JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2000, **33,** 401–410 NUMBER 4 (WINTER 2000)

IMPLICATIONS AND REFINEMENTS OF THE ESTABLISHING OPERATION CONCEPT

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In this paper I discuss (a) three steps in the development of establishing operation (EO) terminology, (b) my early neglect of its possible relevance to applied behavior analysis, (c) the importance of functional analysis methodology for increasing awareness of EO issues, and (d) three comprehensive reviews that clarify the role of EOs in applied work. I then review and further analyze seven topics that require further clarification or that have been raised since my 1982 and 1993 articles: the EO evocative effect, deprivation and satiation, problem behavior maintained by attention, decreasing behavior evoked by a transitive conditioned establishing operation, EOs in the context of escape and avoidance, academic demand, and decreasing behavior evoked by a reflexive conditioned establishing operation.

DESCRIPTORS: establishing operations, problem behavior, antecedent influences, conditioned establishing operations

My 1982 and 1993 papers on establishing operations (EOs) were attempts to make motivational concepts more important parts of current behavior analysis theory. This required three terminological refinements: (a) a specific definition of two behavioral effects of a motivative variable; (b) a distinction between motivative and discriminative variables in terms of reinforcing effectiveness versus availability of a consequence; and (c) third, the application of this distinction to identify various kinds of learned motivative variables that were often considered to be discriminative stimuli (S^Ds). The two behavioral effects (reinforcer establishing and evocative) were quite clear in Skinner's 1953 book, and I simply provided a name (establishing operation), which I took from Keller and Schoenfeld (1950), for any variable having those two effects. This step was uncontroversial, although the emphasis on an independent status for the evocative effect seems to be not always understood or accepted (I elaborate on this later). The definition of the S^D in terms of the availability rather than the reinforcing effectiveness of a behavioral consequence is clearly implied in most common technical usage. However, a more restrictive availability requirement as a basis for invoking S^D status is not implied in common technical usage, and is not being widely utilized at the present time in treatments of establishing operations.

In the process of producing the 1982, 1988, and 1993 papers, teaching about these concepts in my undergraduate and graduate courses, and giving conference presentations and workshops, I generally neglected the possible relevance of the EO concept to the applied field. It seemed obvious that any significant improvement in the conceptual integrity and consistency of our language about behavior would have far-reaching practical implications, but I did not (possibly could not) spell out these implications myself. During my 1990 Association for Behavior Analysis workshop on motivation, and after I had finished "drilling" the participants on distinguishing between S^Ds and the various learned EOs, one of the participants asked, not hostilely but with an edge to his voice, "What difference does it really make whether we consider the slotted screws

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to be an S^D for the request for the screwdriver or a transitive conditioned establishing operation for the request?" I was somewhat surprised by the question, and all I could come up with at the moment was to say that thinking of two evocative variables with such different histories and such different implications for prediction and control as though they were the same would surely result in theoretical and practical ineffectiveness, the exact nature of which I was not prepared to describe at that time.

The relevance of the EO concept to behavior in applied settings was clearly demonstrated by Vollmer and Iwata (1991), and even before that the applied relevance was becoming more apparent as a result of the functional analysis methodology introduced in 1982 by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994). The necessity of experimentally determining the reinforcement for particular instances of self-injurious behavior focused attention on antecedent variables that altered the reinforcing effectiveness of behavioral consequences—in effect, establishing operations. The EO concept has become an increasingly common part of the language of functional analysis, and as a result is much more widely understood and applied than would have resulted solely from the articles on establishing operations.

The increased reference to EOs in functional analysis and related literature has resulted in two general review articles in the *Journal of Applied Behavior Analysis* (*JABA*) (McGill, 1999; Smith & Iwata, 1997) and one in *Behavioral Interventions* (Wilder & Carr, 1998). I learned a great deal about antecedent variables in general, and about the EO in particular, from the Smith and Iwata review. Especially valuable to me was the detailed and thorough analysis of EOs (including conditioned establishing operations, or CEOs) related to negative reinforcement, and also the carefully stated coverage of Kantor's setting events. The McGill paper is very comprehensive, especially with respect to the CEOs both as establishers and abolishers. I also found his analysis of various existing treatments in terms of the EO concepts very enlightening. The Wilder and Carr review is a brief but thorough overview of recent developments involving EO interventions as treatments of aberrant behavior. For anyone unfamiliar with EOs, these three reviews can function as very effective introductions to this special issue of *JABA*.

As to my own contribution to this special issue, given the three readily available review articles and my own overview of the topic (Michael, 1993), it would be redundant to go over the basic EO concepts. However, in reading the current applications of these concepts I can see that there are several terminological implications that may sometimes be overlooked or misconstrued, some concepts and principles that are assumed but are not adequately explained or emphasized, and some details that may benefit from restatement. A number of my statements about EOs are a form of conceptual analysis that I consider quite defensible, but they often go beyond well-established empirical support. Such statements, when given without qualification or extensive justification, may seem to be dogma, but I would like the reader to assume a parenthetical "from my perspective" or "in my opinion" after many such statements. Some readers may quite reasonably disagree with the implications or contest the validity of some assumptions that are being used in the analysis. Clarity will be served, however, if these issues are made explicit, and can then serve as bases for disagreement and possible further terminological refinement. The topics that follow will be given titles to help in the organization, but by their very nature they are a somewhat heterogeneous collection.

Nature of the EO Evocative Relation

The two effects of an EO are an alteration in the reinforcing effectiveness of some stimulus, object, or event (the reinforcer-establishing effect) and an alteration in the current frequency of all behavior that has been reinforced by that stimulus, object or event (the evocative effect). For example, food deprivation makes food a more effective form of reinforcement and increases the current frequency of all behavior that has been reinforced with food. These two effects occur simultaneously and independently, but the evocative effect is sometimes assumed erroneously to be solely a product of the organism's contact with the more effective reinforcement. In some versions it is stated that the organism responds more frequently "because the food is more reinforcing." This implies that the increased response frequency results only after the more effective reinforcement has occurred. The relation between rate of responding on a variable-interval food schedule and food-deprivation level might be thought of as a model for the evocative effect, but it is not an appropriate model because on such a schedule the increased rate is a function of both EO effects. The organism's rate of food-reinforced behavior increases prior to obtaining any food as the evocative effect of the EO, and may increase further after a response is followed by the more effective food reinforcement. A more appropriate conceptual model for the evocative effect by itself is the direct relation between deprivation level and the initial rate of responding or the total number of responses emitted *during extinction* (see Keller & Schoenfeld, 1950, pp. 266–267 and Figure 60). From an evolutionary perspective (although this is no substitute for empirical evidence) when there is a problem, it is important for the EO to evoke the behavior that has overcome the problem in the past, even if this behavior is not at first successful.

Deprivation and Satiation

EOs generally come in pairs, with one condition *increasing* the effectiveness of something as reinforcement and *increasing* the current frequency of the behavior that has been reinforced by that thing, and a related condition working in the opposite direction. The terms *deprivation* and *satiation* are sometimes used as general terms for these two conditions, with the implication of analogy to food and water deprivation and satiation, but this practice may cause trouble. Because of their history of reference to variables with far-reaching biological effects, these terms in some contexts have other implications than just the alteration of reinforcing effectiveness and response frequency. Deprivation can often be taken to refer to nothing more than a period of restricted access to something, but the environmental operations having the opposite effect vary sufficiently from one another that the term *satiation* is not very useful. At this point in the evolution of motivational terminology, it is probably safer to refer simply to establishing and abolishing operations.

Modifying an EO to Reduce the Frequency of Problem Behavior

In principle, reducing the frequency of problem behavior by modifying its EO will not constitute a permanent improvement. The behavior will return when its EO is again in effect. If during the time the problem behavior is at a low frequency because its EO is weak or absent a form of reinforcement related to a different EO can be used to generate a repertoire that interferes with the problem behavior when its EO is again in effect or makes it unnecessary, then the change may be usefully lasting. Reducing the frequency of behavior by reducing the strength of EOs is also important, as McGill points out (1999, p. 407) in terms of improving the quality of life of individuals who

are disabled in various ways. One could argue that people should not be deprived of meaningful social contact with others, should not have demands made upon them that they cannot meet, should not have to live in a stimulus-impoverished environment with no way to "have fun," and so forth. Broad changes in living conditions would result in a reduction in the frequency of problem behavior evoked by these EOs. Still, some consideration should always be given to teaching effective ways to deal with environmental difficulties that can never be totally eliminated. Replacement of whining, aggression, self-injury, and so on, with effective problem solving will be an important part of all education, for nondisabled individuals as well as those who are disabled.

Problem Behavior Maintained by Attention

If, as may be the case with infants, attention by another person (touching, making soft vocal sounds, etc.) is a form of unconditioned reinforcement, with restricted access (deprivation) being the establishing operation and exposure to such stimulation being the abolishing operation, then problem behavior reinforced by attention can be *temporarily* reduced in frequency by exposure (e.g., noncontingent attention), or by eliminating as much as possible the attention-impoverished living conditions that some people with developmentally disabilities find themselves in. More permanent reduction in the frequency of any behavior maintained by attention can be accomplished by withholding the attention when the problem behavior occurs (extinction).

Irrespective of its possible status as unconditioned reinforcement related to an unconditioned EO, attention must for most humans also function as conditioned reinforcement because of its relation to other forms of reinforcement. In this case, the EOs governing those other forms of reinforcement will function as transitive CEOs in determining the value of attention as reinforcement. Many forms of reinforcement have typically required, or have been facilitated by, help from another person, and such help requires some form of attention by the helper. Common examples involve help with a task that physically requires two persons, help in the form of information, and help in contacting or interacting with another person, all of which must usually be preceded by stimuli indicating that the potential helper is looking at us, attending to what we say, smiling or otherwise showing signs that help might be provided. Problem behavior maintained by attention as conditioned reinforcement, and thus evoked by one or more transitive CEOs, can be reduced in frequency in several ways, described below.

Decreasing the Frequency of Behavior Evoked by a Transitive CEO

Now that CEOs are becoming better known, it becomes important to discuss the various ways to weaken behavior that is evoked by such an EO and in particular the relevant terminology for the various weakening operations. Let us consider first a simple behavioral chain of the type often used in student demonstration laboratories. With a food-deprived rat, the first response (R1) turns on an auditory stimulus (a tone), and in the presence of the tone a second response (R2) causes delivery of a food pellet, termination of the tone, and initiation of the intertrial interval (ITI). In such a chain the tone, because of its relation to food reinforcement, functions as conditioned reinforcement for R1 and as an S^D for R2. Food deprivation functions as a transitive CEO for R1 by making the tone effective as a form of reinforcement and as an unconditioned establishing operation (UEO) for R2 by making food effective as reinforcement.

Now, what are the various ways to decrease the frequency of R1, and what should they be called? A temporary decrease can be

accomplished by allowing unrestricted access to a large amount of food prior to placing the animal in the chamber. After food ingestion (an abolishing operation) the reinforcing effectiveness of the tone is much reduced, and simultaneously so is the frequency of R1. Of course, when the rat is again food deprived, R1 will occur at its previous frequency. The functional relation between food deprivation (the transitive CEO) and R1 has not been altered. The most obvious permanent way to decrease the frequency of R1 is to leave the food deprivation in effect and change the apparatus so that R1 no longer turns on the tone. Let us confine the term *operant extinction* to procedures in which a response occurs without its reinforcement, so the occurrence of R1 without being followed by the tone qualifies as extinction. This will weaken and eventually eliminate the relation between the transitive CEO and R1.

Another way to reduce the frequency of the R1 is to allow it to turn on the tone, but when R2 occurs in the tone, withhold the food reinforcement, turn off the tone, and start the procedure over again. This will constitute extinction for R2 and at the same time will decrease the reinforcing effectiveness of the tone, which is now no longer being paired with the food. Eventually R1 will cease because its immediate consequence, the tone, is losing its reinforcing effectiveness. This procedure involves *unpairing* the tone and the food. There is some tendency in the field to refer to this procedure as extinguishing R1, which makes sense only if it is thought that the reinforcement for R1 is the food that is provided when R2 occurs. From a molecular perspective, however, the relevant reinforcement for R1 is the tone onset, not the food delivery. There is another type of unpairing that will also weaken R1. If R2 continues to produce food in the tone, but the situation is changed so that it produces food just as often in the absence of the tone, the advantage of the tone-on condition over the tone-off condition will be lost, and changing from tone-off to tone-on will lose its reinforcing effectiveness. The first kind of unpairing results in the remote event being *unavailable* both in the absence and the presence of the stimulus. The second results in the remote event being *equally available* in the absence *and* the presence of the stimulus.

The first unpairing operation is sometimes referred to as *respondent* or *classical* extinction, with the implication that the development of a conditioned reinforcer is a form of classical conditioning. This seems to me to be a potentially confusing terminological practice. The essential outcome in respondent conditioning is the development of a conditioned stimulus, a stimulus that elicits somewhat the same type of response elicited by the unconditioned stimulus that it was paired with. The essential outcome in the development of a conditioned reinforcer is a stimulus that will function to reinforce—to increase the future frequency of—the type of response that preceded it. That a stimulus elicits some respondent behavior is neither necessary nor sufficient for the stimulus to fit the definition of a conditioned reinforcer. At present I think terminological precision is best served by simply referring to these unpairing operations as unpairing, remembering that there are two forms of unpairing, and to restrict the term *operant extinction* to the situation in which a response occurs without its reinforcement.

Three ways to permanently weaken behavior evoked by a transitive CEO were illustrated with the rat example. For applied purposes, it will help to reconsider the electrician, the slotted screws, and the request for the screwdriver. To extinguish the request that is evoked by the slotted screws, something in the environment would have to change so that such requests are no longer honored—requests for screwdrivers (possibly

for tools in general) are no longer followed by receiving the tool. Perhaps a change occurs in the social relations involved to the effect that the assistant now enforces a policy under which electricians must get their own tools. In contrast, the first kind of unpairing could be illustrated if screwdrivers no longer worked to unscrew slotted screws—perhaps all such screws are now welded. The electrician can still obtain a screwdriver by asking, but the value of the screwdriver is ultimately lost because such a tool does not work anymore. The second kind of unpairing would occur if construction practices changed so that all slotted screws could now be easily unscrewed by hand as well as with a screwdriver. The value of having the screwdriver over doing without would be lost.

EOs in the Context of Escape and Avoidance

The same event can be one type of EO with respect to a particular type of reinforcing effectiveness and response and a different type of EO with respect to a different type of reinforcing effectiveness and response. First consider a typical nonhuman shock-escape procedure, starting with an ITI of 20 s. At the end of the 20-s period the floor grid is electrified, but the rat can terminate the painful shock stimulus by pressing a lever, which initiates another ITI. With respect to its effect on the reinforcing effectiveness of shock termination, the shock is a UEO because the effect of pain in making pain reduction effective as reinforcement can be considered an unlearned relation. Assume now that the chamber is fairly large and during the ITI the rat wanders around the chamber, and sometimes is away from the lever when the shock comes on. The shock then makes the sight of the lever effective as reinforcement and evokes looking for the lever, behavior that has been successful in finding the lever in the past. In this respect the shock is functioning as a transitive CEO because the reinforcer-establishing effect is learned: The sight of a lever is reinforcing during shock only because of the history of shock being terminated by the lever press; its reinforcing value is not innate. Note that a UEO should be considered such only because its reinforcer-establishing effect is unlearned, not in terms of its biological significance. Similarly, food deprivation as a UEO makes food effective as unconditioned reinforcement, and as a transitive CEO it makes the sight of objects that are related to obtaining food effective as conditioned reinforcement. (Like CEOs, UEOs can be classified as *reflexive* if they make their own removal effective as reinforcement and *transitive* if they make something else effective as reinforcement. Painful stimulation illustrates the former and food deprivation the latter type of UEO.)

It may be useful here to review the argument against shock being considered an S^D for the lever press or an S^D for looking for the lever. With respect to the lever press, for a stimulus to function as an S^D, there must also be a negative discriminative stimulus (S^Δ) situation in which the reinforcement that is available in the S^D is unavailable in the S^Δ**,** but *would be effective as reinforcement if it were obtained*. Shock termination is the event that is unavailable in the absence of shock, but in the absence of shock (the EO that makes shock termination reinforcing) there is nothing that is unavailable *and* would be reinforcing if obtained. The shock also fails as an S^D for the behavior of looking for the lever, because in a true discriminative relation the reinforcement that is available in the SD condition must be unavailable in the S^Δ, but if the reinforcement for looking for the lever is seeing the lever, this consequence of looking is just as available in the absence of shock as in its presence. (This analysis is an example of a strongly molecular bias in considering short-term or more immediate events, rather than more remote events, to

be the primary controlling forms of reinforcement for behavior. Of course pairing with the more remote events is usually responsible for the reinforcing effectiveness of the more immediate ones.) As with the electrician example, the reinforcement for asking for a screwdriver is getting the screwdriver, which is just as available in the absence of the slotted screws as in their presence.

In a shock-avoidance procedure, an ITI is followed by the onset of a warning stimulus (e.g., the sounding of a tone). If a response (e.g., a lever press) occurs before a specified time period elapses, the tone is terminated and the ITI starts over. If the specified time period (e.g., 5 s) elapses before the response occurs, the floor grid is electrified, and either the same response or a different response will then terminate the shock and the tone and start the ITI. In such a procedure the tone will function as a reflexive CEO, a stimulus that makes its own removal effective as a form of reinforcement and evokes any behavior (in this case the lever press) that has had that effect. Like the shock in the escape procedure, the tone also functions as a transitive CEO in making the sight of the lever effective as reinforcement and evoking some form of visual search behavior that has had this effect. The reason that the tone should not be considered an S^D for the avoidance response or as an S^D for the visual search behavior is the same as for the shock in the shock-escape situation. (An analysis of EO control in avoidance without an exteroceptive warning stimulus requires consideration of response-produced stimuli as the reflexive CEO, but this analysis will not be attempted here.)

Academic Demand and Negative Reinforcement

The role of an academic demand situation in evoking problem behavior seems to be like that of the warning stimulus in an avoidance procedure evoking the avoidance response as a reflexive CEO. The situation is complicated by not involving a warning stimulus that is clearly distinct from the thing that it warns of. If the demand stimuli are like the warning stimulus, what is like the shock? Let us assume, however, that the initial aspects of the demand—the arrival of the trainer, the trainer directing the student to the learning area and presenting the materials relevant to the task—have systematically preceded more intense directive activity on the part of the trainer, eventual task failure with implied or actually delivered social disapproval, and possible further inconveniences. The demand situation might be thought of as a steadily worsening continuum of social interactions, the termination of which at any point functions as social negative reinforcement for the problem behavior. Some academic demand situations may have actual UEO aspects, not in the form of painful stimulation, but rather by being forced to stay in the situation, being repeatedly prompted to do something, ultimately being physically guided through the response, and so on. The aversiveness of these inconveniences may not be solely due to their relation to social disapproval.

In any case, in that the demand makes its own termination effective as reinforcement, it functions as a reflexive CEO or as a UEO and evokes avoidance or escape behavior, sometimes in the form of self-injury or aggression. As with the shock in the escape procedure and the warning stimulus in avoidance, we would expect to see the demand situation function as a transitive CEO in making effective as reinforcement the sight of or access to other features of the environment that have facilitated avoidance or escape. For some pupils it might make the sight of an object that could be used to inflict damage to oneself or others effective as reinforcement and evoke a search for such an object. Or it might make the sight of a sympathetic person effective as reinforce-

ment and evoke an effort to find or make contact with such a person. Why is the demand not an S^D for the avoidance or escape behavior or an S^D for the search for implements of destruction or for a sympathetic person? The reasons are the same as for the shock and for the warning stimulus in the procedures described above: Demand absence is not a proper S^Δ because demand removal in that condition would not be reinforcing *if it were obtained*; the implements or the sympathetic person are just as available in the absence of the demand as in its presence.

There may be S^D relations involving the problem behavior in a demand situation. Suppose that the main trainer never terminates the demand contingent upon the problem behavior, but that an assistant trainer who occasionally replaces the main trainer does reinforce the problem behavior by terminating the demand. The main trainer then functions as an S^Δ for problem behavior, and the arrival of the assistant trainer functions as an S^D for that behavior. The problem behavior is evoked by the demand situation functioning as a reflexive CEO or a UEO, but is also under the control of other aspects of the situation that are related to the availability of reinforcement. In the electrician example, the presence of the assistant may function as an S^D for asking behavior. Suppose that the assistant has stepped out of the electrician's view. The electrician sees the slotted screws holding the junction box on the wall and turns to where the assistant usually stands. The slotted screws evoke the request for the screwdriver as a transitive CEO, but the response does not occur because reinforcement for requests has not been available in the absence of a listener. The electrician waits a few seconds, and when the assistant appears, the request occurs with the arrival of the assistant functioning as an S^D (just as a lever press for food in a discriminative procedure is jointly evoked by the food deprivation EO and by the onset of the exteroceptive S^D).

Decreasing the Frequency of Behavior Evoked by a Reflexive CEO

Now let us consider the reflexive CEO and the avoidance situation. How could we decrease the frequency of the avoidance response, the lever press, in the rat example above? Of course if the warning stimulus is not turned on, the avoidance response will not occur; this is like food ingestion for the rat in the simple operant chain described above. Extinction consists in breaking the connection between the avoidance response (e.g., a lever press) and the offset of the warning stimulus (the tone). The rat presses the lever, but the warning stimulus stays on and the shock is given when the time elapses. This is extinguishing the avoidance response. The first kind of unpairing can be illustrated by allowing the lever press to terminate the tone, but then giving the shock when it would have been due if the tone had remained on, whether or not the tone was turned off. This procedure will result in the tone-off condition losing its advantage over the tone-on condition, as tone-off becomes just as aversive as tone-on. The second kind of unpairing will occur if the shock no longer comes on at the end of the warning stimulus period, and instead the ITI simply starts over. This unpairing will result in the tone-off condition losing its advantage over the tone-on condition, and the effectiveness of the reinforcement consisting of the change from tone-on to tone-off being gradually decreased. Here the tone-on condition becomes no more aversive than the tone-off condition. This procedure is sometimes (I think quite erroneously) referred to as extinguishing the avoidance response, which seems plausible only if one identifies the reinforcement for the avoidance response as avoiding the shock, a molar perspective.

Consider now the academic demand sit-

uation that occurs in work with persons with developmental disabilities. Under some conditions the problem behavior is evoked by the early phases of a demand sequence and is reinforced by terminating the early phase and not progressing to the later and possibly more demanding phases. How can this avoidance behavior be reduced in frequency? Of course when the demand does not occur, the behavior that avoids further demands will not occur. This is like not turning on the warning stimulus, but of course it does not produce a permanent change in the evocative relation between the reflexive CEO and the relevant problem behavior. Extinction of the avoidance behavior consists of continuing the demand sequence irrespective of the occurrence of problem behavior. The first kind of unpairing consists of the odd procedure of terminating the early phase of the demand sequence when the problem behavior occurs, but then presenting the more demanding phase when it is due to occur whether or not the early phase was terminated by the problem behavior. The second kind of unpairing consists of terminating the demand sequence simply as a function of reaching the end of the early phase of the sequence. Here the aversiveness of the early phase would be gradually lost, and the behavior that is reinforced by its termination is reduced. This is like withholding the shock whether or not the rat presses the lever and terminates the warning stimulus.

Assuming that the ultimate phases of the demand sequence must occur because of the importance of the relevant repertoire being taught, and assuming that they cannot be made less aversive, then extinction of the problem behavior is the only procedure that is of practical value. The first type of unpairing would simply result in the problem behavior occurring as soon as the later phases of the training began. The second would not result in any relevant training. But of course, one should not assume that the ultimate phases of the demand cannot be made less aversive. Increasing the effectiveness of instruction results in less failure, more frequent social and other forms of reinforcement, and other general improvements in the demand situation to the point at which it may not function as a demand but rather as an opportunity.

Conclusion

As I review these various implications and refinements, it seems quite likely that I have overlooked some major problems and have raised some issues that may not be issues for most *JABA* readers. I know that I have failed to provide adequate justification for the molecular perspective that underlies much of the analysis, and I have deliberately avoided identifying and criticizing the many mentalistic and cognitive interpretations of EO phenomena that are a part of commonsense language about motivation and that surprisingly often slip into our own behavioral language. Perhaps these topics can be the basis of further treatments of the EO and related topics. I would like to express my thanks to the editors of this special issue of *JABA*, Rick Smith and Brian Iwata for giving me an opportunity to enlarge my understanding EO applications, and to Bud Mace for his role in initiating the special issue.

REFERENCES

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27,* 197–209. (Reprinted from *Analysis and Intervention in Developmental Disabilities, 2,* 3–20, 1982)

Keller, F. S., & Schoenfeld, W. N. (1950). *Principles of psychology.* New York: Appleton-Century-Crofts.

McGill, P. (1999). Establishing operations: Implications for the assessment, treatment, and prevention of problem behavior. *Journal of Applied Behavior Analysis, 32,* 393–418.

Michael, J. (1982). Distinguishing between discriminative and motivational functions of stimuli.

Journal of the Experimental Analysis of Behavior, 37, 149–155.
Michael, J. (1988). Establishing operations and the mand. *The Analysis of Verbal Behavior, 6,* 3–9.
Michael, J. (1993). Establishing operations. *The Behavior Analyst, 16,* 191–206.
Skinner, B. F. (1953). *Science and human behavior.* New York: Macmillan.
Smith, R. G., & Iwata, B. A. (1997). Antecedent influences on behavior disorders. *Journal of Applied Behavior Analysis, 30,* 343–375.
Vollmer, T. R., & Iwata, B. A. (1991). Establishing operations and reinforcement effects. *Journal of Applied Behavior Analysis, 24,* 279–291.
Wilder, D. A., & Carr, J. E. (1998). Recent advances in the modification of establishing operations to reduce aberrant behavior. *Behavioral Interventions, 13,* 43–59.

Received August 25, 2000
Final acceptance August 29, 2000
Action Editor, F. Charles Mace