

A Behavioral Analysis of Motivation and its Relation to Mand Training

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Introduction

The field of behavior analysis has a long-standing, but confusing and conflicting treatment of motivation as a source of behavioral control. In many behavioral textbooks motivation is not considered as an independent variable, nor given its own chapter along with the other behavioral principles and major concepts (e.g., reinforcement, extinction, stimulus control, generalization). However, in all of Skinner's early books on behavior analysis (1938, 1953, 1957), and in the first generation of textbooks on behavior analysis (Holland & Skinner, 1961; Keller & Schoenfeld, 1950; Millenson, 1967) motivation was presented as a basic principle of behavior. The primary purpose of the current chapter is to examine the behavioral analysis of motivation and its relation to mand training for persons with language delays. First however, a brief review of the history of a behavioral analysis of motivation will be provided.

In *Behavior of Organisms* (1938) Skinner devoted two chapters to the treatment of motivation; Chapter 9 titled "Drive" and Chapter 10 titled "Drive and Conditioning: The Interaction of Two Variables." In Chapter 9, he presented his arguments against the term "drive" and the treatment of motivation common at that time. "The 'drive' is a hypothetical state interpolated between operation and behavior and is not actually required in a descriptive system" (p. 368). Skinner argued against the common practice of viewing drive as an internal causal variable, and proposed that environmental variables be the focus of the analysis. In the analysis of hunger for example, rather than talking about a "hunger drive" he proposed that the relation between food deprivation and its evocative effect on behavior be the focus of the analysis. Skinner argued, "The degree of hunger developed during the fast is, of course, increased, and the rate at which the rat begins to eat is therefore increased as well" (p. 350). Following his analysis of hunger, Skinner went on to suggest, "The formulation applied to hunger in the preceding pages may be extended to other drives" (p. 358). He also made it clear in the section titled "Drive Not a Stimulus" (pp. 374-376) that the type of antecedent control over behavior that occurs with motivation is not the same as the type of antecedent control exerted by discriminative, unconditioned, or conditioned stimuli.

The next significant development in the behavioral treatment of motivation occurred with the publication of Keller and Schoenfeld's book *Principles of Psychology* (1950). Chapter 9 was titled "Motivation" and contained several refinements of the

behavioral analysis of motivation. In this chapter Keller and Schoenfeld further developed the relation between deprivation and satiation, and response strength. These authors stated, “depriving an animal of food is a way of increasing the strength of a conditioned reflex like bar-pressing...with sufficient intake of food (*satiation*), these reflexes drop in strength to zero” (p. 264). They also provided a detailed analysis of how aversive stimuli can function as motivative variables (pp. 303-316), and supported this analysis with experimental data (e.g., Keller, 1941).

Keller and Schoenfeld further developed Skinner’s point, “A drive is not a stimulus” (p. 276), and suggested, “It is because responses can be controlled in other ways than by reinforcement, that a new descriptive term is called for and a new behavioral concept emerges” (p. 264). The authors spent several interesting pages attempting to identify an appropriate term for this different behavioral effect, and gradually worked their way to the term “establishing operation.” They first suggested, “We shall, then, henceforth use expressions like ‘establishing a drive’ ‘reducing a drive’ and others, because they are neat” (271). However, the term “drive” was still problematic because of its etymological sanctions, and the authors went on to say, “The discovery, classification, measurement, and the study of any drive are inextricably related to the identification of (and, hopefully, mastery over) its establishing operations” (p. 272). Ultimately, the authors concluded that the term “establishing operation” was a more precise term than drive, and that “The establishing operation is our independent variable, the behavior our dependent variable; the former is specifiable as to kind and degree, the latter is measured for extent of change. The concomitant variation of the two gives rise to, and defines, the concept and problem of motivation” (p. 273). It is here that we see clearly the suggestion that the “establishing operation” be considered as a separate independent variable in behavior analysis, and a call for the experimental analysis of this variable.

The Application of Establishing Operations Emerge

In *Science and Human Behavior* (1953) Skinner devoted three chapters to motivation as an independent variable; Chapter 9: “Deprivation and Satiation,” Chapter 10: “Emotion,” and Chapter 11: “Aversion, Avoidance, Anxiety.” Although he does not use the term establishing operation (EO), his definition of motivative variables still consisted of a functional relation between (1) the level of deprivation, satiation, and aversive stimulation and (2) its evocative effect on behavior. Skinner also expanded on his analysis of motivational variables in several ways in these 3 chapters. For example, he made it clear that a single motivational variable can affect a large class of behaviors when he stated, “A given act of deprivation usually increases the strength of many kinds of behavior simultaneously...when an adult goes without water for a long time, a large group of operants are strengthened” (p. 143). He also further elaborated on his original point, “A drive is not a stimulus” (p. 144), rather it is a separate type of antecedent control. In addition, he provided a full chapter (Chapter 10) on the treatment of aversive stimuli as motivational variables. Skinner concluded that the evocative effects of aversive stimulation were more like those of deprivation and satiation, than those of

stimulus control. He wrote “When we present an aversive stimulus, any behavior which has previously been conditioned by the withdrawal of the stimulus immediately follows....The presentation of the aversive stimulus therefore resembles a sudden increase in deprivation” (p. 172).

Given the general theme of the book *Science and Human Behavior* as the application of behavioral principles to the analysis of human behavior, Skinner provided several examples of how motivation affects human behavior. For example, “*Deprivation* is put to practical use when a child is made more likely to drink milk by restriction of his water intake” (p. 146). Thus, by increasing the level of deprivation it may be possible to evoke a specific behavior or class of behaviors that is related to a history of reinforcement relevant to that deprivation variable. The opposite is also possible with reduced deprivation levels where “*Satiation* is put to practical use when...an abundance of hors d’oeuvres is used to conceal the scantiness of the dinner which follows” (p. 147). Hence, deprivation and satiation can be used as independent variables to evoke or suppress operant behavior.

In *Verbal Behavior* (1957) Skinner provided a comprehensive analysis of how motivational variables play a significant role in a human’s initial acquisition of language, as well as in later verbal functions. In Chapter 2 he identifies the independent variables in the analysis of language and suggested that motivation and emotion (pp. 31-32), as well as aversive control (p. 33) are separate from the other behavioral principles. For example, “By reinforcing with candy we strengthen the response *Candy!* but the response will be emitted only when the child is, as we say, hungry for candy. Subsequently we control the response, not by further reinforcement, but by depriving or satiating the child with candy” (p. 31). These motivational variables can evoke verbal or nonverbal behaviors. For example, “Whether a door is opened with a ‘twist-and-push’ or with an *Out!* we make the response more or less likely by altering the deprivation associated with the reinforcement of getting through the door” (p. 31).

In Chapter 3 he introduced the concept of the mand. “A ‘mand’ then may be defined as a verbal operant in which the response is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation” (pp. 35-36). Skinner proposed that the mand was separate from the other types of language (i.e., echoic, tact, intraverbal, textual, and transcriptive) because of its control by motivational variables, rather than discriminative stimuli that control the other types of verbal behavior. He identified several different types of mands, and explained how deprivation, satiation, and aversive stimulation controlled these mands, as well as other types of nonverbal behavior (p. 31). Skinner also described how motivational variables could be controlled and manipulated to evoke verbal behaviors. For example “The response *Quiet!* is reinforced through the reduction of an aversive condition, and we can increase the probability of its occurrence by creating such a condition—that is, by making noise” (p. 35). Many other examples of the use of motivational variables as independent variables can be found throughout the book.

Holland and Skinner (1961) and Millenson (1967)

The programmed text by Holland and Skinner (1961) covered the basic concepts of behavior analysis as presented in *Science and Human Behavior* (Skinner, 1953), and some of the resulting research and developments from the emerging field of behavior analysis. The book contained four chapters relevant to Skinner's analysis of motivation. Chapters 7 ("Deprivation"), 8 ("Emotion I"), 9 ("Avoidance and Escape Behavior") and 10 ("Emotion II"). They presented a behavioral analysis of motivation as involving a functional relation between variables determining the momentary value of events functioning as reinforcement or punishment, and the current frequency of behavior that has been so reinforced or punished.

Millenson's *Principles of Behavioral Analysis* (1967), contained four chapters relevant to motivation and presented an excellent summary of the relevant empirical research. Chapters 15 and 16 were titled "Motivation I," and "Motivation II," Chapter 17 was titled "Aversive Contingencies," and Chapter 18 was titled "Emotional Behavior." Skinner (1938) had pointed out several years earlier that the next step in the development of an environmental analysis of motivation was to quantify the relation. "Some measure of the strength of the behavior must be obtained, and the relation between that strength and the various operations that affect it then determined" (p. 358). In the section titled "Measurement of drives" (pp. 372-384), Millenson summarized the existing research as "showing that behavior of several sorts varies in an orderly fashion with changes in deprivation, satiation, and allied operations. There appears to exist a set of behavioral measures which, within limits, covary with deprivation of the reinforcer" (p. 383).

A number of empirical studies are described in this section, such as Clark's (1958) demonstration that various degrees of food deprivation had differential effects on stabilized VI response rates in rats. And Broadhurst's (1957) research with rats in an underwater Y maze that showed "the longer the deprivation time for air, the more efficient was the acquisition performance" (p. 378). This section concluded with a call for a new term; "The systematic covariation in a number of independent behavioral measures in relation to a single operation (for example deprivation) provides grounds for the introduction of a concept which will summarize and stand for this covariance....The actual concept of drive...remains a relation between a reinforcement-establishing operation and the reinforcing value of a class of stimuli" (p. 383). (It should be noted that while no mention was made of Keller and Schoenfeld's (1950) use of the term "establishing operation" in this section, or anywhere in the chapters on motivational variables, Millenson credited Schoenfeld in the Preface of the book saying that to him (and Francis Mechner) "must go credit for whatever of any original value is to be found within.") A second edition of Millenson's book, coauthored by Millenson and Leslie was published in 1979, and although a number of details were added to the earlier treatment, there seem to be no major changes.

There are at least three alternatives to Skinner's analysis of motivation that are behaviorally based and should be mentioned: Kantor's (1959) analysis of setting

events, Goldiamond's concept of potentiating variables (Goldiamond & Dyrud, 1967), and Premack's (1971) work on manipulations that change reinforcing properties. While all have their merit, it is beyond the scope of the current paper to compare and contrast these different points of view. It appears that the conceptualization of motivation following Skinner's original analysis has survived the test of time, and has led to a productive line of research and applications (see below).

What Happened to the Behavioral Analysis of Motivation?

The topic of motivation was for the most part dropped from the behavioral textbooks that followed Millenson's book (e.g., Fantino & Logan, 1979; Martin & Pear, 1978; Powers & Osborne, 1976; Whaley & Malott, 1971). None had a full chapter on motivation like all the earlier textbooks, or considered Skinner (1938, 1953, 1957) and Keller and Schoenfeld's (1950) position that deprivation, satiation, and aversive stimulation (EOs) constituted a separate behavioral principle. The topic was simply not mentioned in many of the books, nor was it incorporated into the behavioral analyses provided in these textbooks. In addition, motivation as a topic of research was absent from the behavioral journals. For example, *The Journal of Applied Behavior Analysis* which began publication in 1968, contained no entries of "establishing operations" in the cumulative indexes (1978, 1988) covering the first 20 years of publication. However, there were 5 entries on "motivation," but they all involved the use of motivation as a consequence rather than as an antecedent variable (see below).

In explaining what happened to the analysis of motivation in behavior analysis, Michael (1993) pointed out, "In applied behavior analysis or behavior modification, the concept of reinforcement seems to have taken over much of the subject matter that was once considered a part of the topic of motivation" (p. 191). Michael (1982, 1988, 1993) argued that this was an inadequate solution to the issue of motivation and that the topic continues to deserve special treatment and consideration as a separate antecedent principle of behavior. As a result of Michael's persistent efforts, motivational variables began to appear more frequently in the behavioral literature. For example, Martin and Pear's (1988) 3rd Edition of *Behavior Modification* contained a two page extended note on EOs, and their 4th, 5th, and 6th Editions contained even more detailed treatments with each new edition. Cooper, Heron, & Heward's (1987) book *Applied Behavior Analysis* contained several sections on the EO. Catania's, (1994) 3rd Edition of *Learning* contained not only the basic definition of the EO, but it was incorporated throughout the book in the analysis of many aspects of behavior. The 3rd Edition of *Elementary Principles of Behavior* by Malott, Whaley, and Malott (1997) contained a full chapter on the EO.

Research on the EO also began to appear in the behavioral journals. *The Analysis of Verbal Behavior* contained several studies on the EO as an independent variable (e.g., Carroll & Hesse, 1987; Hall & Sundberg, 1987; Sundberg, San Juan, Dawdy, & Arguelles, 1990). The *Journal of the Experimental Analysis of Behavior* also contained a line of basic research on the EO (e.g., Lamarre & Holland, 1985; McPherson &

Osborne, 1988; Pierce, Epling, & Boer, 1986). Papers on the EO have also been published in *The Behavior Analyst* (e.g., Leigland, 1984), and in 1993 a special section of that journal was devoted to the EO (Catania, 1993; Hesse, 1993; McDevitt & Fantino, 1993; Michael, 1993; Schlinger, 1993; Sundberg, 1993). The *Journal of Applied Behavior Analysis* saw a rapid expansion of EO research in the 1990s and early 2000s (e.g., Gottschalk, Libby, & Graff, 2000; McGill, 1999; Smith & Iwata, 1997; Vollmer & Iwata, 1991), and in 2000 dedicated much of a single issue to papers on the EO (e.g., Iwata, Smith, & Michael, 2000; McComas, Hoch, Paone, & El-Roy, 2000; Michael, 2000). In addition, other behavioral journals have shown an increase in papers relevant to EOs such as *Research in Developmental Disabilities* (e.g., Fisher, Thompson, DeLeon, Piazza, Kuhn, Rodriguez-Catter, & Adelinis, 1999), *Behavior Modification* (e.g., Sundberg & Michael, 2001), and *Behavioral Interventions* (e.g., Wilder & Carr, 1998). Thus, it appears that the EO and the behavior analysis of motivation have worked their way back into mainstream behavior analysis.

Michael's Refinement and Extension of the Establishing Operation

In a series of papers Michael (1982, 1988, 1993, 2000) elaborated on Skinner's analysis of motivation, while adopting Keller and Schoenfeld's (1950) term "establishing operation." Michael's definition of the EO was essentially the same as Skinner's (1938, 1953, 1957) definition of the behavioral effects of deprivation, satiation, and aversive stimulation. However, Michael, like Keller and Schoenfeld, felt that a special term was needed for the different types of variables that fit Skinner's definition. "The term 'deprivation' has generally been used...but does not adequately characterize....Salt ingestion, perspiration, and blood loss...likewise temperature changes...emotional operations...and fear....A general term is needed for operations having these two effects on behavior" (Michael, 1982, p. 150). Perhaps the most significant aspect of Michael's work was an extension of the basic EO concept from innate physiological motivative variables to learned motivative variables. A brief overview of Michael's definition of the EO and his classification of the different types of EOs will be presented.

Michael (1993) defined the EO as "an environmental event...that affects an organism by momentarily altering (a) the reinforcing effectiveness (*value*) of other events, and (b) the frequency of occurrence of that part of the organism's repertoire relevant to those events as consequences" (p. 192). For example, food deprivation (a) increases the momentary effectiveness of food as a reinforcer, and (b) increases the frequency of any behavior that has been followed by food. For a child, food deprivation will (a) make food effective as reinforcement and (b) evoke behavior such as going to the place where food has been found, or possibly evoke a mand such as, "eat," or "popcorn," if this verbal behavior has been followed by the receipt of food in the past. "The first effect can be called reinforcer establishing and the second evocative" (Michael, 1993, p. 192). These two effects will be presented in detail later as the key elements to mand training for individuals with delayed or defective mand repertoires.

EOs not only increase the value of reinforcers, but they also decrease the value of reinforcers (e.g., satiation). Michael (1993) points out, “it is more accurate to think of motivative variables as establishing or abolishing operations and to think of their evocative effect as an increase or a decrease in the momentary or current frequency of the relevant kind of behavior” (p. 193). In a recent paper, the term “abative” as been suggested for this reduction effect (Laraway, Snycerski, Michael, & Poling, 2002).

Michael (1993) distinguished between two main types of EOs, unconditioned establishing operations (UEOs) and conditioned establishing operations (CEOs). Unconditioned EOs are related to unlearned forms of motivation (those frequently discussed in psychology textbooks as “innate drives” or “physiological motives”), such as deprivation of food, water, sleep, activity and oxygen; temperature regulation such as too hot or too cold; variables related to sexual reinforcement; and painful stimulation. The reinforcer-establishing effect of the UEO is innate, however, the behavior that is evoked by the UEO is learned. For example, food deprivation increases the effectiveness of food as reinforcement as an unlearned or innate effect, but the behavior of searching for food or asking for (manding) food is learned. The change in value is innate, but the change in behavior depends on the organism’s learning history.

Conditioned EOs are related to learned forms of motivation (those frequently discussed in psychology textbooks as “acquired drives” or “social motives”) such as those responsible for social attention, toys, and money functioning as reinforcement. The reinforcer establishing effect in the CEO is learned, and the behavior that is evoked by the change in the value of certain consequences is also learned. For example, when video taping an important event, such as a child’s first birthday, the “end of tape” icon flashes on the screen. This stimulus change alters the value of a new tape (the reinforcer-establishing effect) and evokes behavior that has been followed by obtaining new videotapes in the past. As with UEOs, this behavior can be nonverbal such as searching in a drawer that often contains new tapes, or verbal such as the mand “Honey, can you get me a new tape?” The increase in the value of the tape is a learned relation, as is the behavior relating to obtaining a new tape. We are not born needing videotapes, nor do we inherit the behavior of looking or manding for them.

Michael (1993) identified three types of CEOs: transitive, reflexive, and surrogate. The transitive CEO consists of a stimulus condition that makes *some other stimulus condition* effective as a form of conditioned reinforcement, and evokes behavior that has obtained that item in the past. The example above with the videotape represents this type of CEO. The flashing icon is a stimulus condition that makes the other stimulus conditions (a new tape) reinforcing, and evokes the behavior of searching or manding. Transitive CEOs occur frequently throughout a person’s day. Common activities such as self-care, cooking, cleaning, shopping, social interaction, schoolwork, and employment all involve transitive CEOs as a source of motivation.

The reflexive CEO involves an aversive stimulus condition that is a warning of some form of further worsening. This warning stimulus increases the current frequency of responses that have terminated the warning stimulus. For example, while eating lunch you drip tomato sauce on your tie. This stimulus change is probably an aversive stimulus, especially if you will be meeting with an important client after lunch. Thus, the soiled tie is a warning stimulus that more bad things are about to come (this is the reinforcer-establishing effect of the EO, in this case a clean tie is the reinforcer). The warning stimulus will evoke behavior that has resulted in the termination of the aversive stimulus. The person may begin to look for a napkin and water, if none are available he may mand to a waiter for them. Or, the person may mand for advice from others at the table as to the best method of removing tomato sauce from a tie. Reflexive CEOs occur frequently throughout a person's day. Many daily activities can involve aversive stimuli that need to be terminated (e.g., the water boiling over, smoke coming from the vacuum, not enough money in your wallet). Reflexive CEOs can be a main source of stress in one's life, especially if they do not evoke effective terminating behavior.

The surrogate CEO is a stimulus that is paired with some other effective EO, and can have the same effects as that EO. Beginning with the work of Pavlov (1927) on respondent conditioning, it became clear that a neutral stimulus can be paired with another effective stimulus and acquire some of the evocative effects of the original stimulus. Skinner (1938) extended this concept of stimulus-stimulus pairing to operant conditioning by demonstrating that previously neutral stimuli could acquire reinforcing or punishing properties by being paired with established forms of reinforcement or punishment (i.e., the behavioral principles of conditioned reinforcement and conditioned punishment). Michael (1993) suggested that similar effect is possible with EOs. While acknowledging that there are, as of yet, no data to support this extension of behavioral concepts, Michael suggested that the surrogate CEO is a different type of CEO because of the way it acquires its reinforcer-establishing and evocative effect. The concept also parallels the way other neutral stimuli acquire functional control in relation to other behavioral principles.

For example, say a person is food deprived (UEO) and a friend takes him to Krispy Kreme™ donuts to buy him a donut. While in line, the Krispy Kreme logo may be paired with food deprivation and acquire some of its reinforcer-establishing and evocative effects. This could only be observed on a future occasion when say, the person drives by a Krispy Kreme shop and finds he suddenly wants a donut, even though he previously was not hungry. The sign may have established donuts as a form of reinforcement and evoked the behavior of pulling into the parking lot and going into the shop and buying a donut. Michael (1993) also suggested that the operant components of some several types of emotional behavior may be more parsimoniously analyzed as surrogate CEOs, but the complexity of the analysis exceeds the purpose of the present chapter. For a more detailed analysis of EOs and emotion see Dougher & Hackbert, 2000.

Multiple Effects

A single stimulus change may have several effects on behavior (Michael, 1985). In the example above, the sight of the Krispy Kreme logo could also function as a conditioned stimulus and elicit salivation (or an increased heart rate, perspiration, etc., if it was paired with the breakup). It also could function as a conditioned reinforcer (or punisher) and strengthen (or weaken) any behavior that preceded the presentation of the logo, such as singing a certain song in the car. The logo could also function as a discriminative stimulus, evoking verbal behavior such as the textual response “Krispy Kreme.” In addition to all these effects, the EO effect may be most obvious when a mand occurs such as “I want a Krispy Kreme donut now!”

Application of the EO to Language Training

EOs play a significant role in the early language acquisition of typical children (Bijou & Baer, 1965; Skinner, 1957). They are also an essential part of the training procedures used with nonverbal developmentally disabled individuals. In addition, they are directly relevant to a wide variety of more complex mands in advanced verbal behavior, and they often share control with verbal and nonverbal discriminative stimuli in other verbal operants. The definition of the mand and the EO, and the types of EOs identified by Michael (1993), can serve as a guide for the application of the EO as an independent variable in language training (Sundberg, 1993; Sundberg & Michael, 2001; Sundberg & Partington, 1998). However, the type of antecedent control for the mand, the EO, is often not as conspicuous as a discriminative stimulus, and may be overlooked as an essential part of the verbal functional relation.

Effective application of the EO, like the effective application of the other behavioral principles and concepts, requires special training. For example, the use of reinforcement as a teaching tool requires that the teacher be able to identify what functions as reinforcement, deliver it immediately and contingently on successive approximations of the target behavior, ultimately thin out the reinforcement schedule, and so on. The application of the EO to language instruction similarly requires specific skills on the part of the behavior analyst or practitioner to maximize its effectiveness as an independent variable.

The Difference Between EOs and S^Ds

In order to successfully use the EO as an independent variable, it is critical to be able to distinguish an EO from an S^D. Both antecedent variables evoke behavior, often the same behavior, but for different reasons. For example, a child may say “Juice” because he wants juice (a mand), or he may say “Juice” because he sees a juice box (a tact), or because the word “juice” is heard (an echoic), or a combination of these variables (multiple control). Michael (1982, 1993) states the difference as follows, “Discriminative variables are related to the differential availability of an effective form of reinforcement given a particular type of behavior; motivative variables are related to the differential *reinforcing effectiveness* of environmental events” (1993, p. 193). Availability means that a consequence for a particular

response is more likely to occur in the presence of the stimulus than in its absence. For example, a greeting response to a passerby (e.g., “Good morning”) is likely to be reinforced in the presence, but not the absence, of the person. Thus, passers-by become discriminative stimuli for greeting responses because of their relation to various forms of generalized conditioned reinforcement. Reinforcer-effectiveness is related to momentary value of those consequences. If a person is not reinforced by stranger attention at that moment, or is currently affected by some other EO, such as those related to a recent mugging, then the greeting response is less likely to occur, even though the reinforcement might be available.

Skinner’s (1957) distinction between the mand and the tact provides a good example (and a way to learn) of the difference between the two forms of control. Mand is evoked when the value of what functions as reinforcement becomes strong, and the consequences for manding are specifically related to that form of reinforcement. Juice will be effective as reinforcement only when the child is thirsty. If the child is satiated with juice, then juice is not effective as reinforcement and the mand is less likely to occur. “Juice” as a tact is not related to the momentary value of juice, but rather to the availability of other forms of generalized conditioned reinforcement, such as praise or attention. Tacting juice does not result in receiving juice, but some other form of reinforcement (e.g., “Right!”). This is why what is often recorded as a correct response on a data sheet, may actually be an incorrect response if the data sheet is focusing on mand development, rather than tact development.

Tacting the Presence and Strength of an EO

All mands are controlled by EOs, thus in order to teach a child to mand there must be an EO in effect during training. If there is not an EO controlling the response, then the response is not a mand. For example, when asked, “What toy do you want?” a child may respond “slinky,” but when presented with the slinky he refuses the toy. The response “slinky” could be under the intraverbal control of the verbal stimulus “toy.” It could be under tact control if a slinky is present, or echoic control if someone previously said “slinky,” or textual control if he saw and could read the word “slinky.” The point is, the defining feature of a mand is that the verbal response is primarily under the functional control of an EO. Other types of stimulus control are often present (i.e., verbal, nonverbal, audience), but the form of the response is controlled by an EO.

In order to use the EO as an independent variable in day-to-day language instruction, the trainer must be able to tact the presence and strength of an EO. When conducting mand training, as previously stated, an EO must be in effect or one cannot do mand training. If a child does not want bubbles at a particular time, a mand for bubbles cannot be taught at that time. Thus, it is critical that the trainer be able to tact the presence of an EO. Does the child want a particular item? Reinforcement surveys may tell you what the child liked at some time or another, but they will not tell you if a child wants that particular item at that particular moment. One must determine what functions as an effective form of reinforcement at that moment. Observation of a child’s behavior in a natural setting can tell you

some of what a child wants. Choice procedures can also be effective in determining the relative value of various forms of reinforcement (e.g., DeLeon & Iwata, 1996).

EOs vary in strength across time, and may be related to other EOs or the demands placed on a child. Therefore, teachers conducting mand training must be constantly aware of the relative strength of EOs at any given point in time. EOs also compete with each other. For example, a child may first want a specific toy, but when another child has a better toy, the first toy is dropped in preference for the second. Satiation will also affect the value of the EO. For example, popcorn may function as reinforcement for the first 50 kernels, but as the child satiates, the value of the reinforcer decreases. Thus, a language trainer must be aware of the fact that mands may not occur, or if a response does occur, it might not be a mand, but rather some other type of verbal behavior.

EOs may have an instant or gradual onset or offset. Food deprivation may build up slowly, but decrease quickly. The value of a particular toy may increase quickly and decrease quickly. For example, if a child is given a Magna Doodle® writing board, but no magnetic pen, the value of the pen might be strong immediately. Following a few minutes of drawing, the child might drop the pen and board and move on to another activity. A language trainer must be aware of all of these varying aspects of the EO. Otherwise mand training becomes much more difficult, if not impossible to conduct.

Delivering Specific Reinforcement

The mand is strengthened by a type of reinforcement that is unique to the mand relation. Skinner (1957) terms this consequence “specific reinforcement” (p. 38). Specific reinforcement is directly related to the relevant EO, and may increase the future frequency of several different response forms if several different response forms have been reinforced. For example, if there is an EO for water, the effective consequence that is established is water. The response form may occur in several topographical variations, such as pointing to one’s throat or a glass of water, or saying “Water,” “I’m thirsty,” “Can I have a drink?” and so on. However, the response form alone is insufficient for the classification of verbal behavior. It is the functional relation between antecedents, behavior, and consequence that is the unit of analysis (Skinner, 1957).

A thematic line of research has demonstrated that specific reinforcement has behavioral effects that are different from nonspecific reinforcement. The results have shown that specific reinforcement produces a higher percentage of correct responses (Sanders & Sailor, 1979); shorter response latencies, and subject preference for specific reinforcement conditions (Stafford, Sundberg, & Braam, 1988); better generalization, and the emergence of untrained receptive language (Braam & Sundberg, 1991).

Capturing and Contriving EOs

There are several ways to capture or contrive EOs for purposes of language instruction. Michael’s (1993) classification of the different types of EOs provides a useful guide for such applications. UEOs such as thirst and hunger are perhaps the

simplest to use, since it is the passage of time that increases the momentary effectiveness of these consequences. These sources of control can be easily captured and manipulated in the natural environment simply by waiting until the EO is strong (a similar procedure could be used to remove an aversive stimulus occurring in the natural environment). UEOs can also be contrived by, for example, giving someone salty crackers to increase the value of liquids, or decreasing the temperature in a room to increase the value of warmth.

The three types of CEOs described by Michael (1993), transitive, reflexive and surrogate, can be captured or contrived, and used for behavioral assessments and interventions. Capturing a transitive CEO in the natural environment, for example, involves capitalizing on a situation where one stimulus increases the value of a second stimulus. For example, a nonverbal child who likes fire trucks sees a fire truck parked outside the window. This stimulus increases the value of a second stimulus, an unlocked door, and will evoke behavior that has resulted in doors opening in the past. A skilled trainer would be watchful for these events and would be quick to conduct a mand trial for the word "Open" or "Out." Since the EO is strong, this is the time to conduct mand training. The work of Hart and Risley (1975) and their incidental teaching model exemplifies this teaching strategy.

Transitive CEOs can also be contrived in order to conduct mand training (e.g., Carroll & Hesse, 1987; Hall & Sundberg, 1987; Sigafos, Doss, & Reichele, 1989; Sundberg, Loeb, Hail, & Eigenheer, 2002; Sundberg & Partington, 1998). For example, in using this type of CEO procedure Hall and Sundberg (1987) presented a stimulus that increased the value of another stimulus, such as instant coffee without hot water. The coffee altered the value of hot water and thereby evoked behavior that had been followed by that form of reinforcement in the past. Appropriate mands were easy to teach when this EO was in effect. In fact, a number of mands were taught by using this procedure, and often the procedure led to the emission of untrained mands.

There are several possible applications of the reflexive CEO. For example, many individuals diagnosed with developmentally disabilities have acquired strong repertoires of escape and avoidance behavior (e.g., aggression, self-injurious behaviors). These behaviors often occur when attempts are made to teach language and other skills. Verbal stimuli presented to the individual may function like a reflexive CEO in that these stimuli are warning stimuli indicating that more bad things are coming, and behaviors that have terminated similar stimuli in the past occur immediately. The offset of the warning stimulus (e.g., the removal of the demand) will immediately reinforce any behavior that precedes such offset. Reducing these behaviors requires extinguishing the behaviors by not terminating the teaching situation, and by teaching an alternative mand that involves a more acceptable response form (e.g., Wilder & Carr, 1998).

The surrogate CEO, where a stimulus is correlated with a UEO, is relevant to analyses of emotional behavior. Specifically, neutral stimuli correlated with aversive stimuli may evoke emotional behavior as a CEO rather than as an S^D or conditioned eliciting stimulus. For example, a child may engage in a high rate of crying upon

entering a dentist's office because that particular room has been previously paired with painful stimuli. The previously neutral stimulus (the room) now may evoke behavior (tantrums) that has terminated such stimuli (the child is removed from the room). There could be many other negative behaviors that are caused, in part, by the surrogate CEO such as shyness or other emotional behaviors (Dougher & Hackbert, 2000). Reducing such negative behavior requires extinction of the behavior, and teaching the individual to remove the CEO by manding with a more acceptable response form.

It is not enough to be able to identify, capture, or contrive an EO. Once the value of a form of reinforcement is strong, the trainer must then be able to shape the appropriate verbal response. Effective shaping requires that a trainer be able to differentially reinforce successive approximations to the target behavior when the EO is strong. For example, the moment a child expresses interest in bubbles, the delivery of echoic prompts and the fading of those prompts is necessary to establish the verbal response "bubbles." In addition, the trainer must be assured that the response is truly free from other types of stimulus control, such as the presence of the bottle of bubbles, or the wand.

Language Assessment

Most standardized language assessments test a child's language skills under the control of discriminative stimuli (e.g., pictures, words, questions, etc.). However, a substantial percentage of a typical child's verbal behavior is under the functional control of EOs. Manding is a dominating type of verbal behavior, yet rarely is this repertoire assessed in standardized testing. It is quite common to observe children diagnosed with autism or other developmental disabilities who are unable to mand, or have defective mand repertoires. Negative behavior may serve the mand function, or the response that is assumed to be a mand is actually controlled by discriminative stimuli rather than by EOs. If a language assessment fails to identify delayed or defective language skills that are related to EO control, an appropriate intervention program may be difficult to establish. A complete language assessment should determine the strength of verbal responses under not only discriminative stimuli, but also under the control of EOs (e.g., Partington & Sundberg, 1998; Sundberg, 1983; Sundberg & Partington, 1998).

EOs and Mand Training

Mands are the first type of verbal behavior acquired by a human child (Bijou & Baer, 1965; Skinner, 1957). These mands typically occur in the form of differential crying when a child is hungry, tired, in pain, afraid, etc. Mands are very important to early language learners. They allow a child to control not only the delivery of conditioned and unconditioned reinforcers, but they begin to establish the speaker and listener roles that are essential to further verbal development. Mands are also the most likely type of verbal behavior to be emitted spontaneously, and generalization may occur quickly because of the unique effects of the EO. The data are quite clear that manding does not emerge from tact and receptive training for severely language

delayed children (for a review see Shafer, 1994). Controlling and manipulating EOs can be more complex than presenting S^Ds, but if one is familiar with the methods of contriving and capturing EOs, the procedures are relatively straightforward. In addition, it is frequently reported by parents and trainers that mand training is more enjoyable for both parties, negative behavior occurs less, and children are more willing to participate in language training activities.

The best place to start mand training is with mands for reinforcers that have high EO values (e.g., food, outside, music, books, toys, tickles, juice, swing). Typically there is no need to contrive the EO for these strong motivators. The focus is on development of an acceptable response form under the control of the relevant EO. Other types of stimulus control (e.g., imitative prompts) can be used to develop EO control, but ultimately the mand should be free of verbal, nonverbal, echoic, or imitative stimulus control (e.g., see the “quick transfer procedure” described by Sundberg & Partington, 1998). Following the acquisition of mands related to EOs that are typically strong, the language trainer must often look to procedures that involve contriving EOs in order to establish the targeted mand. Below are a number of important mand repertoires that involve contriving EOs.

Mands for Missing Items

The value of the mand to a speaker is that it has obtained objects and actions, or has brought about conditions that are not present. This means that to be optimally useful a mand should occur in the absence of the object or condition that is the reinforcement for the mand; it should occur primarily under the control of the EO. A common problem faced by many children diagnosed with autism or other developmental disabilities is that they are unable to mand for items that are not physically present. For example, a child may be able to ask for a specific toy when that toy is present, but if the toy is missing the child may be unable to tell anyone what is desired. The child may engage in generalized mand behavior such as pulling at the adult, or crying. Thus, many parents find themselves playing a guessing game by presenting several toys or objects or actions in order to satisfy the child. Mand training may consist largely of presenting an object that is assumed to be effective as a reinforcer, and asking, “What do you want?” The “correct” answer to the question is then the same response form that has been appropriate as a tact, and the social reinforcement for making the response as a tact may be as important to the child as receiving the object. This procedure results in a functional relation that is part tact and part mand, and the mand relation may be the smaller part. The result may be no strong tendency to make the same response in the absence of the object (when the tact stimulus is not present) even when it would be effective as a form of reinforcement. The target repertoire for mand training is a response that is primarily under the control of an EO, even though additional contextual variables such as a specific setting or audience may be important. Training on these verbal skills is typically necessary and must occur when the EO is strong by either capturing an existing EO, or contriving a new EO (Hall & Sundberg, 1987; Sundberg, 1993; Sundberg, Loeb, Hail, & Eigenheer, 2002; Sundberg & Partington, 1998).

Mands Involving the Different Parts of Speech

Perhaps one of the most significant aspects of Skinner's analysis of verbal behavior is the point that the same response form can occur in different verbal operants. For example, the response "red" can occur as an echoic, tact, mand, intraverbal, or textual response. The controlling variables are different, but the form of the response is the same. Therefore, an important aspect of language training is to establish all of these different types of control for the different vocabulary words a person may emit. The traditional classification of nouns, verbs, adjectives, prepositions, etc. is a classification based somewhat on the form of the response (in addition to its function), however, it is still quite relevant to a behavioral analysis of language. The important point is to be sure to establish each of these different parts of speech in each of the elementary verbal operants. Perhaps the most elusive of these tasks is the establishment of these responses as mands, because they require that the functional source of control be an EO rather than a discriminative stimulus. Below are several examples of contriving or capturing the relevant EOs for teaching mands involving different parts of speech.

Verbs: Mands controlled by an EO for movement. For example, if watching things roll down an incline functions as reinforcement for a student, the trainer should hold the item at the top of the incline and prompt and differentially reinforce the mand "Roll."

Adjectives: Mands controlled by an EO for specific properties of objects. For example, if a student is reinforced by objects of a certain color, the trainer should prompt and differentially reinforce a mand involving that color (e.g., "Red candy").

Prepositions: Mands controlled by an EO for specific positions. For example, if a student is reinforced by playing games such as hide and seek, the trainer should prompt and differentially reinforce mands for movement to certain hiding places (e.g., "Behind the door").

Adverbs: Mands controlled by an EO involving the properties of movement. For example, if a student is reinforced by the song "Head, shoulders, knees and toes" sung at different paces, the trainer should prompt and differentially reinforce the responses "Go fast," or "Go slow."

Mands for Information

According to Skinner (1957), "A question is a mand which specifies verbal action" (p. 39). The relevant EOs for asking questions are variables that result in an increase in the value of specific verbal information as a form of conditioned reinforcement and that evoke behavior that has been followed by such information. Questions are important for verbal development because they allow a speaker to react more precisely to the environment and to acquire additional verbal behavior. When an EO relevant to its mother's location becomes strong the relevant information would function as reinforcement for any response that preceded receiving such information and responses such as "Where's Mommy" will be strong. In this example, the relevant consequences involve the listener providing the child

with verbal information regarding his mother's location (e.g., "She went to the store").

Part of the reason that language delayed children may have difficulty acquiring question-asking behavior is that for many of these children verbal information does not function as a form of conditioned reinforcement. Any procedure that attempts to teach this behavior without a relevant EO that makes information valuable must rely on EOs for other reinforcers such as tokens and tangibles to establish the correct response form. However, once the response form is established, it may actually be under the control of these other EOs and not an EO related to information as a reinforcer. That is, a speaker may emit a topographically correct "Wh" question, but the response is a function of the availability of reinforcement, rather than an increase in the value of specific verbal reinforcement (Michael, 1982, 1988; Skinner, 1957; Sundberg, Loeb, Hail, & Eigenheer, 2002). In common sense terms, the child may not really want to know the answer to the question, but is emitting the behavior to obtain some other form of reinforcement (e.g., attention, tokens). Below are several examples of contriving or capturing the relevant EOs for teaching mands for information.

What?: Mands controlled by an EO involving the names of things. For example, if a student sees a novel stimulus that cannot be tacted, the response "What's that?" should be prompted and differentially reinforced.

Where?: Mands controlled by an EO involving the location of people or things. For example, if a student cannot find his toy frog the trainer should prompt and differentially reinforce the response "Where's my frog?"

Who?: Mands controlled by an EO involving information regarding a specific person. For example, if a teacher gives a student's favorite toy to another teacher and tells the student "I gave your toy to a teacher" the trainer should then prompt and differentially reinforce the response "Who has it?"

When?: Mands controlled by an EO involving an EO for information concerning time. For example, if a student wants to see a movie and it is not currently available, the trainer should prompt and differentially reinforce the response "When will we watch the movie?"

How?: Mands controlled by an EO involving instructional information or the function of things. For example, if a student cannot make a certain toy work the trainer should prompt and differentially reinforce the response "How does it work?"

Why?: Mands controlled by an EO involving the causes of actions or events, and other explanations of behavior. For example, if a trainer emits a sudden behavior such as stopping while on a walk, and the student looks quizzically at her, trainer should prompt and differentially reinforce the response "Why are you stopping?"

Additional Types of Mands

There are a wide variety of other mands that occur in day-to-day discourse that often must be directly taught to a language delayed person. Below are a sample of these mands and an identification of the relevant EO.

General Mand controlled by an EO involving human contact or assistance. For example, if a student is reinforced by a high five, the trainer should prompt and differentially reinforce the response “High five,” when an EO is present.

Mands controlled by an EO involving eye contact or the physical proximity of others. For example, if a student demonstrates an EO for attention is strong, the trainer should prompt and differentially reinforce a response such as tapping a teacher’s arm.

Mands for the Removal of Aversives

There are several different mands that can be evoked by learned aversive stimuli. Many individuals need to be specifically taught each of them (e.g., “Go away,” “Don’t,” “Stop,” “Give that back,” “Leave me alone”). It is important that these responses be under EO control rather than evoked by a discriminative stimulus. Therefore, the aversive stimulus must be present during training, and terminating the aversive stimulus must be the main form of reinforcement for the correct response, otherwise the mand will not occur in the natural environment under the appropriate conditions. The language trainer must capture or contrive an EO involving the value of the termination of the aversive stimulus (e.g., pain, something stuck, something broken, darkness, a loud noise, someone too close, a peer who takes reinforcers). For example, if a student often emits head banging when a toy is stuck, the trainer should present the stuck toy (e.g., enclosed in his hands) and echoically prompt “Let go” before the head banging can occur. Correct echoic responses should be initially reinforced, then fade the echoic prompt.

EOs Can Help to Establish Other Verbal Behaviors

It also appears that mand training, and the use of the EO as an independent variable, can facilitate the later development of echoic, tact, and intraverbal training in at least two ways. First, a successful mand program with a previously nonverbal child often changes the child’s willingness to participate in training sessions. The child may experience success, where only failure had occurred in the past. Second, the EO can be used as an additional independent variable in teaching echoics, tacts, and intraverbals (multiple control). Once a specific response form is acquired under multiple sources of control, then procedures to break free from EO control and bring the response solely under the relevant discriminative stimulus control can be implemented (Carroll & Hesse, 1987; Drash, High, & Tutor, 1999; Sundberg & Partington, 1998).

Summary

EOs play an important role in behavior analysis and have many applications to human behavior, especially in the area of language training for persons with delayed or defective language. However, in order to effectively use EOs as independent variables specialized repertoires are required. Once behavior analysts and practitioners acquire those repertoires, EOs can be identified, captured, and contrived to help establish a wide variety of important verbal behaviors, such as an initial mand repertoire, mands for missing items, mands for information, and mands involving

the different parts of speech. Without these important verbal skills a verbal repertoire cannot be complete, and important verbal and social behaviors such as maintaining a conversation are impossible.

A Call for a New Term

Michael and colleagues (Laraway, Snyckerski, Michael, & Poling, 2003; Michael, 2002) recently proposed changing the term “establishing operation” to “motivative operation.” While acknowledging that the term EO is gaining acceptance, the authors identify several advantages of the term motivative operation (MO). In addition to the immediate understanding by listeners as to the topic of analysis, the term MO (which would result in the UEO being identified as the UMO, and the CEO identified as the CMO) more easily accommodates the analysis of reduced motivation, and is overall more conceptually complete. According to Michael (personal communication), “the main advantages are that the terms are more logically consistent, are mutually exclusive and collectively exhaustive, and should for this reason be more easily learned and more effectively used for communicating with others and for communicating with oneself in the sense of thinking about the topic.”

In the area of teaching language to children diagnosed with autism and other developmental disabilities it seems easier for parents and teachers to understand and implement procedures when the term motivative operation is used rather than establishing operation. The result can be an improved implementation of the recommended intervention procedures. For example, telling a parent to conduct a mand trial when the child’s motivation for an object is strong, is more likely to succeed than telling the parent to wait for an establishing operation. Like all terminological changes, time will determine if the term MO will be an improvement over the previous term EO .

Conclusion

Motivation is perhaps one of the most widely discussed topics in the field of psychology. The relevance of motivation to human behavior is ubiquitous, and most introductory psychology textbooks contain at least one chapter on the topic. However, motivation has not been considered a major topic in the field of behavior analysis, despite the fact that Skinner wrote extensively about motivation as an important antecedent variable. Much of what was once considered by Skinner as the topic of motivation in the early development of behavior analysis has been inappropriately subsumed under the topic of reinforcement. This situation has changed during the past 20 years, mainly due to the work by Michael (e.g., 1993) on the EO. The successful applications of the EO to mand training and the reduction of problem behaviors for persons with developmental disabilities have brought the topic of motivation into a larger focus in behavior analysis. There has been a sharp increase in research, and there are now hundreds of publications relevant to the EO and motivation. However, when compared to the extensive research on the other

basic principles of behavior, the quantification of motivative variables encouraged by Skinner (1938) has just begun.

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Footnotes

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