

USING NEUTRALIZING ROUTINES TO  
REDUCE PROBLEM BEHAVIORS

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Establishing operations can alter problem behaviors by changing the momentary value of reinforcers associated with those problem behaviors. If establishing operations (EOs) precede the presentation of discriminative stimuli ( $S^D$ s) for problem behaviors, it may be possible to introduce neutralizing routines that both reduce the value of reinforcers associated with problem behaviors and decrease the occurrence of problem behaviors. The present study examined this logic with 3 adolescents with severe intellectual disabilities. Initial functional analyses indicated that problem behaviors were motivated by either escape or tangible items. Functional assessment interviews identified possible establishing operations that were associated with the occurrence of problem behavior and indicated that these establishing operations occurred over 1 hr before presentation of the  $S^D$  for problem behaviors. We used an alternating treatments design to examine problem behaviors during instruction under four conditions: EO+ $S^D$ ,  $S^D$  only, EO only, and neither  $S^D$  nor EO. For all 3 participants, problem behaviors occurred almost exclusively during the EO+ $S^D$  condition. A further analysis compared the EO+ $S^D$  condition when neutralizing routines were embedded between the EO and the  $S^D$ . Results from an ABAB reversal design supported the effectiveness of neutralizing routines to reduce these problem behaviors. Applied and theoretical implications are discussed.

DESCRIPTORS: functional assessment, neutralizing routines, establishing operations, developmental disabilities

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Establishing operations are antecedent events that momentarily alter both the reinforcing (or punishing) effectiveness of a stimulus and the likelihood of responses associated with the contingent delivery of that stimulus. The term *establishing operation* was first introduced over 4 decades ago (Keller

& Schoenfeld, 1950; Millenson, 1967) and builds on foundation concepts that address the role of motivation in behavior analysis (Bijou & Baer, 1961; Kantor, 1959; Skinner, 1938). More recently, Michael has defined the establishing operation as a key element in our taxonomy of behavior (Michael, 1982, 1988, 1993), and applied behavior analysts are providing empirical documentation of the effects of establishing operations on behavior (Carr, Reeve, & Magito-McLaughlin, 1996; Kennedy & Itkonen, 1993; O'Reilly, 1995; Smith, Iwata, Goh, & Shore, 1995; Vollmer & Iwata, 1991; Wacker et al., 1996). The central importance of this literature is recognition that the effectiveness of an antecedent stimulus to evoke a conditioned response is always affected by

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the momentary reinforcing (or punishing) value of the consequences associated with that response. To the extent that an antecedent event establishes the reinforcing value of a consequence, it interacts with available discriminative stimuli to alter the occurrence of responses associated with that consequence.

Gewirtz (1972) and Kennedy and Itkonen (1993) differentiated between concurrent and preceding establishing operations. Concurrent establishing operations occur at the same time as the behavior, and preceding establishing operations occur prior to the behavior. We are especially interested in the role of preceding establishing operations and the manner in which these events interact with discriminative stimuli to alter problem behaviors. Smith *et al.* (1995) documented the role of task novelty, session duration, and rate of demands on self-injurious behavior. Other researchers demonstrated that variables such as consistency of scheduled routines (Horner, Vaughn, Day, & Ard, 1996; Kennedy & Itkonen, 1993), pain (Carr *et al.*, 1996; Horner *et al.*, 1996), sleep deprivation (Horner *et al.*, 1996; Kennedy & Meyer, 1996; O'Reilly, 1995), food deprivation (Corte, Wolf, & Locke, 1971; Wacker *et al.*, 1996), and aversive events (Horner *et al.*, 1996) can establish consequences (e.g., escape, attention, tangible objects) as effective reinforcers for problem behavior.

The impact of establishing operations on problem behavior suggests a need for expanding both functional assessment procedures and the content of behavioral interventions. Functional assessment needs to identify not only those stimuli immediately antecedent and following problem behaviors but also those antecedent events that are temporally distant yet function to establish reinforcement for problem behaviors. Behavioral interventions need to include strategies for reducing the effects of establishing operations. Gardner, Cole, Davidson, and Kar-

an (1986) and Horner *et al.* (1996) suggested five procedures for reducing the effects of preceding establishing operations on problem behavior. One of these is to introduce neutralizing routines that minimize the effects of the establishing operation.

A neutralizing routine is, in effect, an establishing operation that reduces the value of reinforcers that are associated with problem behavior. The use of neutralizing routines is most practical if the initial establishing operation occurs at a point temporally distant from the discriminative stimulus for problem behavior. Given that a functional assessment identifies (a) the problem behavior, (b) stimuli that set the occasion for the problem behavior, and (c) preceding establishing operations for problem behavior, then one element of an intervention may be to insert a neutralizing routine between the occurrence of the establishing operation and presentation of the discriminative stimulus. The function of the neutralizing routine is to reduce the reinforcing value of consequences associated with problem behavior before the discriminative stimulus is presented. A simple example is the delivery of food prior to instructional sessions when food deprivation is identified as establishing escape from demands as a potent reinforcer and instructional demands are identified as discriminative stimuli for escape-motivated problem behavior. The purpose of the present study was to examine the relationship between neutralizing routines and problem behavior.

## METHOD

### *Participants, Settings, and Tasks*

Three adolescent boys with severe developmental disabilities participated in the study. Each participant had a long history of self-injury or aggression, and each was living in a home in the community where he received 24-hr support. The 3 participants

were not taking medications during the study.

Clay was 12 years old and had been diagnosed with severe intellectual disabilities and autism. His score on the Vineland Social Maturity Scale (Doll, 1965) produced an age equivalence of 2 years 5 months. Clay's plan of support targeted developmental skills in the areas of self-management, personal care, expressive language, household skills, and reduction of aggression and self-injury.

Patrick was 17 years old and had been diagnosed with cerebral dysgenesis, left hemiparesis, severe hearing loss in his left ear, and severe intellectual disabilities. His Vineland Social Maturity Scale score indicated an age equivalence of 1 year 10 months. His habilitation plan focused on personal care skills, acquisition of manual sign language, household skills, and reduction of aggression.

Karl was 14 years old and had been diagnosed with autism, profound bilateral hearing loss, and severe intellectual disabilities. His Vineland Social Maturity Scale score indicated an age equivalent of 1 year 9 months. He was learning to follow signed and written directions, complete basic daily living skills, and reduce self-injury and aggression.

The study was conducted in the homes in which the 3 participants lived. Sessions were conducted in the kitchen or living room, with staff members who had over 10 years of experience in behavior analysis and at least 1 year of experience working with the participant.

All instructional elements of the study were drawn from each participant's individualized plan of support. Clay's instructional tasks involved homework handwriting exercises in which he copied 30 to 35 sentences from a workbook. Pat's instructional sessions involved one-to-one training using manual signs to request items. He was presented with a variety of items and was asked,

"What do you want?" and he responded with, "I want [verb] [adjective] [object]." Karl's instructional tasks required sight-word reading skills. A set of nine cards, with a word on each card, were arranged in a  $3 \times 3$  matrix in front of Karl. One of the nine items was presented, and Karl was asked to point to the corresponding word. The difficulty of all instructional tasks was designed to produce approximately 70% correct responses.

#### *Measurement*

Data were collected during initial functional analyses and during the analysis of neutralizing routines. The primary dependent variables throughout the study were aggression, self-injury, or both. *Aggression* was defined as striking the instructor with a fist or open hand, striking the instructor with the forehead, grabbing and twisting the instructor's skin with a finger and thumb (pinching), throwing instructional materials on the floor, or pulling (or attempting to pull) the hair of the instructor. *Self-injury* was defined as striking the head against the table, hitting the head with an open hand or fist, or biting (placing hand in mouth). Data were collected by a trained observer who sat approximately 3 m from the instructional setting and recorded all measures. During the initial functional analysis, data were recorded across 5-min sessions using a partial-interval scoring system with 10-s intervals. During the analysis of neutralizing routines, data were collected on a trial-by-trial basis.

A trial was defined as the period between presentation of one instructional request (e.g., "what do you want?") and presentation of the next instructional request. Instructional sessions were held one to three times per week, lasted approximately 15 min, and involved the delivery of at least 40 instructional trials.

Data also were collected on the occur-

rence of establishing operations and staff presentation of discriminative stimuli for problem behavior. Potential establishing operations were identified through direct interview with the staff member who worked with each participant, following interview questions and procedures recommended by O'Neill, Horner, Albin, Storey, and Sprague (1990) and O'Neill *et al.* (1997). The identified establishing operations for Clay, Pat, and Karl, respectively, were (a) a delay of 15 min or more in a planned, preferred activity; (b) postponement of a planned, preferred activity to the next day; and (c) less than 5 hr of sleep the previous night. One hour prior to instructional sessions, observers documented whether the targeted establishing operation had occurred for that participant. For Karl's sleep cycles, the night staff person recorded his sleep status every 30 min, and this log was used to define the number of hours awake and the total amount of time in bed.

Discriminative stimuli ( $S^D$ ) for problem behaviors for Clay and Pat involved error corrections. Clay was told that he made a handwriting error and must fix the mistake. Pat was told, "that's wrong" and "try again," with a staff member modeling the correct response. The discriminative stimulus for problem behaviors for Karl was being physically interrupted when he was reaching for a food item on the reinforcer tray. The extent to which instructors delivered discriminative stimuli was monitored by observers on a trial-by-trial basis. During sessions in which discriminative stimuli were to be delivered, the participant was to experience the  $S^D$  during 12 to 15 trials (approximately 33% of trials in a session).

#### *Interobserver Agreement*

A second observer independently monitored all measures during all functional analysis sessions and 25% of the neutralizing routine sessions for each participant. Agree-

ment between observers was determined on an interval-by-interval (functional analysis) or a trial-by-trial (neutralizing routine) basis for each problem behavior, establishing operation, and discriminative stimulus. Occurrence agreement was scored only when the two observers indicated the same information for a trial or interval. Percentage agreement was calculated by dividing the number of trials (intervals) with an agreement by the total number of trials (intervals) in which at least one of the observers indicated an occurrence and multiplying by 100%. Interobserver agreement for problem behaviors during the initial functional analysis averaged 99.4% for Clay, 100% for Pat, and 100% for Karl.

Interobserver agreement for occurrence of problem behaviors during the analysis of neutralizing routines averaged 83.8% for Clay, 100% for Pat, and 92.5% for Karl. Interobserver agreement on the occurrence of establishing operations was 100% for all participants. Average interobserver agreement for the delivery of  $S^D$ s was 97.8% for Clay, 100% for Pat, and 94.4% for Karl.

#### *Design*

The study was conducted in three stages. The first stage involved functional assessment interviews following the procedures recommended by O'Neill *et al.* (1990). The staff members who worked most closely with each participant were interviewed to identify (a) the topography, intensity, frequency, and duration of problem behaviors; (b) the antecedent stimuli that were most likely and least likely to be associated with the problem behaviors; (c) the consequences and contingencies that maintained the problem behaviors; and (d) any establishing operations that may have affected the problem behaviors.

The hypotheses developed from the interviews were formally tested in the second stage of the study through functional analyses conducted following procedures rec-

ommended by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994). For Clay and Pat, the functional analyses involved three conditions: escape, attention, and control. For Karl, the assessment interviews prompted inclusion of a tangible condition and a no-attention control condition in addition to the same escape and attention conditions used with Clay and Pat.

Stage 3 of the study involved an ABAB (baseline, neutralizing routine) reversal design to assess the effects of neutralizing routines on problem behavior. In the initial baseline phase, however, four subconditions (EO+S<sup>D</sup>, S<sup>D</sup> only, EO only, and neither) were presented in a multielement format to assess the interactive impact of the EO and S<sup>D</sup> for each participant. The specific procedures for each condition in the functional analyses and the analyses of neutralizing routines are described below.

#### *Functional Analysis*

*Escape.* In the escape condition, the participant received requests to perform instructional tasks that he could not do correctly more than 20% of the time (these tasks were unrelated to those used in the analysis of the neutralizing routine). If he performed the task, he was praised, and if he made an error, he was corrected and given another opportunity to perform the trial. If the participant engaged in problem behavior, the task was removed for 30 s.

*Attention.* In the attention condition, the participant was provided with an activity that had been identified by staff as preferred. The instructor sat within 3 m of the participant and attended to paperwork. If the participant engaged in problem behavior, the instructor provided 10 s of attention and then redirected the participant to the activity. All other behavior was ignored.

*Control.* During the control condition, the participant was provided with the same activity used in the attention condition, but

the instructor attended to and interacted with the participant throughout the session. No instructional demands were delivered, and all problem behavior was ignored.

*No-attention control.* In the no-attention control condition, the participant had the same activities as in the attention and control conditions. In the no-attention control condition, however, the instructor did not interact with the participant, and all problem behaviors were ignored.

*Tangible.* In the tangible condition, Karl was working on word identification skills with a tray of edible rewards available. If he reached for the edible items, he was physically blocked and redirected to the task. If he engaged in problem behavior, he was allowed to take one item.

#### *Analysis of Neutralizing Routines*

*Baseline 1.* The first baseline involved 15-min instructional sessions conducted in each participant's home. All instructional sessions for a particular participant involved the same materials, same instructor, and same time of day. The sessions differed only as prescribed by the four subconditions.

In the EO+S<sup>D</sup> subcondition, the participant experienced the establishing operation at least 1 hr prior to the instructional session, and the S<sup>D</sup> for problem behavior was delivered on approximately one third of the trials during the session. For Clay and Pat, the establishing operation (delay or canceling of events) was systematically controlled by staff and was delivered two to three times per week, but never 2 days in a row. For Karl, the establishing operation of sleep deprivation was not manipulated by staff. Karl typically had 1 to 2 nights per week with poor sleep, and these nights preceded the days when EO subconditions were run.

Instructional sessions included the participant, the instructor, and one or two observers. The instructor presented instructional trials and praised participation and accuracy.

For Clay and Pat, instructional errors were followed by a request to repeat the trial with additional assistance. For Karl, pointing to the correct card resulted in praise and the opportunity to select a small food item from a reinforcer tray. Incorrect responses resulted in error correction, repetition of the trial with assistance, and then access to the reinforcer tray. The food items on the reinforcer tray were selected by Karl's staff as highly preferred. On approximately one third of the trials, Karl reached for an item from the reinforcer tray. When this occurred, he was physically interrupted and asked to wait and then do another trial. This interruption served as the  $S^D$  for problem behavior.

Throughout the  $EO+S^D$  subcondition, problem behaviors resulted in access to presumed reinforcers. For Clay and Pat, problem behaviors immediately produced a 30-s break from instruction. For Karl, problem behaviors produced immediate access to selecting an item from the reinforcer tray.

In the  $S^D$ -only subcondition, the participant had not experienced the establishing operation, but the  $S^D$  for problem behaviors was administered. All other procedures were the same as the  $EO + S^D$  condition.

In the  $EO$ -only subcondition, the participant experienced the establishing operation, but the  $S^D$  for problem behavior was not provided. For Clay and Pat, errors were ignored, and for Karl, his efforts to reach for an item from the reinforcer tray after each trial were not blocked.

In the neither subcondition, the participant did not experience the establishing operation, and discriminative stimuli for problem behaviors were not presented.

*Neutralizing routine.* Staff members were asked to identify short activities or routines that might reduce the value of the reinforcer presumed to be maintaining problem behavior. During this condition,  $EO+S^D$  procedures were in effect, except that the identified neutralizing routine was delivered ap-

proximately 30 to 40 min prior to the instructional session.

The neutralizing routine for Clay was based on the assumption that when a planned event was delayed, he would maintain a high level of agitation before and during the instructional sessions. Clay's staff recommended that, following the delay of a planned event, he be given the opportunity to engage in a highly preferred 10-min routine in which he drew pictures and wrote repetitive phrases. This routine was perceived to be highly preferred, calming, and able to reduce his level of agitation. The neutralizing routine typically was administered by a staff member within 10 min of the establishing operation and was usually completed 30 to 40 min prior to the start of instructional sessions.

The neutralizing routine for Pat was developed using the same procedure that had been applied with Clay. When a planned outing was canceled, Pat exhibited negative utterances and agitation for several hours. When asked to define a routine that would shift him from agitation to a calm and responsive state, Pat's staff recommended that, when a planned outing was canceled, an effective neutralizing routine was (a) to formally reschedule the same event on his calendar for another day and (b) to spend 5 to 10 min reviewing Pat's "yearbook" (a set of pictures from his past). The yearbook review was a highly structured routine in which Pat led the staff member through a series of pictures. This routine was identified as a calming activity that also reestablished praise as a preferred reward.

The neutralizing routine for Karl was to provide him with the opportunity to take a 1-hr nap. This opportunity was offered only on days that were preceded by a night with less than 5 hr of sleep. Karl's neutralizing routine was selected by staff as an effective approach for increasing the value of praise and Karl's responsiveness to directions (e.g.,

Table 1  
Summary Hypotheses Produced by the Functional Assessment Interviews

Participant	Establishing operation	Discriminative stimulus	Problem behavior	Maintaining consequence
Clay	Delay in planned activity	Error correction	Kick, throw, pull hair, scream	Escape task
Pat	Planned outing canceled	Error correction	Kick, self-hit, head butt	Escape task
Karl	Less than 5 hr of sleep	Physically interrupting his reaching for objects	Bite self, bite others, pinch others, pull hair	Obtain object

redirection from grabbing food). Staff members reported that Karl was in bed resting for at least 50 min each time he was given the opportunity to take a nap.

*Baseline 2.* The second baseline condition replicated the EO+S<sup>D</sup> procedures from the first baseline.

*Neutralizing Routine 2.* The second neutralizing routine condition replicated the procedures of the first neutralizing routine condition.

## RESULTS

The hypotheses from the initial functional assessment interviews are presented in Table 1. Clay's and Pat's problem behaviors were perceived as being escape motivated, and Karl's problem behaviors were identified as being motivated by tangible items.

Results from the functional analyses for each participant are provided in Figure 1. The results for Clay and Pat support the hypothesis that their problem behavior was maintained by escape from tasks. The results for Karl support the hypothesis that his problem behavior was maintained by access to tangible items.

The results from the analysis of neutralizing routines are provided in Figure 2. The initial baseline condition provided an alternating treatments design in which instructional tasks and consequences were held constant, and only the occurrence of the establishing operation and the delivery of S<sup>D</sup>s were manipulated. For all 3 participants, problem behaviors remained at near-zero

levels when neither the EO nor the S<sup>D</sup> was presented, or when either the EO or the S<sup>D</sup> was presented alone. Only when both the EO and the S<sup>D</sup> were presented together were elevated levels of problem behavior observed. Sessions 7 and 29 were terminated after 7 to 8 min when Pat's aggression did not subside after two efforts to block and redirect.

Analysis of the neutralizing routines indicated a consistent ABAB reversal pattern for each participant when the neutralizing routines were added and removed. The EO+S<sup>D</sup> subcondition across both baselines for Clay, Pat, and Karl averaged 27%, 43.2%, and 21.7% of trials with problem behavior, respectively. These levels contrast with Clay's, Pat's, and Karl's respective averages across the two neutralizing routine conditions of 2.8%, 0%, and 3.4%.

Data on the occurrence of establishing operations and presentation of S<sup>D</sup>s indicate that the establishing operation did occur during all EO sessions and that S<sup>D</sup>s were delivered on at least 33% of trials during the S<sup>D</sup> conditions.

Table 2 provides results on the conditional probability of problem behavior per trial given the presence or absence of the target S<sup>D</sup>. During the EO+S<sup>D</sup> sessions, problem behaviors were more probable during trials with the S<sup>D</sup>. During the S<sup>D</sup>-only sessions and the EO+S<sup>D</sup>+neutralizing routines sessions, problem behaviors were unlikely during all trials for Pat and Karl, and were somewhat more likely during the S<sup>D</sup> trials for Clay. The results in Table 2 support the hypothesized role of S<sup>D</sup>s when the preceding establishing operations had occurred.

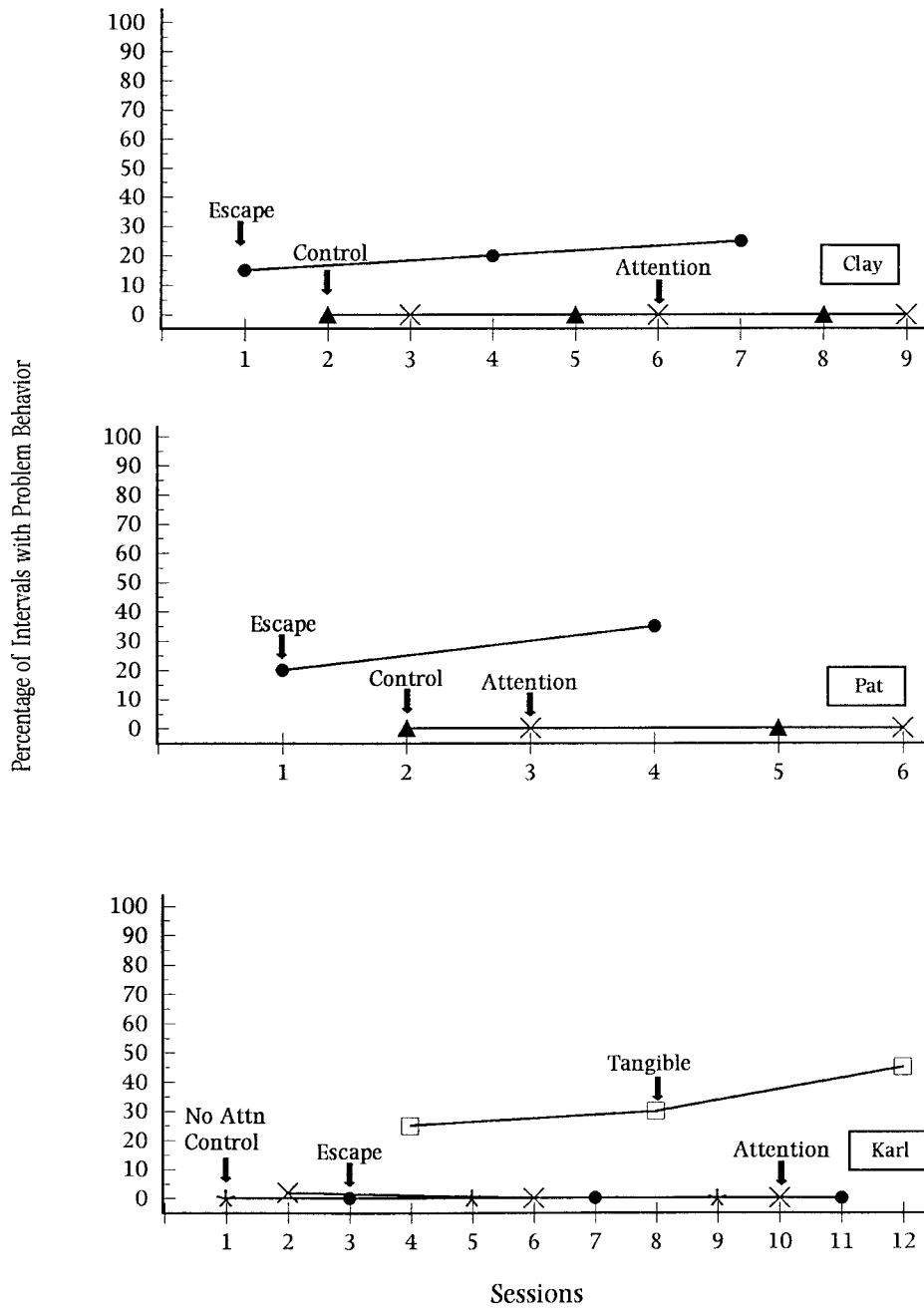


Figure 1. The percentage of intervals with problem behavior across functional analysis conditions for each participant.

DISCUSSION

The initial functional analyses validated the consequence portion of the functional assessment hypotheses. Clay's and Pat's problem behaviors were maintained by escape from difficult tasks with error corrections,

and Karl's problem behaviors were maintained by access to tangible objects (edible items).

Results from the analysis of the neutralizing routines documented both the impact of establishing operations on problem be-



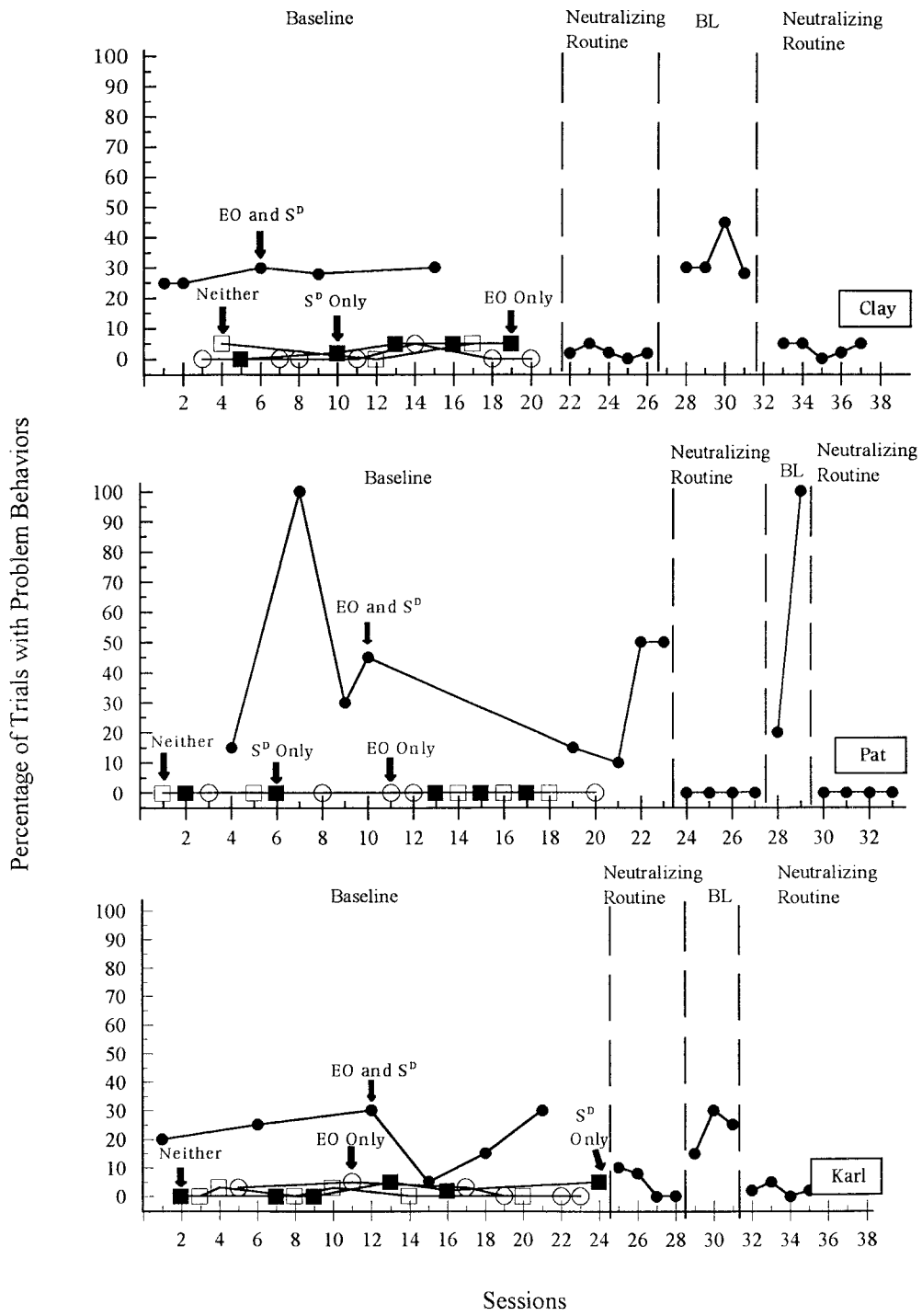


Figure 2. The percentage of instructional trials with problem behavior across conditions for each participant. BL = baseline; EO = establishing operation.

Table 2  
 Conditional Probability of Problem Behavior per Instructional Trial Given the Presence or Absence of S<sup>D</sup>s Under Experimental Conditions

Partici- pant	EO + S <sup>D</sup>		S <sup>D</sup> only		EO + S <sup>D</sup> + NR	
	$p(\text{PB}/S^D)$	$p(\text{PB}/S^N)$	$p(\text{PB}/S^D)$	$p(\text{PB}/S^N)$	$p(\text{PB}/S^D)$	$p(\text{PB}/S^N)$
Clay	.923	.077	.150	.008	.234	.002
Pat	.526	.030	.00	.00	.00	.00
Karl	.295	.167	.029	.019	.012	.05

*Note.* EO = establishing operation, NR = neutralizing routine, PB = problem behavior, S<sup>D</sup> = discriminative stimulus, S<sup>N</sup> = no discriminative stimulus.

havior and the effects of neutralizing routines. The Baseline 1 data for each participant (see Figure 2) replicate earlier research demonstrating the functional effect of establishing operations on problem behavior (Carr, 1996; Kennedy & Itkonen, 1993; Smith et al., 1995; Vollmer & Iwata, 1991). For Clay and Pat, the results are consistent with the interpretation that the delay of preferred activities increased the value of escaping from error corrections. Problem behaviors increased following error correction if preferred activities had been delayed.

Karl's Baseline 1 results are consistent with the sleep deprivation patterns noted by O'Reilly (1995). Karl reached for edible items on the reinforcer tray during his instructional sessions. When he was physically prevented from reaching for food and was also sleep deprived, he was more likely to engage in problem behaviors. If his reaching was interrupted and he was not sleep deprived, he was much more likely to move on to the next instructional trial.

Taken together, the Baseline 1 results for the 3 participants support the impact of establishing operations on problem behavior and suggest two possible interventions to reduce problem behaviors: (a) minimizing the occurrence of the establishing operation (when the EO is controlled by the staff) and (b) withholding the S<sup>D</sup> for problem behaviors when a preceding EO has occurred

(Gardner et al., 1986; Horner et al., 1996; Kennedy & Itkonen, 1993).

The results from the remainder of the analysis suggest that a third strategy for addressing problem behaviors influenced by preceding EOs may be to introduce neutralizing routines. For Clay and Pat, the neutralizing routines involved a brief period of one-to-one contact with a staff member in which a familiar, preferred routine was performed. In each case, it was common for the staff member to report that Clay and Pat entered these neutralizing routines in agitated states and left the routines in a calmer state. Although level of agitation was not a variable measured in this study, anecdotal reports suggest that for Clay and Pat, the neutralizing routine reduced the likelihood that they would enter the instructional sessions in an agitated condition, increased the reinforcing value of praise, and reduced the reinforcing value of escape. These anecdotal reports are consistent with patterns predicted by Carr et al. (1996).

For Karl, the opportunity to take a nap influenced the strategy he employed to obtain preferred objects. If Karl was sleep deprived, he was less likely to keep working and more likely to use problem behaviors when interrupted. If, however, Karl was sleep deprived *and* had just taken a nap, he was more likely to continue working and less likely to engage in problem behaviors.

Table 3 provides a summary of the hypothesized effects of the EO and neutralizing routines for each participant.

*Theoretical Implications*

The present results are consistent with Michael's (1982) conceptual analysis of establishing operations and support the hypothesis that the mechanism by which establishing operations influence behavior is by momentarily altering the value of reinforcers associated with those behaviors. Note that throughout the analysis of the neutral-

Table 3  
Summary of Hypothesized Effects of EO and Neutralizing Routine for Each Participant

Participant	Establishing operation	Hypothesized effect of EO	Neutralizing routine	Hypothesized effect of neutralizing routine
Clay	Delay in planned activity	Reduced value of staff praise; increased value of task escape	Draw pictures, write phrases	Increased value of staff praise; decreased value of task escape
Pat	Planned outing canceled	Reduced value of staff praise; increased value of task escape	Review his yearbook	Increased value of staff praise; decreased value of task escape
Karl	Less than 5 hr sleep	Reduced value of staff praise; increased value of immediate access to edible items; increased aversiveness of being blocked	Nap	Increased value of staff praise; decreased value of immediate access to edible items; increased aversiveness of being blocked

izing routines, (a) problem behaviors continued to be reinforced, (b) the  $S^D$  continued to be delivered, and (c) the EO had occurred. The difference in levels of problem behavior across baseline and neutralizing routine conditions most logically lies with changes in the value of the available reinforcer. The neutralizing routines seemed to function as establishing operations to reduce the value of reinforcers associated with problem behaviors.

The results also emphasize the growing need to examine more complex behavioral interactions. The increased interest in the matching law and competing schedules of reinforcement are examples of the ways in which multiple variables interact to influence behavior (Mace, Neef, Shade, & Mauro, 1994; Pierce & Epling, 1995). The present results focus on the interacting roles of the EO and  $S^D$  to influence behavior (Wacker et al., 1996). Michael (1982) emphasized the need to distinguish between the motivational and discriminative functions of stimuli. Inherent in that recommendation is the companion need to better understand how discriminative and motivational variables interact to influence behavior. In fact, a strict interpretation of our procedures might argue that the error corrections for Clay and Pat were compound stimuli that

functioned both as conditioned establishing operations (Michael, 1993) and as discriminative stimuli. Our analysis focused on the effects of preceding EOs, but the results suggest that additional research is needed to isolate the interaction effects of preceding and concurrent EOs with discriminative stimuli.

A final conceptual implication is an extension of the effect attributed to establishing operations. Theory argues that an establishing operation alters the value of reinforcers directly linked to that operation (e.g., food deprivation will increase the reinforcing value of food). It is important to note that for Clay and for Pat, the presence of aversive events (delay of planned, preferred activities) functioned to increase the value of escaping instruction with error corrections. For Karl, sleep deprivation functioned to increase the likelihood that problem behaviors would be used to obtain desired items. Although further work is needed, the present results suggest that establishing operations may have a generalized impact. Part of this broader effect may be to simultaneously increase the value of reinforcers for one behavior and decrease the value of reinforcers for competing behaviors. For example, the value of escape from tasks may increase and the value of teacher praise may decrease. This combined effect may be important for a more complete

understanding of the role of EOs within concurrent schedules. Future research on neutralizing routines also may examine issues such as the durability of effects, the breadth of effects, and the extent to which repeated use of neutralizing routines is functional.

### *Applied Implications*

The applied relevance of these results lies first in documenting the substantial impact that establishing operations may have on problem behavior. Remembering that the S<sup>D</sup> for problem behavior was delivered on only about 33% of the trials in an EO+S<sup>D</sup> condition, the levels of problem behavior when neutralizing routines were not used are impressive. These data join a growing body of applied research documenting that establishing operations can have a major impact on problem behavior.

The results also support the use of manipulations of establishing operations as part of behavioral interventions. The analysis of neutralizing routines suggests that neutralizing routines may be a useful element of a multielement intervention (Carr *et al.*, 1994; Gardner *et al.*, 1986; Horner & Carr, 1997; Horner *et al.*, 1996). Further, the Baseline 1 results suggest that two other possible strategies to reduce problem behaviors may be (a) to minimize the occurrence of identified establishing operations and (b) to withhold the S<sup>D</sup> for problem behaviors when a preceding EO has occurred. Documentation that establishing operations can have a dramatic effect on problem behaviors also suggests that functional assessments should focus on identifying establishing operations (preceding and concurrent) as well as the S<sup>D</sup>s and reinforcers associated with problem behavior (Pyles & Bailey, 1990).

One limitation of this study is that both the neutralizing routines and the instructional sessions involved multiple stimuli. We must assume that the combinations of these

events during the extended time between EO and instruction or neutralizing routines and instruction were not the same from day to day. These differences may have influenced responding during instruction. Another limitation is that we did not control Karl's nights with poor sleep. As such, other factors may have covaried with sleeplessness, and these may have compromised the internal validity of the study. Despite these limitations, the present results add to the applied literature on antecedent stimuli and their relation to challenging behavior. The need remains, however, for further analysis of how our understanding of establishing operations can be incorporated into the design of applied interventions. The present results offer preliminary support that this will prove to be a fruitful research focus.

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## STUDY QUESTIONS

1. To what extent do the functional assessment summary statements in Table 1 and the functional analysis results in Figure 1 agree or disagree?
2. Karl's establishing operation (less than 5 hr of sleep) was not manipulated by the researchers (he was not kept awake on certain nights). Does this compromise Karl's functional analysis results in Figure 2?

3. Are the results in Figure 2 consistent with the authors' interpretation of neutralizing routines as establishing operations?
4. The neutralizing routines for each subject were selected by support staff. What advantages and disadvantages exist with this approach to selection of neutralizing routines?
5. Is it likely or unlikely that a neutralizing routine that is effective for one subject would be effective with other subjects? Why?
6. Explain how the research design for each subject in Figure 2 provides both a multielement analysis and a withdrawal analysis.
7. To what extent do the results confirm or disconfirm the effects of EOs to simultaneously alter the momentary reinforcing value of multiple consequences?
8. The results from the first baseline phase for each subject in Figure 2 suggest two strategies for minimizing problem behaviors. What are they?