On Terms

Do Establishing Operations Alter Reinforcement Effectiveness?

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Michael (this issue) defines an establishing operation (EO), such as food deprivation, as (a) altering the effectiveness of reinforcement as well as (b) evoking behavior. Although this dual role for EOs is compelling, it is possible that such operations have only evocative effects (i.e., function only in the form of antecedent control). The main question raised here is how the reinforcement-altering function can be experimentally analyzed. Evolutionary and conceptual implications of the two-function EO are also considered.

Key words: establishing operations, evocative effects, deprivation, reinforcement effectiveness

Michael (this issue) defines an *establishing operation* (EO) as "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). Both functions are intuitively plausible. But although it has been experimentally determined that EOs evoke behavior (e.g., Skinner, 1938), it is questionable to what degree they also alter reinforcement effectiveness. Skinner (1953), for example, asserts that food deprivation affects only the evocation of behavior:

Contrary to what one might expect, experimental studies have shown that the magnitude of the reinforcing effect of food may not depend on the degree of such deprivation. But the frequency of response which results from reinforcement depends on the degree of deprivation at the time the response is observed. (p. 68)

Before considering what experimental procedure might distinguish the two functions, one can imagine an evolutionary advantage in there being primarily, if not exclusively, an evocative effect. Picture a food-satiated animal wandering

into a novel area covered with a distinctive gravel that becomes increasingly dense as the organism proceeds in the same direction. The animal encounters some food and takes an exploratory nibble. The next day the animal is food deprived. Will the animal promptly approach the more densely graveled areas, or will its experience of eating in the previous day's satiated condition have been ineffective as reinforcement? If an organism does not need to be food deprived for food to be effective as reinforcement, there might be a survival advantage, one that could lead to the evolutionary selection of a reinforcement-without-deprivation function.

Of course, experimental evidence should have priority over speculations about evolutionary advantages. What experimental evidence is Skinner (1953) referring to that supposedly limits an EO to an evocative function? Apparently, Skinner intends to provide this evidence some pages later:

By conditioning and extinguishing a response under different degrees of deprivation, it is possible to see the effect of deprivation in detail. If we reinforce a response in a group of organisms at the same level of deprivation and extinguish it in subgroups at different levels, we find that the number of responses in the extinction curve is a function of deprivation. The hungrier the organism the more responses it will emit during extinction. If, on the other hand, we condition at different levels of deprivation and extinguish at the same level, we find, surprisingly enough, that the two extinction curves

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contain approximately the same number of responses. The effect of deprivation is felt during extinction, not during conditioning. (pp. 149–150)

If one interprets the number of responses in extinction in the first phase of the experiment as a measure of the EO's evocative effect and interprets this number in the second phase of the experiment as a measure of the EO's reinforcement-altering effect, Skinner's earlier assertion is supported. But although one must always use some measure of the evocation of (future) behavior to interpret current alterations in reinforcement effectiveness—making the experimental separation of the EO's functions difficult enough—Skinner's particular use of the number of responses in extinction is confusing. One may even wonder if there is yet another, overlooked, EO function that is only "felt during extinction." One might also prefer a design that features within-subject, rather than group, comparisons.

Fischer and Fantino (1968) tried to distinguish between the effects of an EO (food satiation) on the discriminative function of a stimulus for the terminal link and its conditioned reinforcing effect for the initial link of a two-link chain. The former is an evocative function, and the latter is presumably a reinforcement-altering function. Increasing degrees of satiation lowered the response rate in the initial link more quickly than in the terminal link. The authors concluded that satiation affected the reinforcement function more than the discriminative function, thus implicitly distinguishing the two effects. Although this result may strengthen Michael's position and weaken Skinner's, the results can be viewed as initial-link discriminative control attenuating faster than terminal-link discriminative control, a result consistent with Nevin's (1974) formulation of response strength.

Is there an experiment that can clearly determine whether EOs have a single or dual role in controlling operant behavior? Two obvious ways to construct a different kind of experiment would be to (a) study a different EO than food deprivation or (b) change the procedure and its

associated method of measurement. Food deprivation may not be the easiest variable to experimentally manipulate to distinguish the two functions, but it is probably the most frequently exercised EO in the experimental analysis of behavior, and not to study it would leave a rather large gap in the empirical base for what is presumably a fundamental principle.

Perhaps a choice procedure would be easier to interpret than those in the studies previously cited. First, determine that separately conditioning key pecking on two different keys with, say, variable-interval (VI) 1-min and VI 6-min schedules would result in greater relative responding for the VI 1-min key when both were presented (i.e., concurrently) in probe sessions. If this is the case, then the procedure provides a way to analyze reinforcement effectiveness, and one can move on to studying the effects of the EO *per se*. Separately condition, under high deprivation, responding on a green key with a VI 1-min schedule, and, under low deprivation, responding on a red key, also with a VI 1-min schedule. Then, present the stimuli concurrently under various deprivation conditions in probe sessions.

If the subjects choose the green key more often, then deprivation presumably increases the effectiveness of reinforcement. If not, there might be a deprivation-specific effect: That is, under high deprivation green would be preferred, whereas under low deprivation red might be preferred. Another possibility is that the subjects would choose them equally often, in which case it appears that only an evocative effect is present (i.e., overall rate of responding would change with deprivation in the probe sessions, but relative rate would remain constant). However unlikely, there could be a greater choice for the red key, in which case deprivation would presumably have altered the effectiveness of reinforcement, but downward.

Evolutionary and experimental considerations aside, the two-function EO has some related conceptual problems to overcome. First, the obvious influence of Skinner's writings on students of behavior analysis makes it important that Mi-

chael directly address the apparent differences between his and Skinner's conceptions of the EO. Otherwise, assuming the EO survives and flourishes as a concept, an unnecessary and potentially confusing discontinuity will remain in the record of the evolution of a basic behavioral principle.

Second, although the term *establishing operation* sounds as if the most important function of an EO is that of establishing reinforcement effectiveness, Michael appears to be much more interested in the EO to make distinctions between evocative functions, especially between discriminative and motivative functions (Michael, 1982). The reinforcement-establishing function is more or less assumed. It might be better to find a name that puts the emphasis on the evocative function, especially if the EO is found to have minimal or no reinforcement-altering effect experimentally.

Finally, assume the EO does establish reinforcement effectiveness. In that case, Michael's notion of the *availability* of reinforcement being distinct from the *value* of reinforcement can get a little confusing, because what is available is not really reinforcement unless it is rendered effective by an EO. In other words, is the EO inside or outside what we call a contingency of reinforcement? If it is outside, then we must be looking at the "reinforcement" term as strictly procedural, and potentially behaviorally neutral. This

would surely disappoint those behavior analysts who say they have always thought in terms of at least a four-term contingency (i.e., including the EO). If we accept the EO inside the contingency, then we are back to the problem of saying that (effective) reinforcement is *contingent* on the EO—that it is (effectively) *not available* without the appropriate EO.

In conclusion, Michael's two-function EO concept is intuitively quite compelling. However, more explicit argument and some data to prove that there really is a reinforcement-altering function would make it even more compelling. The concept may have considerable heuristic value in its current form for new research and applications, but both the EO and the behavior-analytic conceptual framework into which Michael is depositing it need to be fine-tuned if the fit is to last.

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