

*REEMERGENCE AND EXTINCTION OF SELF-INJURIOUS  
ESCAPE BEHAVIOR DURING STIMULUS (INSTRUCTIONAL) FADING*

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Based on results of a functional analysis indicating that the self-injurious behavior (SIB) of 3 individuals was maintained by negative reinforcement (escape from instructional situations), the effects of stimulus (instructional) fading were evaluated in a multiple baseline design across subjects. The rate of instructions was reduced to zero at the beginning of treatment and was gradually increased (faded in) across sessions as long as SIB remained low. However, if SIB remained high for 10 consecutive sessions, extinction was implemented until SIB decreased, at which point extinction was withdrawn and fading was resumed. Treatment was completed when the rate of instructions was the same as in baseline (two per minute), and SIB remained below 0.5 responses per minute for two consecutive sessions. Results showed that instructional fading (without extinction) virtually eliminated SIB initially, but these effects were not maintained. All 3 subjects required multiple exposures to extinction and over 150 treatment sessions in order to meet the end-of-treatment criteria. Advantages and limitations of fading procedures without an extinction component, as well as extensions of both interventions to other clinical problems, are discussed.

DESCRIPTORS: escape behavior, extinction, functional analysis, negative reinforcement, self-injurious behavior, stimulus fading

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Results from several studies on the functional analysis of self-injurious behavior (SIB) have shown that when SIB is maintained by negative reinforcement in the form of escape from task demands, the behavior may be extinguished by eliminating the escape contingency (Iwata, Pace, Kalsher, Cowdery, & Cataldo, 1990; Repp, Felce, & Barton, 1988; Steege, Wacker, Berg, Cigrand, & Cooper, 1989). Although effective, escape extinction can be associated with a "burst" of responding that may

take several forms during initial treatment sessions: a temporary increase in SIB above its baseline rate, persistence in responding, or the occurrence of other undesirable behaviors (Goh & Iwata, 1994).

An alternative approach to treatment consists of modifying the antecedent conditions that serve as establishing operations for escape behavior (see Michael, 1982, 1993, for an extensive discussion of establishing operations). For example, research has shown that when the presentation of "difficult" tasks was found to produce high rates of SIB, an abrupt switch to "easy" tasks resulted in immediate reductions in SIB (e.g., Horner, Day, Sprague, O'Brien, & Heathfield, 1991; Weeks & Gaylord-Ross, 1981). Two recent studies examined the extent to which initial reductions in the frequency (as opposed to difficulty) of instructional trials facilitated extinction of escape-maintained SIB (Pace, Iwata, Cowdery, Andree, & McIntyre, 1993; Zarccone, Iwata, Vollmer, et al., 1993). In both studies, immediate decreases in SIB were observed when

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the rate of instructional trials was reduced to zero during the onset of treatment. For 5 of 6 subjects, SIB remained low as frequency of instructional trials was gradually increased (faded in) across sessions.

Thus, data from a number of studies suggest that treatment procedures based on the elimination of establishing operations can produce both rapid and large reductions in escape behavior. This finding raises the possibility that such interventions might be effective regardless of whether or not escape behavior continues to be reinforced. If so, antecedent interventions such as presenting easier tasks, slow-paced instructions, or briefer sessions might prevent the occurrence of possible negative side effects associated with extinction and would be particularly useful when extinction is impractical (i.e., when SIB or other escape behaviors are sufficiently severe to prevent continuation of a work session). Furthermore, if the fading procedures examined by Pace *et al.* (1993) and Zarcone, Iwata, Vollmer, *et al.* (1993) were found to be effective in the absence of extinction, the original conditions that produced escape behavior (i.e., typical academic or work requirements) could eventually be reinstated. On the other hand, to the extent that escape behavior recurs during fading, it might be maintained due to the continued availability of escape as a reinforcing consequence.

Most research conducted to date has not examined the effects of antecedent task modification in the absence of extinction. For example, in studies comparing the effects of easy versus difficult tasks (Horner *et al.*, 1991; Weeks & Gaylord-Ross, 1981), neither condition contained an escape contingency for SIB. Even though subjects' exposure to the difficult conditions was very brief, some decrease in escape behavior was noted across sessions. Thus, it is possible that low levels of SIB during the easy condition, and decreasing levels during the difficult condition, could be attributed at least in part to absence of reinforcement for escape behavior (i.e., extinction). Most studies that have examined the use of various fading procedures (Carr, Newsom, & Binkoff, 1980; Heidorn & Jensen, 1984; Kennedy, 1994; Pace *et al.*, 1993; Weeks & Gaylord-Ross, 1981; Zarcone, Iwata, Vollmer, *et al.*, 1993) have also included an extinction component

for escape.<sup>1</sup> In a notable exception, Pace, Ivancic, and Jefferson (1994) gradually increased the frequency of instructional trials for 1 subject, while continuing to follow occurrences of obscene vocalizations with escape from the task. The procedure was extremely successful, but the extent to which the absence of an extinction component might have resulted in inadvertent reinforcement is unknown because the subject's obscene verbalizations were virtually eliminated.

The purpose of this study was to determine if a decrease in the rate of instructional trials, when used as a sole intervention, would produce large initial reductions in escape-maintained SIB such as those found in previous studies and, furthermore, if such effects would be maintained as the instructional rate was gradually increased across sessions.

## METHOD

### *Subjects and Setting*

Three individuals living in a state residential facility participated. All were diagnosed with profound mental retardation. Kate was an ambulatory 27-year-old woman whose SIB consisted of hitting her face with her palm or fist. She also exhibited a number of stereotypic behaviors such as body rocking, turning in circles, and pushing chairs in circles. Her sensory impairments included blindness from cataracts and profound hearing loss. She had

<sup>1</sup> Authors of these studies either acknowledged the role of extinction as an active component of intervention or made no mention of its possible influence on the behavior(s) being treated. As an exception, Kennedy (1994) concluded that the behavior reduction observed during instructional fading in his study was unlikely to be related to extinction effects because "Students could ignore task demands and no programmed contingency was established that required a student to perform a task when a demand was delivered" (p. 169). However, these responses were irrelevant to a consideration of extinction effects because they were not the targets of intervention. The escape responses under study were a variety of "problem behaviors," for which extinction was in effect during baseline and treatment (i.e., the responses did not produce escape). Because the baseline for 1 subject was extremely brief (three sessions, which may not have been sufficient to reveal an extinction effect), and data for another subject showed a decreasing trend in problem behavior during baseline, it is impossible to determine the relative contributions of extinction versus fading in that study.

limited self-care and feeding skills and was not toilet trained. Kate could follow a few simple instructions, but she had no expressive language skills. She did not receive any psychotropic medication during the course of the study.

Chris was an ambulatory 38-year-old male whose SIB consisted of banging his head against hard surfaces and biting his hand. He did not have any sensory impairments but wore a helmet throughout the day due to seizures and poor balance. He required assistance in bathing and dressing, but he could feed himself and signal when he needed to be assisted to the bathroom. Although Chris could follow a number of one-step instructions, his expressive language consisted of a single word ("no"). Chris received low doses of Dilantin® throughout the study to control seizures.

Jesse was an ambulatory 40-year-old male whose SIB consisted of slapping his face, banging his head against hard surfaces, punching his sides, and hitting his hands and arms against hard surfaces. Jesse exhibited additional behavior problems such as aggression and spitting. He was toilet trained, able to feed himself, and perform most self-care skills without physical assistance. Jesse had no sensory impairments. Although his expressive language skills consisted of only a few echolalic words, his receptive language skills were very good; he could follow a number of multiple-step instructions. Jesse often assisted staff members in his residence in activities such as mopping the floor, setting the table, and cleaning food trays; however, staff reported that if he was working on a task and became "upset," they would give him a break from the activity. During the course of the study, he received several medications: Dilantin® for seizures, and Sinequan® (an antidepressant) and Mellaril® (an antipsychotic) for behavior problems. Dosages for these medications remained constant throughout the study.

The study was conducted on the grounds of the facility at a day program for the assessment and treatment of SIB. Three to five daily sessions were conducted with each subject, usually 5 days per week. Sessions lasted for 15 min, separated by 10- to 15-min breaks. Therapy rooms were either 3.7 m by 5.7 m or 6.8 m by 12.5 m and contained

chairs and appropriate materials for each session. Chris did not wear his protective helmet during assessment or treatment sessions; however, the wall directly behind his chair was padded. Sessions were terminated and all responses were blocked if subjects engaged in any behavior producing an open injury (this rarely occurred). An experimenter, and when necessary an assistant, and one or two observers were present during sessions.

### *Response Definitions, Measurement, and Reliability*

Self-injurious responses were defined as follows: *biting* (Kate and Jesse): contact of any part of the hand or arm with any part of the head, body, or any hard surface such as a wall or table; *head banging* (Chris and Jesse): contact of any part of the head with a hard surface; *hand biting* (Chris): closure of the teeth on any part of the skin from fingertips to wrist. Data also were collected on experimenters' compliance with the protocol (i.e., delivery of antecedent and consequent events) and indicated procedural integrity above 90%. During each session, an observer recorded data on a handheld computer (Assistant, Model AST 102) during continuous 10-s intervals. Session data were converted to responses per minute for both SIB and instructions delivered by the experimenter.

Interobserver agreement was assessed by having a second observer simultaneously but independently collect data during 47.4% of all sessions. Agreement percentages were calculated based on an interval-by-interval comparison of observers' records, in which the smaller number of responses in each interval was divided by the larger number of responses. These fractions were then summed across all intervals and divided by the total number of intervals in the session to obtain the percentage agreement between the two observers. Mean agreement percentages were 98.4%, 99.1%, and 97.9% for Kate, Chris, and Jesse, respectively.

### *Experimental Sequence and Designs*

The first phase of the study consisted of a functional analysis baseline, in which a series of conditions was presented in a multielement format (Sidman, 1960; Ulman & Sulzer-Azaroff, 1975).

The purpose of this analysis was to identify the variable(s) maintaining each subject's SIB. Baseline conditions were then initiated with all 3 subjects, and treatment was subsequently introduced on a multiple baseline across subjects design.

### *Functional Analysis Conditions*

Subjects were exposed to four assessment conditions based on those described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982). During the attention condition, the experimenter entered the room (which contained a variety of leisure materials), told the subject, "I will be here if you need me," and then ignored the subject. Contingent on SIB, the experimenter delivered attention in the form of concern and disapproval of the behavior (e.g., "Stop that, you'll hurt yourself"), and briefly interrupted the SIB. During the demand condition, the experimenter presented tasks on a fixed-time (FT) 30-s schedule. The tasks used in this and all subsequent demand conditions were similar to those found in the subject's habilitation plan. If the subject did not comply with the instruction, the experimenter demonstrated the correct response and physically guided the response if necessary. Praise was provided if the subject complied without requiring physical guidance. If the subject exhibited SIB during any part of the instructional sequence, the experimenter terminated the task (i.e., removed the materials and turned or walked away). The next instruction was presented according to schedule. In the alone condition, the subject was placed alone in a therapy room containing neither educational nor leisure materials. Finally, the play condition served as a control. Leisure materials were available, and the experimenter provided attention to the subject on an FT 30-s schedule. Any SIB that occurred during this session was ignored by the experimenter.

### *Treatment Conditions*

**Baseline.** Procedures in effect during baseline were identical to those in the demand condition (i.e., the experimenter presented tasks, provided social praise contingent on compliance, used physical guidance as necessary to prompt correct re-

sponses, and terminated the trial contingent on the occurrence of SIB). Tasks used during baseline and treatment were those associated with high rates of SIB during the functional analysis. Specific tasks varied from subject to subject, but generally included gross motor and self-care tasks, such as "stand up," "sweep the floor," and "comb your hair."

**Instructional fading.** This procedure consisted of eliminating all instructions from initial treatment sessions and subsequently fading the instructions back into sessions over time. The number of instructional trials per session was increased by one if the subject's SIB was at or below 0.5 responses per minute for two consecutive sessions. This progression continued (except as noted below) until the rate of instructions equaled that during baseline (i.e., two instructions per minute or 30 per session), and the subject's rate of SIB remained below 0.5 for 2 consecutive sessions, at which time treatment was considered complete. Consequences for SIB were the same as during baseline; that is, SIB produced escape from the trial.

**Extinction.** Because initially reducing the frequency of instructions to zero during the fading condition would be expected to produce immediate decreases in SIB, subsequent reemergence of SIB as instructions were faded in would indicate that the behavior had contacted and was being maintained by the ongoing escape contingency. Rather than to continue reinforcing escape behavior, or to decrease the rate of instructions to one that did not occasion SIB, we chose to suspend the fading procedure while extinguishing SIB at the current rate of instructions. Thus, if a subject's rate of SIB did not decrease in the fading condition (i.e., after 10 consecutive sessions without meeting the criterion of two consecutive sessions with SIB below 0.5 responses per minute), extinction was implemented. That is, SIB no longer produced escape from the trial; instead, the experimenter guided the subject to complete the response and presented the next trial according to schedule. The rate of instructions per session was held constant while extinction was in effect. When the subject had two consecutive sessions with SIB at a rate below 0.5, instructional

fading resumed and extinction was withdrawn (i.e., SIB again produced escape).

RESULTS

Assessment results are shown in Figure 1. Kate and Chris exhibited little or no SIB except during the demand condition, whereas Jesse exhibited some SIB during each of the assessment conditions. However, all subjects' highest rates of SIB consistently occurred during the demand condition, with little or no overlap in the data between this and the other assessment conditions. These results indicate that subjects' SIB was maintained by escape from task demands (negative reinforcement) and are consistent with those from a number of previous studies (e.g., Iwata et al., 1990).

Figure 2 shows results obtained during baseline and treatment conditions for all 3 subjects. Kate's SIB (upper panel) occurred at a mean rate of 6.4 responses per minute during baseline. When the instructional fading procedure was introduced, her SIB decreased immediately to zero. However, as the rate of instructions increased across sessions, her rate of SIB increased and became more variable. At an instructional rate of 0.5 per minute (seven instructional trials per session), 10 consecutive sessions occurred in which she did not meet criterion for increasing the rate of instructions any further (i.e., two consecutive sessions with a rate of SIB at or below 0.5 did not occur). Extinction was added to the treatment program at this point. After 17 sessions with extinction in effect, Kate had two consecutive sessions with SIB below 0.5, at which time extinction was withdrawn and instructional fading was resumed. Her rate of SIB under the fading procedure increased again at 11, 17, and 20 instructions per session, resulting in the use of extinction four times during the course of her treatment. Kate's treatment was completed after 194 sessions and ended with the fading procedure in effect.

Chris's data (middle panel) show a variable rate of SIB during baseline, with his mean rate of 2.3 responses per minute nearly matching the rate of instructions (two per minute). When the fading

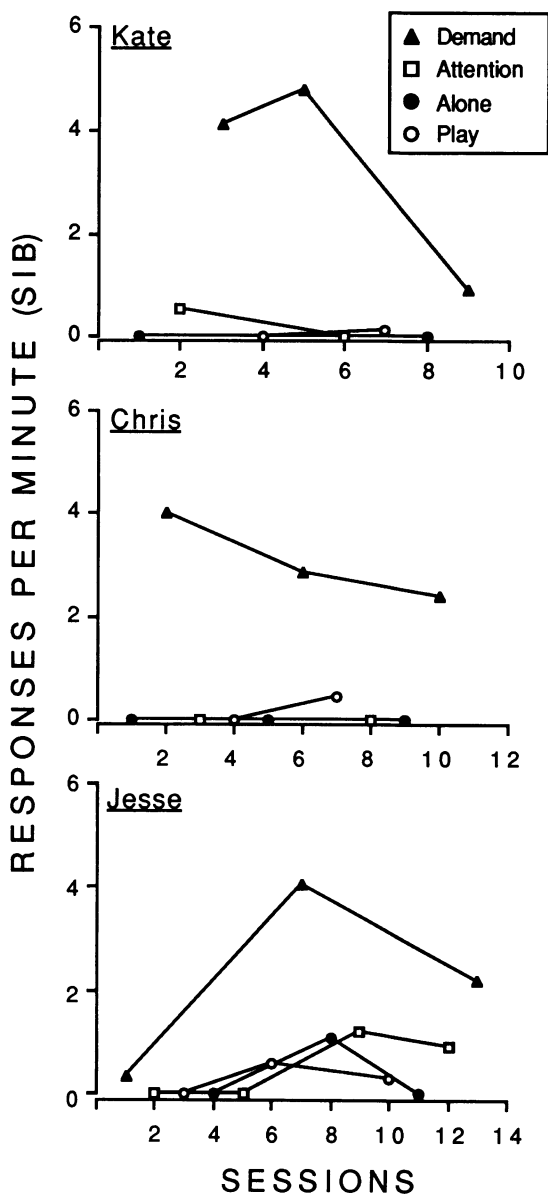


Figure 1. Responses per minute of SIB across conditions of the functional analysis assessment.

procedure was implemented, Chris's SIB immediately decreased to zero for several sessions, while the instructional rate increased rapidly. At a rate of 1.33 instructions per minute (20 per session), his rate of SIB was maintained for 10 consecutive sessions. When extinction was implemented, Chris's SIB decreased below 0.5 immediately; thus, fading was resumed after only two sessions of treatment

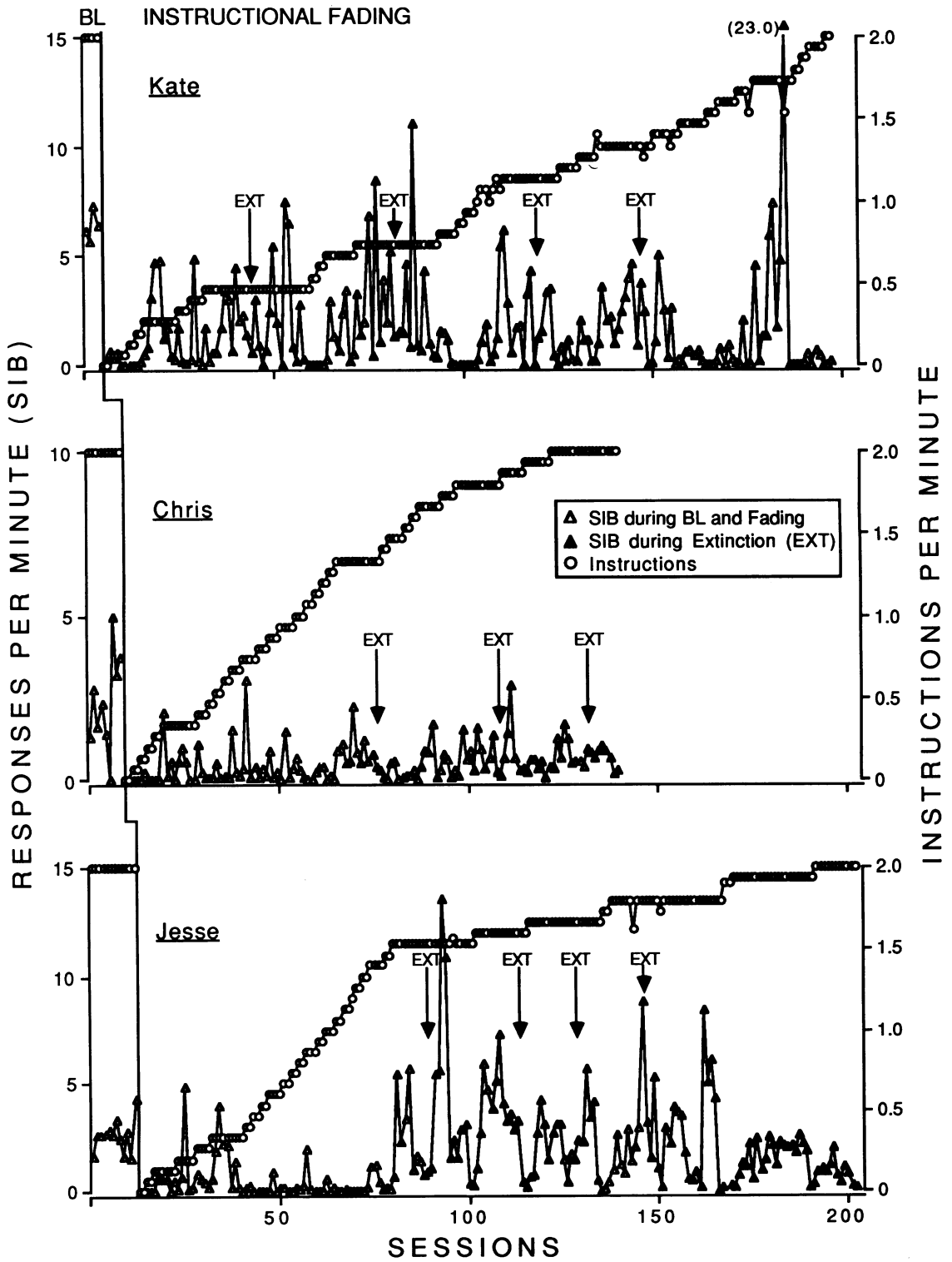


Figure 2. Responses per minute of SIB (left axis) and instructional trials per minute (right axis) during baseline and treatment. For SIB, open triangles indicate sessions during which only fading was in effect; closed triangles indicate sessions during which extinction was implemented.

with extinction. Extinction was introduced again at 1.8 and 2.0 instructions per minute (27 and 30 per session, respectively) and was associated with rapid reductions in SIB. Chris's treatment was completed after 129 sessions and ended with extinction in effect.

Jesse's data (lower panel) showed a fairly stable rate of SIB across 11 sessions during baseline ( $M = 2.6$  responses per minute). As was the case with Kate and Chris, Jesse's SIB immediately decreased to zero when the instructional rate was also decreased to zero at the beginning of the fading condition. Unlike Kate and Chris, however, Jesse's SIB was maintained at a very low rate for many sessions until the instructional rate was increased to 1.53 per minute (23 per session). At that point, Jesse's SIB increased noticeably to rates higher than those observed during baseline. When extinction was implemented, his SIB was maintained at a high rate for several sessions but eventually met criterion after 10 sessions. When extinction was withdrawn and instructional fading was resumed, Jesse's SIB increased immediately. From this point on during treatment, his SIB increased each time the instructional rate increased, requiring reintroduction of extinction. Thus, it appeared that the fading procedure had lost its effectiveness. When extinction was implemented the fourth time, it remained in effect until Jesse completed treatment. Even with extinction in effect, however, an additional 56 additional sessions were required before treatment was completed at 190 sessions.

## DISCUSSION

Results of this study extend those reported by Pace et al. (1993) and Zarcone, Iwata, Vollmer, et al. (1993) on the use of instructional fading as a method for reducing the frequency of self-injurious escape behavior. The focus of both the Pace et al. and Zarcone, Iwata, Vollmer, et al. research was on fading as an adjunct to extinction. That is, instructional fading was implemented concurrent with extinction of escape and was shown to facilitate behavioral reduction. In the present study, rapid elimination of SIB was observed with all subjects merely by reducing the frequency of instructions,

even though occurrences of SIB still produced termination of the instructional trial. However, these effects were not maintained as fading progressed. As the rate of instructions was gradually increased across sessions, so was the likelihood that SIB would occur and be reinforced. None of the subjects successfully met the end-of-treatment criterion without repeated exposure to extinction.

Results of the present study also showed that each subject required an extended course of treatment. In the Pace et al. (1993) study, treatment lasted approximately 100, 80, and 60 sessions for the 3 subjects, respectively, when fading was used in conjunction with extinction. No specific criteria were used to determine either the rate of fading or when to terminate treatment; thus, it is possible that treatment could have been completed with even fewer sessions. For the 2 subjects who completed the fading-plus-extinction condition in the Zarcone, Iwata, Vollmer, et al. (1993) study, the criterion to terminate treatment was met within approximately 30 to 50 sessions. In the present study, many more sessions were required: over 140 sessions for Chris and almost 200 sessions for Kate and Jesse. The criterion used for fading in this study (two sessions with SIB below 0.5 responses per minute) was slightly more conservative than that used by Zarcone, Iwata, Vollmer, et al. (one session with SIB below 0.5) in an attempt to decrease the likelihood that abrupt shifts in the rate of instructions would occasion increases in SIB. Thus, it is possible that an even more stringent criterion (e.g., 5 to 10 sessions with SIB occurring at a low rate) may have allowed fading to proceed successfully without having to use extinction. But given that the length of treatment in this study doubled or tripled that of the other studies, a more stringent fading criterion would have necessitated perhaps hundreds of additional sessions.

Whether or not an exceedingly slow rate of fading would be effective (without extinction) cannot be determined from the present data and requires additional research. If such a prolonged approach to fading *were* to be effective, its clinical utility would be a practical matter. Previous research on extinction of escape-maintained SIB has shown decreases in responding to low levels usually within

20 sessions of treatment. If fading without extinction required as many as 400 to 500 sessions, the procedure still might be useful for those situations in which extinction cannot be implemented.

Another aspect of the present data related to a practical consideration of fading without extinction is the fact that each subject maintained low rates of SIB—up to a point—even though the behavior continued to be reinforced. Loss of control with fading occurred at instructional rates ranging from 0.5 to 1.5 per minute across subjects. These results suggest that some type of “partial” fading might be effective without extinction. That is, if a permanently reduced rate of instructions occasions little escape behavior, perhaps a slow rate of learner progress, if not preferable, might at least be acceptable. Because we wanted to determine if it were possible to fade instructions back to their baseline rate, we did not stop at any point during the fading process to determine whether low levels of SIB would have been maintained indefinitely had instructional rates remained below subjects’ apparent initial “thresholds” of tolerance.

The protracted interventions in this study even when extinction *was* used may have been a function of the absence of a continuous extinction component throughout treatment. For example, the behavior-reducing effects of successive exposures to extinction varied across subjects. Chris’s SIB decreased immediately (i.e., within 2 sessions) the first two times extinction was implemented and within eight sessions the third time it was implemented, suggesting that extinction was effective in reducing his behavior very quickly. For Kate, fewer sessions with extinction were required across successive applications. Her SIB decreased within 17 sessions during the first application and within 12, 7, and 5 sessions during the second, third, and fourth applications, respectively. These results suggest that for Kate, extinction may have become more effective in suppressing SIB each time it was introduced, even though the instructional rate had increased between applications (although it should be noted that Kate still required a total of 41 extinction sessions). These data are consistent with other research indicating that behavioral reduction

may occur more rapidly with successive exposure to extinction following reinforcement (Clark, 1964; Clark & Taylor, 1960). However, no such pattern was observed in Jesse’s data. His SIB during four exposures to extinction decreased within 12, 4, 8, and 56 sessions (80 sessions total). For Jesse, an intermittent history of escape available versus unavailable may have had the same effect as an intermittent history of reinforcement in producing variability in responding during extinction. Presumably, if a more stringent criterion had been used when extinction was in effect (e.g., more than two sessions with SIB occurring at a low rate), fewer exposures to extinction would have been necessary. However, this also would have prolonged the course of treatment even further.

One limitation of both of the approaches examined in this study is that neither contains a provision for replacing the aberrant escape response (SIB in the present case) with a more socially acceptable alternative. Research on differential reinforcement procedures known as functional communication training (FCT) (e.g., Carr & Durand, 1985) has filled this gap by showing that once the reinforcer (e.g., attention or escape) for inappropriate behavior has been identified, behavioral reduction may be achieved if an alternative response can be strengthened through access to the same reinforcer. However, as is the case with research on fading and other antecedent interventions, most of the studies conducted to date on FCT have not examined its effects in the absence of other behavior-reducing consequences, and recent data indicate that FCT alone is not as effective as when it is combined with either extinction or punishment (Fisher *et al.*, 1993; Wacker *et al.*, 1990).

A second type of reinforcement procedure, known as the high-probability (high-*p*) instructional sequence (Mace *et al.*, 1988), attempts to strengthen compliance through the process of behavioral momentum (Nevin, Mandell, & Atak, 1983). Results of several recent studies that manipulated the sequence of instructions have shown that compliance can be increased by presenting a series of instructions for which there is a high probability of compliance immediately before the presentation of an



instruction for which there is a low probability of compliance (Davis, Brady, Williams, & Hamilton, 1992; Mace et al., 1988). However, when the instructional context produces escape behavior that competes with compliance, extinction has been found to be an important adjunct to the high-*p* sequence (Mace & Belfiore, 1990; Zarcone, Iwata, Hughes, & Vollmer, 1993; Zarcone, Iwata, Mazaleski, & Smith, in press). Thus, data from several lines of investigation (e.g., on instructional fading, FCT, and momentum-based interventions) suggest that discontinuation of the reinforcing consequences for inappropriate behavior may serve a critical therapeutic function.

Future research on the use of fading and related antecedent interventions would benefit from attempts to identify the specific elements of an instructional context that establish escape as reinforcement. For example, in addition to task frequency and difficulty, factors such as duration and type of task have been found to be differentially associated with the occurrence of disruptive behavior (Dunlap, Kern-Dunlap, Clarke, & Robbins, 1991). Further delineation of the "aversive" characteristics of instructional situations would allow the development of fading procedures based on those dimensions of a task most relevant to the production of escape behavior for a given individual.

Finally, research on all aspects of treatment for escape behavior in individuals with developmental disabilities could readily be extended to, and perhaps benefit from, the study of clinical problems such as phobias found in the general population. Issues involving measurement (use of the escape behavior itself vs. self-report measures of "anxiety" as the dependent variable), behavioral momentum (establishing "approach" behavior toward a feared stimulus by reinforcing early responses in the chain), fading (gradual exposure to fear-producing stimuli), extinction (via flooding or in vivo exposure techniques), and reinforcement of alternative escape responses are all relevant to the treatment of these problems, and attempts to identify limitations or to establish generality across behavior disorders, treatment procedures, and populations would fur-

ther enhance our understanding of escape as a reinforcing mechanism and lead to a more integrated approach to treatment (Iwata, 1987).

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