitive psychologists would say "rehearsed") the instructions until she saw the puzzle, at which point it might be argued that the self-repeated instructions were still evoking the behavior as an S^D. However, this possibility seems unlikely.

Consider the aforementioned study by Braam and Malott (1990), in which they

examined the effects of deadlines and delayed consequences on rule compliance in preschool children. In their study the following conditions were compared: (a) no deadline and no reinforcer, (b) immediate deadline and immediate reinforcer, (c) immediate deadline and no reinforcer, (d) no deadline and delayed reinforcer, and (e) immediate deadline and a delayed reinforcer. Each of the conditions was accompanied by a statement from the experimenter; for example, in the condition with immediate deadlines and delayed reinforcers, the experimenter said, "Here's a puzzle you can do. I don't care if you do it or not. Here's the rule: If you do the puzzle, now, one week after you finish the puzzle, you can go to the Magic Box" (p. 71). Braam and Malott found, not surprisingly, that the conditions with immediate deadlines and reinforcers produced the highest "compliance." However, they also found that immediate deadlines and delayed reinforcers resulted in fairly high compliance. Braam and Malott concluded that it is not the delay of the reinforcer that is critically important in control by the "rules," but rather the presence or absence of a specified deadline. Although Braam and Malott referred throughout their article to the instructions as SPs and S-deltas (i.e., they used the language of discrimination), they concluded that the "rules" controlled the relevant behavior as EOs. According to them, "the statement of the rules established noncompliance with the rule as a learned aversive condition, so compliance with the rule immediately, and perhaps automatically, terminated or reduced this aversive condition" (p. 75). Perhaps they are right. Although they attempted to control for the neutrality of the experimenter's instruction to the children, the use of the word "now" may have been the critical word (Mistr, 1992). It is likely that for many children the word "now" spoken by an adult has in the past been correlated with other aversive events that could be reduced by compliance. Braam and Malott (1990) did not present data indicating how quickly the children complied with the rule when they did, but if the instruction did function as an EO, then we would expect that the be-

havior controlled by it would have occurred fairly quickly. That is, it would have been evoked by the instruction (Michael, 1982). Indeed, in a study that replicated and extended Braam and Malott's (1990) study, Mistr (1992) noted that when the opportunity to respond was immediately available, most of the children responded immediately regardless of the deadline. So, what is interesting about the Braam and Malott study? The answer must be that the results are interesting *if* we get caught up in the structural interpretation of certain verbal stimuli, for example, whether "rules" specify direct or indirect-acting contingencies.³ But are these, as Braam and Malott suggest, really the "critical components" of rules? Based on the arguments in the present paper, we can suggest that verbal stimuli that control behavior as SPs or EOs are not that interesting for an experimental or theoretical analysis of behavior and that behavior analysts should attempt to discover whether there are other types of controlling relations that have yet to be fully uncovered.

One of the biggest problems of failing to distinguish between evocative and function-altering effects of verbal stimuli is that there has been no research into the provenance of function-altering effects. However, there are some data that suggest something about how such behavioral relations might develop.

STUDIES WITH IMPLICATIONS FOR THE DEVELOPMENT OF VERBAL FASs

An experiment on the relation between subjects' verbal behavior and the formation of equivalence classes by Wulfert,

³ Braam and Malott (1990, p. 68) interestingly defined rule-governed behavior as "behavior under the control of a rule," which is to be "contrasted with behavior controlled directly by the contingency described by the rule." However, although they concluded that they were studying rule-governed behavior, they also concluded that the rules specifying deadlines functioned as EOs, thus "creating a direct-acting contingency," which would mean that they were not studying rule-governed behavior at all, unless we define rules only in terms of their structural, that is, syntactic, properties.

Dougher, and Greenway (1991) suggests not only that equivalence-class formation depends upon the presence of verbal FASs, but also what the necessary verbal constituents for such function-altering effects might be. In their first experiment, Wulfert et al. had college students think aloud as they responded on a matching-to-sample task. The experimenters then correlated accuracy of responding on symmetry and equivalence tests with the type of verbalization for each subject. Verbalizations were classified according to four different categories: (a) "relational responding," which included references to the relationship between two stimuli, for example, "circle goes with the open triangle"; (b) "common physical features," which meant relating pairs of stimuli according to nonarbitrary features, for example, "they look alike"; (c) "stimulus compounds," which meant that the subjects visually integrated the sample and comparison stimulus, for example, "together they look like a house"; and (d) "other," which included all other responses including silence. The experimenters found that those subjects who did not exhibit equivalence rarely engaged in relational verbal responding, although they did name compound stimuli to varying degrees. On the other hand, the subjects who did show equivalence used relational phrases most of the time. In a second experiment, Wulfert et al. (1991) controlled their subjects' verbal histories concerning the experiment by pretraining responding either to the compound stimuli or to the relation between stimuli. The results were as expected: Subjects trained to respond to stimulus compounds did not show equivalence during test trials, whereas subjects trained to respond to the relation did show equivalence. Moreover, subjects in both groups continued to respond verbally during training and testing as they were taught to do during pretraining.

Regarding the present discussion of verbal FASs, the Wulfert et al. (1991) study is important mostly because it demonstrates that the presence of certain verbal stimuli, namely, those that specify relations between stimuli (i.e., CSSs), is

sufficient to alter the evocative function of stimuli in the symmetry or equivalence tests. Conversely, responding only to the stimulus compound did not alter the function of a novel stimulus to evoke the correct match during an equivalence test.

The subjects in the Wulfert et al. (1991) study were adults, therefore, it might be informative to examine the age at which such verbal responding normally appears. An interesting experiment by Pouthas et al. (1990) seems to do just that. Pouthas et al. were interested in whether the duration of button pressing in children aged 4.5, 7, or 11 years would conform to scheduled contingencies of reinforcement and, furthermore, whether the children would correctly describe the contingency and whether their behavior would be more sensitive to their descriptions or the actual contingencies. For one group of children the experimenters used posttrial probes, by asking after each trial, "What did you have to do to get very good?" For a second group of children the experimenters used postsession interviews comprised of similar questions. The results showed that the 11-year-olds, but not the 4.5- or 7-year-olds, were able to correctly describe the "rule" for correct responding, but only when they were asked in posttrial probes rather than in postsession interviews. Moreover, the button-press behavior of the 11-year-olds corresponded to their accurate descriptions. And, although the button-press behavior of the 4.5- and 7-year-olds was fairly accurate, their descriptions were more primitive than those of the 11-year-olds. For example, although the 11-year-olds gave contingency-specifying statements, such as, "You must count up to *n* (to get very good)," the 4.5-year-olds emitted phrases like, "press on the button," which specifies only behavior. In contrast, the 7-year-olds said things like, "You must press very hard," another CSS which, as the authors pointed out, resulted incidentally in more successful responding; that is, the harder the button press, the more likely it will be of longer duration. These results are interesting not only because they reveal something about

the possible developmental course of FASs in children but also because they reveal that even in humans who are probably capable of generating FASs, behavior can still be sensitive to the prevailing contingencies (Baxter & Schlinger, 1990).

Not surprisingly, the age of the child is related to whether verbal stimuli will produce function-altering effects. Consider the aforementioned study with 4- and 5-year-old children by Mistr (1992). This is perhaps the only experiment that has attempted to separate evocative from function-altering effects of verbal stimuli. Mistr compared two sets of conditions, one in which the opportunity to respond after a CSS was immediate and the other in which the opportunity to respond after a CSS was delayed. Her instructions to the children were similar to those used in the Braam and Malott (1990) experiment. For example, in a condition that specified no deadline, an immediate reinforcer, and in which the opportunity to respond was delayed, the instruction to the children was, "I'm going to put out some toys for you to pick up later. I do not care if you pick them up or not. If you pick up the toys, you can go to the Goodie Box when you're finished" (p. 22). Mistr found that, regardless of the specified deadlines or delays of reinforcers, a majority of the children in the immediate-opportunity-to-respond condition responded within seconds of the stated CSS. This suggests that the CSSs evoked the relevant behavior. Interestingly, Mistr found that, with only one exception, when the opportunity to respond was delayed, "Statements which specified a deadline and a reinforcer, either immediate or delayed, did not reliably control the behavior of 4 to 5 year olds" (p. 49). The exception was the condition in which there was no deadline but there was an immediate reinforcer. These results confirm the analysis of the Braam and Malott (1990) study offered above; that is, their so-called "rules" were functioning as evocative events—possibly EOs as they suggest—but not as function-altering events. Incidentally, the no-delay, immediate-reinforcer and delayed-opportunity-to-respond condition in the

Mistr (1992) study is the only condition that suggests that the CSS may have been function altering and not evocative. In this condition the toys, not the CSS, evoked the behavior of picking up the toys. As predicted by a function-altering interpretation, "the child picked up the toys upon spotting the toys specified in the statement" (Mistr, 1992). That is, the evocative function of the sight of the toys had been altered by the CSS. However, the fact that the CSS reliably controlled the behavior of only 60% of the children in this condition suggests that, when the opportunity for immediate responding is prevented, CSSs such as the ones used by Mistr may not perfectly control the behavior of 4- and 5-year-old children. This limitation may not be surprising when one considers the complexity of the CSSs used in this study. For example, in the condition with delayed deadlines but immediate reinforcers and a delayed opportunity to respond, the instruction to the child was, "I'm going to put out some toys for you to pick up later. I do not care if you pick them up or not. If you pick up the toys before outside playtime, you can go to the Goodie Box when you're finished" (p. 20). This statement is fairly complex. That it does not control the behavior of 4- and 5-year-old children as a function-altering event is not surprising.

Taken as a whole, then, the experiments described above on correspondence training (e.g., Baer et al., 1988) and the studies by Braam and Malott (1990), Mistr (1992), Pouthas et al. (1990), and Wulfert et al. (1991) suggest that by the age of 11 years, humans are able to construe their own verbal FASs, and that for children as young as 4 or 5 years, simple, but not complex, verbal stimuli are able to alter stimulus functions reliably.

THEORETICAL IMPLICATIONS: THE PROVENANCE OF FUNCTION-ALTERING CSSs

The question that is most basic to the present discussion is this: How do verbal stimuli acquire function-altering effects? When a verbal stimulus alters evocative discriminative-like functions it is easy to

appeal to a discrimination theory (e.g., Cerutti, 1989) to understand the provenance of the effects. Cerutti refers to the alteration of S^D -like functions by verbal stimuli as "instructed discrimination," and he posits that the instructed stimuli are "generalized discriminative classes" whose "control over responses . . . generalizes to new combinations of stimuli in complex instructions" (p. 262). He gives the example of "Step on the brake pedal and come to a stop at a red light." In Cerutti's terms, the control by red lights over stopping is "instructed." In terms of the present analysis, the statement endows the red light with evocative control over the behavior of stepping on the brake pedal. Although these descriptions sound like they are different ways of saying the same thing, the real difference goes to the main point of the present paper. According to Cerutti's discrimination theory of rule-governed behavior, each of the constituent stimulus elements in the statement controls one property of the response, for example, the response itself, its location, and its stimulus occasion. The entire statement exerts its control by combining previously but separately conditioned parts of the whole.

Although the present paper attempts to make the case for separating discriminative from function-altering effects of verbal stimuli, an interpretation of rules according to a discrimination theory remains reasonable. After all, this sort of interpretation uses fundamental behavioral principles as a basis for the interpretation of complex behavior (e.g., Palmer, 1991; Schlinger, 1992). And, Cerutti's (1989) discrimination theory of rule-governed behavior is an admirable attempt following from Skinner's interpretation of rules as S^D s. However, as stated previously, there are other function-altering effects that do not seem easily interpretable in operant discrimination terms. Perhaps there is more than one process at work, or perhaps there is a unitary process that is more than operant discrimination. Certainly Cerutti must be correct in suggesting that verbal stimuli produce their effect in part because their elements combine in some

novel manner. But what about verbal stimuli that are not CSSs; for example, one-word stimuli that are function altering? What elements combine in these instances? Our task as behavior analysts is to try to guess at the conditions necessary for the function-altering effect to happen.

Let us briefly consider two types of CSSs in an attempt to understand the differences between a discriminative and a function-altering approach to the problem. The first CSS is one that alters the evocative (CS-like) effects of a stimulus, and the second is one that alters the evocative (S^D -like) effects of a stimulus. In the first example, an experimenter tells a subject, "When you hear a bell you will feel a shock." Several minutes later a bell rings and the subject's heart rate immediately increases. This effect resembles, indeed, mimics, respondent conditioning, but the effect was achieved entirely as a result of the CSS. Alessi (1992) has referred to this effect as (verbal) analogue respondent conditioning. In essence, the bell and the shock have been made equivalent by being "paired" or "associated" within the statement, formally a "contingency-specifying stimulus." What kind of history is necessary for such an effect to occur? The question, of course, is ultimately an empirical one, but we may speculate about the answer in the absence of direct empirical evidence. First, it seems that the subject must have independently heard bells and felt some kind of electric shock before. Second, we might assume that the subject can tact bells and shock; that is, given the events themselves, the person can say "bell," or "shock." Third, we might ask whether the person can identify these events when the word "bell," or "shock," is heard, for example, by pointing toward the correct object. This latter type of functional relation has been termed a stimulus-selection-based language (Michael, 1985). We might also want to know whether a matching-to-sample repertoire is necessary or sufficient, especially because this type of repertoire forms the basis of the research on stimulus equivalence and stimulus equivalence has been suggested to be an important component in language func-

tion (Hayes, 1986). And, of course, we might want to know whether equivalence can already be demonstrated between objects and the verbal responses (tacts) evoked by them (e.g., Sidman, 1971). Whether verbal behavior is necessary for stimulus equivalence (cf. Wulfert et al., 1991) or stimulus equivalence is necessary for "true" verbal behavior (Devaney, Hayes, & Nelson, 1986; Hayes, 1986), it is obvious that verbal stimuli, whether in the form of CSSs or not, can alter stimulus function. Perhaps this effect is an emergent phenomenon. If so, maybe it is what is truly unique about verbal stimuli.

In the second example, a mother tells her child: "When the timer goes off, please take the cake out of the oven." Two hours later, the timer goes off and the child immediately takes the cake out of the oven. As a result of the CSS, the timer evokes the behavior of removing the cake from the oven and, therefore, mimics the effects of operant discrimination training. This effect may be called analogue discrimination training (e.g., Alessi, 1992). But how does it happen? It is possible, but unlikely, that the child simply repeated the request during the entire two-hour period, although the child probably did repeat it a couple of times. It is also possible that when the timer timed out, the child immediately said, "Oh I must take the cake out of the oven." In this case the self-statement might function in part like an S^D . Even if this were true, we would still have to explain *how* the timer acquired evocative control over the self-statement. Of course, although the present paper has argued against this practice, we could simply classify this function as another instance of stimulus control and call the statement an S^D for taking the cake out of the oven. But if we resist this discrimination interpretation, how can we account for the function-altering effects of this CSS? One approach is to analyze the formal properties of the CSS under the assumption that an understanding of each part might reveal something about control by the whole. For example, the command, "Take the cake out of the oven," presumably already

controls the behavior as an S^D or an EO. That is, it evokes the behavior (in combination with the sight of the oven) because of a relevant (even generalized) history. But what about the function of, "When the timer goes off . . ."? In essence, the timer and the command, "Take the cake out of the oven," have been rendered functionally equivalent and, as a result, the evocative control by the statement is transferred to the sound of the timer. Calling the statement an FAS simply describes what happens, namely, that the CSS alters the evocative—discriminative-like—functions of the timer. What is needed are empirical investigations into *how* it happens.

CONCLUSION

Perhaps the main strength of behavior analysis has been the discovery of basic units of analysis. According to Zeiler (1986),

The fundamental units (operants, respondents, discriminative operants) are the smallest entities that display the full characteristics of adaptive behavior. . . . Research can involve the variables determining how generic classes are constructed and the factors responsible for particular forms of coordinated behavior. (pp. 4–5)

One implication of the present paper is that such "generic classes" are constructed through processes that can be described as function altering. In other words, all of the processes that produce the long-term behavior change that lead us to speak of learning can be called function altering. A function-altering classification scheme may permit all conditioning processes, the verbal events that mimic them, and other seemingly unrelated learning phenomena (e.g., imprinting) to be considered in a more unified manner, and may well suggest a common underlying mechanism of behavior change. Not only does such a scheme have important implications for how behavior analysts talk about their subject matter, but it also enables them to answer more effectively charges by some cognitively oriented psychologists (e.g., Brewer, 1974; Chomsky, 1959) that behavior analysis is unable to account for complex behav-

ioral processes, especially those involving language.

In conclusion, the fact that verbal stimuli can have discriminative (or reinforcing) functions is indisputable. But there are some events, including many that are verbal, that can mimic the effects of both respondent and operant conditioning by altering the functions of other events. Many behavior analysts agree that rule-governed behavior, however they define it, seems to endow the human species with some very special capacities indeed. However, if behavior analysts continue to be interested only in the possible discriminative (or motivational) effects of verbal stimuli, they might miss what may be most unique about such stimuli. Some behavior analysts have recognized that a more complex analysis may be called for (e.g., Hayes, 1986; Hayes, Kohlenberg, & Hayes, 1991). The present paper concurs and suggests that the complex analysis must include the function-altering nature of stimuli and the processes that underlie their function-altering effects.

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