The Behavior Analyst 2001, 24, 173–180 No. 2 (Fall)

# The Premack Principle, Response Deprivation, and Establishing Operations

Kevin P. Klatt and Edward K. Morris
University of Kansas

This paper describes response deprivation as an establishing operation. In this context, we review the concept of establishing operation, in particular, its reinforcer-establishing and evocative effects; we place response deprivation in the literature on the reinforcing effects of behavioral activity, wherein response deprivation subsumes the Premack principle; we describe the reinforcer-altering and evocative effects of response deprivation; and we address a methodological concern about the evocative effect. In closing, we discuss some conceptual and empirical implications of the foregoing analyses.

*Key words:* response deprivation, establishing operations, the Premack principle

---

The concept of context has two systematic lineages in behavior analysis, one beginning with J. R. Kantor, the other with B. F. Skinner. The former is the lineage of *setting factors* (Kantor, 1918, 1959, p. 14), from which *setting events* emerged in the work of Bijou and Baer (1961, pp. 17–25; see Bijou, 1996). The latter is the lineage of Skinner's (1931) *third variables,* which *establishing operations* (EOs) have partially subsumed (Keller & Schoenfeld, 1950, p. 269; Michael, 1982; Millenson, 1967, p. 383). Although relevant to both lineages, this paper addresses only EOs, extending their purview to the Premack principle and then to response deprivation. Our point is that response deprivation is an EO. In this context, we review the concept of the EO, describe the Premack principle and response deprivation, make the case that response deprivation is an EO, raise a methodological concern, and discuss some conceptual and empirical implications.

This article is based on a paper presented at the meeting of the Association for Behavior Analysis, May 2000. We thank Dan Bernstein, Hank Schlinger, Peter McGill, and Jack Michael for their helpful comments on that and the current version of the paper.

Correspondence may be sent to the first author, Department of Psychology, University of Wisconsin–Eau Claire, Eau Claire, Wisconsin 54702.

## *Establishing Operations*

The genesis of EOs lies in Skinner's (1931, p. 451) concept of third variables. Third variables generally comprised "conditioning, drive, and emotion" (p. 454) and accounted for changes in the correlation among classes of responses and stimuli—the first and the second variables. Although third variables did not survive the 1930s as a technical term, Keller and Schoenfeld (1950, pp. 262–325) later subsumed drive and emotion under "establishing operations" in their analysis of motivation. As a technical term itself, however, *establishing operation* also did not survive its own time, but was revived by Michael (1982). In Michael's (1993) latest systematic account, EOs are defined by two effects:

> An *establishing operation* is an environmental event, operation, or stimulus condition that affects an organism by momentarily altering (a) the reinforcing effectiveness 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 an EO to be a behavioral process unto itself, these effects—the *reinforcer-establishing* and the *evocative* effects, respectively—should operate independently of any ongoing reinforcement contingencies (e.g., schedules of reinforcement; Ferster & Skinner, 1957) and function-altering or repertoire-altering processes (e.g., conditioning, contingency-specifying stimu-

li; reinforcement, stimulus equivalence; see Michael, 1983; Schlinger & Blakely, 1987), a point we raise again below. We also defer until later a discussion of the *abolishing* (or disestablishing) effect of EOs (see Michael, 1982, p. 151, 1993, p. 193), for our concern here is with their *establishing* effects: An EO momentarily establishes or increases (a) "the effectiveness of [other events] as a form of reinforcement and (b) the frequency of the types of behavior that have been previously reinforced with [those events]" (Michael, 1993, p. 192; cf. Keller & Schoenfeld, 1950, pp. 265–267). Water deprivation is an often-cited example. Water deprivation establishes the effectiveness of water as a reinforcer and increases the frequency of responses that, in the past, were reinforced by water (e.g., bar pressing, foraging, manding "water"; see Michael, 1988). Water deprivation is not, however, the only operation that has this effect; so too do heat, physical exercise, and salt ingestion. Thus, not only does the term EO denote a behavioral *process* that momentarily establishes events as reinforcers and evokes reinforcer-related responses, but it is also a systematic *concept* that integrates this behavioral function across disparate events, conditions, and variables.

As both a process and a concept, the EO has garnered considerable attention. It has been systematized to the extent that it is now used as a technical term in the science of behavior and its application (see, e.g., Catania, 1998, pp. 388–389; Sulzer-Azaroff & Mayer, 1991, p. 589). Establishing operation is a conceptual basis for expanding the basic behavior-analytic unit from a three- to a four-term contingency (Michael, 1985, p. 105). Establishing operations are used in behavioral assessments and interventions with socially important behavior (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982; McGill, 1999; Wilder & Carr, 1998; see the special section on EOs in the *Journal of Applied Behavior Analysis*, 2000, Vol. 33, No. 4). Furthermore, the concept has enriched the corpus of principles used in behavioral interpretation, both in post hoc interpretations of uncontrolled physical, biological, and social variables in basic and applied research (e.g., sleep deprivation, allergens, instructional demands; see Kennedy & Meyer, 1996) and in interpretations of everyday (e.g., motivated, social, verbal behavior; see Michael, 1988, 1993) and clinically relevant behavior (e.g., anxiety, depression; see Dougher & Hackbert, 2000). The concept of the establishing operation, however, encompasses still more. It encompasses at least one other behavioral relation: response deprivation and, with it, the Premack principle.

### *Response Deprivation*

Like the other concepts of context, response deprivation has its own lineage. Research on "activity" as a reinforcer, for instance, extends back at least into the 1920s (e.g., Richter, 1922). In reviewing this literature, Keller and Schoenfeld (1950, pp. 278–284) noted that an "activity varies as a function of [its] deprivation like any other appetite" (p. 283). For example, depriving a rat of access to an activity (e.g., running) will increase its rate of that activity above baseline when later given an opportunity to engage in it. Other relevant research concerns what functions as reinforcement: the consequences of responding (e.g., food) or responding that produces those consequences (e.g., eating; Sheffield, 1948; Sheffield, Wulff, & Backer, 1951; see Mazur, 1998, p. 219). Response deprivation concerns the latter. This early work notwithstanding, the modern lineage of response deprivation begins with the Premack principle.

*The Premack principle.* The Premack principle emerged from Premack's (1959) research on the "rate-differential" or "probability-differential" effect, wherein "any response A will reinforce any response B, if and only if, the independent rate of A is *greater* [italics added] than that of B"

(p. 220; see Premack, 1961, 1962, 1963). On this account, a high-rate "contingent" response can reinforce a low-rate "instrumental" response, but not vice versa. For instance, the contingent opportunity for a rat to drink water will reinforce its instrumental wheel running if and only if the probability of drinking water is greater than wheel running. This is not just a theoretical point, but has obvious clinical and applied implications, many of them now realized (see Martin & Pear, 1996, pp. 31–32; Mazur, 1998, pp. 222–223). Allen and Iwata (1980), for example, increased the amount of exercise (a low-rate response) among persons with developmental disabilities by making access to games (a high-rate response) contingent upon it (see also Goh et al., 1995; Homme, deBaca, Devine, Steinhorst, & Rickert, 1963; Mitchell & Stoffelmayr, 1973; Wasik, 1970; but see Knapp, 1976).

*Response suppression.* As his research program evolved, Premack (1965, pp. 164–173) noted that the rate-differential effect was accompanied by another effect: When opportunities to engage in high-rate responding reinforced low-rate responding, the high-rate responding was, at those times, reduced below its baseline. This occurred because Premack's experimental preparation restricted the rats' opportunities to engage in the high-rate response (e.g., access to water), thus reducing that response (e.g., drinking) until the low-rate response was emitted (e.g., wheel running), the consequence of which reinstated the opportunity to engage in the high-rate response. Premack (1965) described this reduction as "characteristic" and "nearly inevitable" (p. 170), remarking however that, although its relation to the reinforcing effectiveness of high-rate responding was "necessary," the reduction was not in itself "sufficient" (p. 171).

Just a few years later, however, Eisenberger, Karpman, and Trattner (1967) demonstrated both the necessity and the sufficiency of response reduction: "The necessary and sufficient condition for reinforcement is 'response suppression.' Any [instrumental] response serving to overcome response suppression [in the contingent response] will be reinforced" (p. 345). On this account, any response A can reinforce any response B if the rate of A is suppressed below its free-operant baseline, regardless of which response occurs more frequently (see also Mazur, 1975; Timberlake & Allison, 1974). Eisenberger et al. showed, for example, that the opportunity for humans to turn a wheel could be used to reinforce their pressing a bar, no matter what the relative rate of the former to the latter—higher or lower—as long as turning the wheel was suppressed below its baseline. With this, the Premack principle was no longer an empirical law unto itself, but was explained by a more general process: response suppression (see Timberlake, 1980).

*Response deprivation.* Timberlake and Allison (1974; Allison & Timberlake, 1974, 1975) later reformulated response suppression into *response deprivation,* which is today the more standard term (see, e.g., Allison, 1993; Chance, 1999, pp. 172–173; Leslie, 1996, pp. 104–106; Malone, 1990, pp. 283–284; Mazur, 1998, pp. 223–224; but see also *response restriction*; Bernstein & Ebbesen, 1978; Dunham & Grantmyre, 1982). Like the Premack principle, response deprivation also has been applied to clinically relevant human behavior. Dougher (1983), for example, demonstrated that response deprivation of drinking a preferred beverage would increase appropriate social behavior in adults diagnosed with schizophrenia when access to drinking was made contingent on the social behavior (see also Heth & Warren, 1978; Konarski, 1987; Konarski, Johnson, Crowell, & Whitman, 1980).

### *Response Deprivation: An Establishing Operation*

Before making the point that response deprivation is an establishing

operation, we turn to Catania (1998) as a resource on matters of definition. Here, we find that although *response deprivation* does not appear in his index, it has an entry in his glossary (p. 407), where it directs the reader to two other terms: *establishing operations* and *reinforcement.* Under *establishing operations* (pp. 388–389), we find descriptions of operations that momentarily change the functions of stimuli as reinforcers, but no reference to response deprivation per se. Under *reinforcement* (pp. 405–406), we find a description of response deprivation, but with only a "cf." to EOs, which means "compare" (see Fowler, 1987, p. xxii). Although the relation Catania drew here between EOs and response deprivation was not explicit, he has elsewhere suggested that response deprivation is an EO (Catania, 1993), as have others (e.g., McDevitt & Fantino, 1993; Michael, 1993). Our point, arrived at independently, extends this analysis.

*The establishing effect.* Recall that an EO has two effects. The first is to establish momentarily "the reinforcing effectiveness of other events" (Michael, 1993, p. 192). Likewise, so too does response deprivation: It momentarily establishes the reinforcing effectiveness of opportunities to engage in suppressed or restricted responding. That is, when a contingent response (e.g., drinking water) is suppressed or restricted below (i.e., is deprived of) its baseline rate, the opportunity to engage in it becomes a reinforcer for an instrumental response (e.g., wheel running).

*The evocative effect.* The second effect of an EO is to evoke momentarily the frequency of the "repertoire relevant to those events as consequences" (Michael, 1993, p. 192). So too does response deprivation: It momentarily increases the frequency of the repertoire relevant to reinstating the opportunity to engage in the suppressed or restricted response. That is, when a contingent response (e.g., drinking water) is restricted below (i.e., is deprived of) its baseline rate, this evokes instrumental responses (e.g., wheel running) relevant to engaging in the deprived response (e.g., drinking water).

Given that response deprivation entails both the momentary establishing and evocative effects of an EO, it can be classified as an EO. However, a methodological concern may be raised about the second effect, for its empirical demonstration is not always readily apparent.

*A methodological concern.* As mentioned earlier, if an EO is a behavioral process unto itself, its momentary establishing and evocative effects should operate independently of any ongoing reinforcement contingencies and function-altering or repertoire-altering processes. Thus, research preparations should control for these contingencies and processes, offering evidence that the establishing and evocative effects occur independently of them. In the response deprivation literature, only the independence of the establishing effect has been routinely demonstrated. The evocative effect is often not measured or reported.

Take Premack (1963), for example. In this study, he differentially controlled rats' baseline rates of drinking (i.e., licking measured by a drinkometer) and running (i.e., measured by running wheel rotations) to demonstrate that drinking could reinforce running and vice versa, depending on which was more probable. His real-time event records showed the temporal sequence of drinking followed by running and vice versa, and hence the reinforcement of one by the other—the establishing effect of response deprivation. However, the evocative effect cannot be discerned from the records, because they lack abscissas denoting where the sessions began, for instance, before any contingent reinforcement occurred for instrumental behavior. Without such information, we cannot know if the instrumental response was evoked independently of the effects of the contingency. Moreover, no related responses, such as approaching the drink-

ometer, were concurrently measured, such that other evidence of the evocative effect could be reported. Other studies are even more difficult to interpret, for some of them present no real-time data or data on individual participants (e.g., Eisenberger et al., 1967). Ideally, the evocative effect should be demonstrated when other contingencies are not operative, for instance, during extinction or prior to a session's first reinforcer delivery.

In summary, then, even though the evocative effect of response deprivation seems to be necessary for the first occurrence of instrumental responding, the effect is often unmeasured. Thus, it must be inferred from the research methods or findings. Of course, the evocative effect may itself be independent of the establishing effect, and thus not necessary to the definition of an EO, but this is an issue better addressed elsewhere. For the moment, we turn to some conceptual and empirical implications of the foregoing analyses.

*Some Implications*

*Conceptual implications.* Among the conceptual implications are, first, that response deprivation can now be viewed as an instance or member of a larger, more generic class of behavioral relations: EOs. Response deprivation momentarily establishes both the effectiveness of consequences as reinforcers and evokes responses relevant to them. As such, it is not an independent behavioral process, but a subclass of EO—a more encompassing class concept.

Second, given that response deprivation implies *response satiation,* the latter can be subsumed under the EO's abolishing (or disestablishing) effect. EOs such as reinforcer satiation, for instance, momentarily abolish the effectiveness of consequences as reinforcers and decrease the frequency of responses relevant to them (Michael, 1982, p. 151, 1993, p. 193). Likewise, so too does response satiation. Response satiation momentarily abolishes the reinforcing effectiveness of opportunities to engage in that response or establishes those opportunities as punishers. For example, when a contingent response (e.g., drinking water) is forced above its baseline rate, the opportunity to engage in it becomes a punisher for instrumental responding (e.g., wheel running; see Allison & Castellan, 1970; Dougher, 1983; Heth & Warren, 1978; Leslie, 1996, p. 105). Response satiation also momentarily decreases the frequency of the repertoire relevant to opportunities to engage in that response or suppresses the relevant repertoire. For example, when a contingent response (e.g., drinking water) is forced above its baseline, this decreases the frequency of instrumental responses (e.g., wheel running) relevant to reinstating the opportunity to engage in the satiated response (e.g., drinking water). Like response deprivation, though, response satiation is also not an independent behavioral process. It is a subclass of the abolishing effects of EOs—a more encompassing class concept.

The symmetry of the establishing and abolishing operations suggests a third implication. In particular, the continuum along which they vary bears some resemblance to the molar equilibrium model of learned performance (see Timberlake, 1980), especially when response deprivation and satiation are analogous to "response deficits" and "response excesses" (see Timberlake & Farmer-Dougan, 1991). This suggests that establishing operations and abolishing operations might explain the equilibrium model or that the equilibrium model might explain the establishing and abolishing operations or that they describe the same process. Further analysis seems warranted (cf. Gewirtz, 1972, pp. 19–22, on "adaptation levels"; Skinner, 1953, p. 142, on "homeostasis").

A final conceptual implication is that the EO may subsume, or be subsumed by, not only the concepts of context mentioned earlier—third variables, setting factors, and setting events (see Mi-

chael, 1993, p. 192)—but also other such concepts, such as Gewirtz's (1972) "contextual conditions" and Goldiamond and Dyrud's (1968) "potentiating variables." Gewirtz, (1972), for instance, listed social deprivation and aversive stimulation among his examples. These are EOs on Michael's account.

*Empirical implications.* Among the empirical implications of the foregoing analyses are, first, that the Premack principle, as originally stated, is an incomplete principle. It is not fundamental, but instead is explained by response deprivation, which expands its scope and precision. This point is not appreciated throughout the behavior-analytic literature, much less outside of the discipline (Konarski, Johnson, Crowell, & Whitman, 1979).

Second, EOs may be fundamental to behavioral relations and procedures other than response derivation. In basic research, EOs, which now include response deprivation, might inform our understanding of extinction (e.g., extinction bursts, the reinforcing functions of extinction-induced aggression; see, e.g., Azrin, Hutchinson, & McLaughlin, 1965), behavioral contrast (e.g., increased responding as a function of signaled changes in schedules of reinforcement; Reynolds, 1961), Pavlovian-directed responses (e.g., response forms that vary with the deprived reinforcer; Jenkins & Moore, 1973), and adjunctive behavior (e.g., schedule-induced behavior such as polydipsia; Falk, 1977). In applied research, EOs and response deprivation might be implicated in the effectiveness of various procedures, for instance, extinction, time-out, overcorrection, restitution, behavioral momentum, incidental teaching, and functional communication training (see McGill, 1999).

Third, just as EOs have expanded our understanding of various content domains of behavior, for instance, of motivation, emotion, and addiction (e.g., Malott, Malott, & Trojan, 2000, pp. 167–170, 172–174; Michael, 1993, p. 197; Millenson, 1967, p. 440), so too might response deprivation. This point holds as well for assessments of and interventions in socially important problems (see Iwata, Smith, & Michael, 2000).

## *Conclusion*

The point of this paper is that response deprivation is an EO. To the extent that EOs bring this and other concepts of context into conceptual and empirical alignment, behavior analysis is enriched and expanded. Conceptual alignment improves the efficiency and economy of our terms, concepts, theories, and interpretations. This increases the coherence of our discipline. Empirical alignment clarifies the system of relations among the basic behavioral processes. This increases the effectiveness of our science and technology.

## REFERENCES

Allen, L. D., & Iwata, B. A. (1980). Reinforcing exercise maintenance: Using existing high-rate activities. *Behavior Modification, 4,* 337–354.

Allison, J. (1993). Response deprivation, reinforcement, and economics. *Journal of the Experimental Analysis of Behavior, 60,* 129–140.

Allison, J., & Castellan, N. J. (1970). Temporal characteristics of nutritive drinking in rats and humans. *Journal of Comparative and Physiological Psychology, 70,* 116–125.

Allison, J., & Timberlake, W. (1974). Instrumental and contingent saccharin licking in rats: Response deprivation and reinforcement. *Learning and Motivation, 5,* 231–247.

Allison, J., & Timberlake, W. (1975). Response deprivation and instrumental performance in the controlled-amount paradigm. *Learning and Motivation, 6,* 122–142.

Azrin, N. H., Hutchinson, R. R., & McLaughlin, R. (1965). The opportunity for aggression as an operant reinforcer during aversive stimulation. *Journal of the Experimental Analysis of Behavior, 8,* 171–180.

Bernstein, D. J., & Ebbesen, E. B. (1978). Reinforcement and substitution in humans: A multiple-response analysis. *Journal of the Experimental Analysis of Behavior, 30,* 243–253.

Bijou, S. W. (1996). Setting factors in the behavior analysis of human development. In S. W. Bijou & E. Ribes (Eds.), *New directions in behavior development* (pp. 147–154). Reno, NV: Context Press.

Bijou, S. W., & Baer, D. M. (1961). *Child de-*

*velopment: Vol. 1. A systematic and empirical theory.* Englewood Cliffs, NJ: Prentice Hall.

Catania, A. C. (1993). Coming to terms with establishing operations. *The Behavior Analyst, 16,* 219–224.

Catania, A. C. (1998). *Learning* (4th ed.). Upper Saddle River, NJ: Prentice Hall.

Chance, P. (1999). *Learning and behavior.* Pacific Grove, CA: Brooks/Cole.

Dougher, M. J. (1983). Clinical effects of response deprivation and response satiation procedures. *Behavior Therapy, 14,* 286–298.

Dougher, M. J., & Hackbert, L. (2000). Establishing operations, cognition, and emotion. *The Behavior Analyst, 23,* 11–24.

Dunham, P. J., & Grantmyre, J. (1982). Changes in a multiple-response repertoire during response-contingent punishment and response restriction: Sequential relationships. *Journal of the Experimental Analysis of Behavior, 37,* 123–133.

Eisenberger, R., Karpman, M., & Trattner, J. (1967). What is the necessary and sufficient condition for reinforcement in the contingency situation? *Journal of Experimental Psychology, 74,* 342–350.

Falk, J. L. (1977). The origins and function of adjunctive behavior. *Animal Learning & Behavior, 5,* 325–335.

Ferster, C. B., & Skinner, B. F. (1957). *Schedules of reinforcement.* New York: Appleton-Century-Crofts.

Fowler, H. W. (1987). *A dictionary of modern English usage* (2nd ed.). New York: Oxford.

Gewirtz, J. L. (1972). Some contextual determinants of stimulus potency. In R. D. Parke (Ed.), *Recent trends in social learning theory* (pp. 7–33). New York: Academic Press.

Goh, H. L., Iwata, B. A., Shore, B. A., DeLeon, I. G., Lerman, D. C., Ulrich, S. M., & Smith, R. G. (1995). An analysis of the reinforcing properties of hand mouthing. *Journal of Applied Behavior Analysis, 28,* 269–283.

Goldiamond, I., & Dyrud, J. (1968). Behavioral analysis for psychotherapy. In J. Schlien (Ed.), *Research in psychotherapy* (Vol. 3, pp. 54–89). Washington, DC: American Psychological Association.

Heth, C. D., & Warren, A. G. (1978). Response deprivation and response satiation as determinants of instrumental performance: Some data and theory. *Animal Learning & Behavior, 6,* 294–300.

Homme, L. E., deBaca, P. C., Devine, J. V., Steinhorst, R., & Rickert, E. J. (1963). Use of the Premack principle in controlling the behavior of nursery school children. *Journal of the Experimental Analysis of Behavior, 6,* 544.

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

Iwata, B. A., Smith, R. G., & Michael, J. (2000). Current research on the influence of establishing operations on behavior in applied settings. *Journal of Applied Behavior Analysis, 33,* 411–418.

Jenkins, H. M., & Moore, B. R. (1973). The form of the auto-shaped response with food and water reinforcers. *Journal of the Experimental Analysis of Behavior, 20,* 163–181.

Kantor, J. R. (1918). Conscious behavior and the abnormal. *Journal of Abnormal Psychology, 13,* 158–168.

Kantor, J. R. (1959). *Interbehavioral psychology.* Chicago: Principia Press.

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

Kennedy, C. H., & Meyer, K. A. (1996). Sleep deprivation, allergy symptoms, and negatively reinforced problem behavior. *Journal of Applied Behavior Analysis, 29,* 133–135.

Knapp, T. J. (1976). The Premack principle in human experimental and applied settings. *Behaviour Research and Therapy, 14,* 133–147.

Konarski, E. A., Jr. (1987). Effects of response deprivation on the instrumental performance of mentally retarded persons. *American Journal of Mental Deficiency, 91,* 537–542.

Konarski, E. A., Jr., Johnson, M. R., Crowell, C. R., & Whitman, T. L. (1979). An alternative approach to reinforcement for applied researchers: Response deprivation. *Behavior Therapy, 12,* 653–666.

Konarski, E. A., Jr., Johnson, M. R., Crowell, C. R., & Whitman, T. L. (1980). Response deprivation and reinforcement in applied settings: A preliminary analysis. *Journal of Applied Behavior Analysis, 13,* 595–609.

Leslie, J. C. (1996). *Principles of behavioral analysis.* Amsterdam: Harwood.

Malone, J. C. (1990). *Theories of learning: A historical approach.* Belmont, CA: Wadsworth.

Malott, R. W., Malott, M. E., & Trojan, E. A. (2000). *Elementary principles of behavior* (4th ed.). Upper Saddle River, NJ: Prentice Hall.

Martin, G., & Pear, J. (1996). *Behavior modification: What it is and how to do it.* Upper Saddle River, NJ: Prentice Hall.

Mazur, J. E. (1975). The matching law and quantifications related to Premack's principle. *Journal of Experimental Psychology: Animal Behavioral Processes, 104,* 374–386.

Mazur, J. E. (1998). *Learning and behavior* (4th ed.). Englewood Cliffs, NJ: Prentice Hall.

McDevitt, M. A., & Fantino, E. (1993). Establishing operations and the discriminative stimulus. *The Behavior Analyst, 16,* 225–227.

McGill, P. (1999). Establishing operations: Implications for 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. (1983). Evocative and repertoire-al-

tering effects of an environmental event. *The Analysis of Verbal Behavior, 2,* 19–21.

Michael, J. (1985). Behavior analysis: A radical perspective. In B. L. Hammonds (Ed.), *Psychology and learning* (pp. 99–121). Washington, DC: American Psychological Association.

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.

Millenson, J. R. (1967). *Principles of behavioral analysis.* New York: Macmillan.

Mitchell, W. S., & Stoffelmayr, B. E. (1973). Application of the Premack principle to the behavioral control of extremely inactive schizophrenics. *Journal of Applied Behavior Analysis, 6,* 419–423.

Premack, D. (1959). Toward empirical behavior laws: I. Positive reinforcement. *Psychological Review, 66,* 219–233.

Premack, D. (1961). Predicting instrumental performance from the independent rate of the contingent response. *Journal of Experimental Psychology, 61,* 613–171.

Premack, D. (1962). Reversibility of the reinforcement relation. *Science, 136,* 255–257.

Premack, D. (1963). Rate differential reinforcement in monkey manipulation. *Journal of the Experimental Analysis of Behavior, 6,* 81–89.

Premack, D. (1965). Reinforcement theory. In D. Levine (Ed.), *Nebraska Symposium on Motivation* (Vol. 13, pp. 123–188). Lincoln: University of Nebraska Press.

Reynolds, G. S. (1961). An analysis of interactions in a multiple schedule. *Journal of the Experimental Analysis of Behavior, 4,* 107–117.

Richter, C. P. (1922). A behavioral study of the activity of the rat. *Comparative Psychology Monographs, 1*(2).

Schlinger, H. D., & Blakely, E. (1987). Function-altering effects of contingency-specifying stimuli. *The Behavior Analyst, 10,* 41–45.

Sheffield, F. D. (1948). Avoidance training and the contiguity principle. *Journal of Comparative and Physiological Psychology, 41,* 165–177.

Sheffield, F. D., Wulff, J. J., & Backer, R. (1951). Reward value of copulation without sex drive reduction. *Journal of Comparative and Physiological Psychology, 44,* 3–8.

Skinner, B. F. (1931). The concept of the reflex in the description of behavior. *Journal of General Psychology, 5,* 427–457.

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

Sulzer-Azaroff, B., & Mayer, G. R. (1991). *Behavior for lasting change.* Fort Worth: Holt, Rinehart and Winston.

Timberlake, W. (1980). A molar equilibrium theory of learned performance. In G. H. Bower (Ed.), *The psychology of learning and motivation* (Vol. 14, pp. 1–58). San Diego, CA: Academic Press.

Timberlake, W., & Allison, J. (1974). Response deprivation: An empirical approach to instrumental performance. *Psychological Review, 81,* 146–164.

Timberlake, W., & Farmer-Dougan, V. A. (1991). Reinforcement in applied settings: Figuring out ahead of time what will work. *Psychological Bulletin, 110,* 379–391.

Wasik, B. H. (1970). The application of Premack's generalization on reinforcement to the management of classroom behavior. *Journal of Experimental Child Psychology, 10,* 33–43.

Wilder, D. A., & Carr, J. E. (1998). Recent advances in the modification of establishing operations to reduce aberrant behavior. *Behavioral Interventions, 13,* 43–59.