JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2009, **42,** 145–160 NUMBER 1 (SPRING 2009)

AN EVALUATION OF RESURGENCE DURING TREATMENT WITH FUNCTIONAL COMMUNICATION TRAINING

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Extinction-induced resurgence is the recurrence of previously reinforced behavior when another behavior is placed on extinction (Lieving, Hagopian, Long, & O'Connor, 2004). This phenomenon may account for some instances of treatment relapse when problem behavior recovers during extinction-based treatments. The current study sought to determine whether resurgence of problem behavior would reliably occur with 5 participants who received treatment with FCT. Results showed that problem behavior reemerged for all but 1 participant when the communicative response was exposed to extinction or thin schedules of reinforcement. These findings suggest that resurgence may account for some instances of response recovery during treatment, and that the described procedure may be useful for the further study of resurgence and eventual prevention of this phenomenon.

DESCRIPTORS: autism, extinction, functional communication training, problem behavior, resurgence

Functional communication training (FCT), a type of differential reinforcement procedure, is a common treatment for problem behavior (e.g., Carr & Durand, 1985; Day, Horner, & O'Neill, 1994). Typically, the reinforcer that maintains problem behavior is withheld through extinction and is provided contingent on a communicative response. Although treatments like FCT are highly effective in reducing problem behavior, the effects sometimes are not maintained when implemented by care providers in the natural environment (Mace & Roberts, 1993). In such cases, problems with treatment integrity may be responsible for treatment relapse.

Research findings indicate that extinction of problem behavior can be critical to the effectiveness of FCT (e.g., Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998; Shirley, Iwata, Kahng, Mazaleski, & Lerman, 1997; Shukla & Albin, 1996). Results of these studies suggest that problem behavior may reemerge during treatment if caregivers do not implement extinction properly.

The schedule of reinforcement for the communicative response also may be important for ensuring the effectiveness of FCT. For example, in a study by Durand and Carr (1991), a participant engaged in high levels of

This study is based on a dissertation submitted in partial fulfillment for the first author's doctoral degree from Louisiana State University.

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doi: 10.1901/jaba.2009.42-145

self-injury following initial successful treatment with FCT. Observations in the natural environment suggested that the participant's teacher often failed to provide help when he asked for it because the teacher could not understand his verbal requests for assistance during work situations. After the participant was taught improved articulation skills, his teacher consistently reinforced his requests, and self-injury returned to low levels. In another study, FCT was used to decrease problem behavior with 5 participants (Durand & Kishi, 1987). One participant was taught to raise her hand to gain access to staff attention. Eventually, some staff members reported being unable to provide attention each time the participant raised her hand, and the effectiveness of the treatment deteriorated in the natural environment. Similarly, applied investigations on methods to thin the schedule of reinforcement or to increase the delay to reinforcement for the FCT response have noted increases in problem behavior when the FCT response contacted periods of nonreinforcement (e.g., Fisher, Thompson, Hagopian, Bowman, & Krug, 2000; Hagopian, Toole, Long, Bowman, & Lieving, 2004; Hanley, Iwata, & Thompson, 2001).

These applied findings are consistent with the results of basic research on a phenomenon called *extinction-induced resurgence*, which suggest that problem behavior may reemerge if reinforcement is not provided consistently for alternative responses during treatment. Extinction-induced resurgence is typically defined as the recurrence of previously reinforced behavior when another behavior is placed on extinction (Lieving, Hagopian, Long, & O'Connor, 2004). A three-condition procedure has been used in most basic research on resurgence (e.g., Epstein, 1983, 1985; Leitenberg, Rawson, & Bath, 1970; Leitenberg, Rawson, & Mulick, 1975; Mulick, Leitenberg, & Rawson, 1976). For example, in an early study with pigeons (Epstein, 1983), key pecking was reinforced and then extinguished in the first condition. In the second condition, an alternative response (e.g., wing flapping) was reinforced. When the alternative response was placed on extinction in the third condition, key pecking reemerged even though reinforcement was withheld for both responses.

Similar results have been obtained when the first response was extinguished concurrently with (rather than prior to) reinforcement of the alternative response (e.g., Epstein, 1985; Leitenberg et al., 1970; Lieving & Lattal, 2003, Experiments 2, 3, and 4). In a more extensive evaluation, Lieving and Lattal found that resurgence could be replicated within an organism and that both extinction and thin schedules of reinforcement were associated with this phenomenon.

Resurgence may account for some instances of treatment relapse when problem behavior recovers during extinction-based treatments such as FCT. For example, suppose an individual's SIB is maintained by escape from demands prior to treatment (similar to the first condition described above). During treatment, the individual may be taught to say, "break please," to request a break while escape is no longer provided for problem behavior (similar to the second condition). In the natural environment, the reinforcer may not be readily available or may be difficult to deliver, resulting in periods of extinction for appropriate communicative responses (similar to the third condition). In these cases, SIB may resurge even though it remains on extinction.

Despite the potential relevance of resurgence to treatment relapse in the natural environment, few applied studies have systematically examined resurgence effects. Although not the focus of their study, resurgence was demonstrated by Sprague and Horner (1992) while they were examining response covariation. Problem behavior clearly recurred when reinforcement was no longer provided for a functionally equivalent communication response. More recently, Lieving et al. (2004) demonstrated resurgence among different topographies of problem

behavior that were members of the same response class. For example, 1 participant's self-injury, disruption, and aggression were maintained by access to tangible items. Although all topographies of problem behavior were reinforced, disruption occurred exclusively. Disruption was then extinguished while aggression continued to be reinforced. In the third condition, disruption reemerged when reinforcement was withdrawn for aggression.

Applied research on variables that influence extinction-induced resurgence may lead to strategies for reducing or preventing the recovery of problem behavior during treatments like FCT. If resurgence occurs often, it may play a key role in the effectiveness of treatment with differential reinforcement. It is likely that the alternative response will contact periods of extinction in the natural environment, resulting in the temporary recovery of problem behavior and a loss of positive treatment outcomes if not managed correctly (Lieving et al., 2004). Therefore, determining the likelihood that resurgence of problem behavior will occur when reinforcement is withheld for an alternative behavior is important.

Methods for studying resurgence in application also need to be evaluated and described. The resurgence effect must be replicated within participants to identify factors that may influence the likelihood or degree of resurgence so that this problem can minimized or eliminated. To date, the procedures for studying resurgence in the basic literature (Epstein, 1983; Lieving & Lattal, 2003) have not been extended to humans and clinically relevant problem behavior within the context of treatment. The three-condition procedure described in the basic literature could serve as an analogue for situations in which caregivers deliver reinforcement for an alternative behavior with poor integrity (i.e., inconsistently or not at all).

The present investigation replicated and extended the results of Lieving and Lattal (2003) by examining resurgence with human participants who engaged in aberrant behavior. We sought to determine whether resurgence of problem behavior would occur when a newly taught alternative behavior was placed on extinction or contacted a thin schedule of reinforcement and whether the resurgence effect could be repeated in the same individual.

GENERAL METHOD

Participants and Setting

Participants were 5 children who had been diagnosed with autism or developmental disabilities and had been referred for the assessment and treatment of self-injury, aggression, or disruption. The criterion for inclusion in the study was the identification of single or multiple social reinforcers for problem behavior. The function of problem behavior was determined via visual inspection of data from a functional analysis (described below). Ben was a 9-year-old boy who engaged in self-injurious behavior (SIB), aggression, and disruption. He primarily exhibited disruption, and his SIB never produced tissue damage but resulted in slight redness on occasion. Bella, an 8-year-old girl, exhibited SIB and aggression. Sam and Max were both 5 years old and engaged in aggression and disruption. Connor was a 5-year-old boy who engaged in aggression. Two of the 5 participants had visual impairments and attended a school for students with visual impairments (Ben and Bella). Sam and Max attended self-contained classrooms for students with developmental disabilities in regular public schools. Connor attended a university-based prekindergarten program before his placement ended due to his problem behavior.

Ben and Bella did not exhibit any expressive language skills. Max primarily communicated by pulling people towards objects or pointing, but he occasionally used one-word utterances to communicate. Sam had extensive expressive and receptive language repertoires, could speak in full sentences, and displayed some intraverbal behavior. Connor communicated primarily

using four- to five-word utterances. All participants also followed one-step instructions. Ben received Guanfacine, Depakote, and Seroquel. Bella received Clonidine. Sam was not taking medication during the study. Max received Lexapro and Metadate. Connor received Flovent twice a day for asthma. No medication changes were reported for the participants over the course of the study. Ben, Bella, and Sam participated in Experiment 1. Ben, Max, and Connor participated in Experiment 2.

Sessions were conducted in classrooms at a university-based summer program or in unused rooms at the participants' schools. Classrooms contained materials necessary to conduct the sessions (e.g., tables, chairs, leisure items). One to two session blocks were conducted per day, with at least a 1-hr break between session blocks. Three to five 10-min sessions were conducted during each session block.

Response Measurement and Interobserver Agreement

Hitting (Ben, Bella, Sam, and Connor) was defined as forceful contact of an open or closed hand with another person's body and throwing objects at another person. *Grabbing* (Ben, Bella, Sam, Max, and Connor) was defined as wrapping the fingers tightly around another person's body part, hair, or clothing if pulled outward at least 2.5 cm; pulling another person's clothing at least 5 cm from the body with more than two fingers; or clinching another person's skin with hand. *Scratching* (Ben, Sam, Max, and Connor) was defined as rapidly scraping the fingernails across another person's skin. *Biting* (Bella, Max, and Connor) was defined as closure of the teeth against another person's body. *Pinching* (Bella, Sam, Max, and Connor) was defined as tightly squeezing another person's skin between two or more fingers. *Kicking* (Ben, Sam, and Connor) was defined as striking another person with the foot. *Head butting* (Connor) was defined as forceful contact of the head with another person's body. *Pushing* (Ben and Sam) was defined as shoving a person with both hands. *Disruption* (Ben, Sam, and Max) was defined as throwing objects with a forward thrusting or swiping motion of the arms or forcefully knocking furniture over. *Head or torso hitting* (Bella) was defined as forceful contact between a single open hand (fingers together, wrist stiff) and the head or torso from a distance of at least 12.5 cm. *Head banging* (Ben) was defined as forceful contact between the head and hard surfaces. *Face or body scratching* (Ben) was defined as scraping of the fingernails across the skin on the face or body. *Hand biting* (Bella) was defined as upper and lower teeth closed against the skin on the hand or wrist.

The specific topography of the alternative response depended on the participant's skills and teacher or caregiver preference. For Ben, a card pull was chosen as the alternative behavior. A card (5 cm by 10 cm) on a retractable string was attached to his waistline. *Card pulling* was defined as placing the hand on the card and moving the card out at least 13 cm. For Bella and Max, an approximation of the American sign language sign for "break" was selected as the alternative behavior. The *break sign* was defined as forming the hands into fists and then tapping the sides of any part of the hands together without assistance. Vocal responses were selected for Sam and Connor. Sam was taught to say, "Talk to me, please," and Connor was taught to say, "Toy, please."

The frequency of each participant's problem behavior and alternative response was recorded on laptop computers during all conditions. All data were converted to a rate measure by dividing the frequency of the behavior by the number of minutes in the session. Previously trained graduate or undergraduate students served as observers. An observer was considered trained when agreement coefficients met or exceeded 80% for all dependent variables across three consecutive sessions.

Interobserver agreement was assessed by having a second data collector score behavior

simultaneously but independently during a mean of 41% of the sessions (range, 33% to 49%) for each child during Experiment 1 and a mean of 50% of the sessions (range, 44% to 56%) for each child during Experiment 2. Interobserver agreement was determined by dividing each session into consecutive 10-s intervals and comparing the data of the two observers. Agreements were defined as the same number of responses scored within a 10-s interval. Agreement coefficients were calculated by dividing the number of agreements by the number of agreements plus disagreements and converting this ratio to a percentage. Across participants in Experiment 1, mean agreement for problem behavior and alternative behavior were 97% (range, 96% to 98%) and 97% (range, 95% to 98%), respectively. Across participants in Experiment 2, mean agreement for problem behavior and alternative behavior were 95% (range, 94% to 96%) and 96% (range, 94% to 98%), respectively.

Functional Analysis

A functional analysis was conducted using procedures similar to those described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994) to identify the function of each participant's problem behavior. Prior to the functional analysis, a doctoral student collected information about antecedents and consequences hypothesized to contribute to the occurrence of each child's problem behavior by interviewing parents and teachers and observing the child in the home or classroom.

Prior to conducting the functional analyses, preference assessments were conducted for each participant to identify highly preferred toys for the toy-play and tangible conditions and low to moderately preferred toys for the attention condition. For Sam, Max, and Connor, a paired-item preference assessment was conducted using procedures similar to those described by Fisher et al. (1992). Alternative assessment formats were used for Bella and Ben, who had visual impairments. The therapist briefly placed Bella's hands on each toy and then on the table between the two items before delivering the instruction, "pick one" (Paclawskyj & Vollmer, 1995). A preference assessment similar to that described by DeLeon, Iwata, Conners, and Wallace (1999) was used for Ben because he did not choose between two items presented to him. Each potential reinforcer was presented one at a time for 2 min. The duration of item interaction and frequency of problem behavior were scored. The items associated with the longest durations of interaction and the lowest amounts of problem behavior were considered to be the most preferred.

Attention, demand, no-interaction, and toy-play conditions were alternated in a multielement design during the functional analysis. A tangible condition was included if direct observation or teacher or caregiver report indicated that the child may have engaged in problem behavior due to a history of tangible reinforcement for problem behavior. Results of the multielement functional analysis were inconclusive for Bella. However, caregiver report and anecdotal observation suggested that Bella's problem behavior was maintained by escape from walking. Thus, a pairwise comparison of toy play and escape from walking conditions was conducted.

Results of the functional analyses are shown in Figures 1 and 2. Ben's, Bella's, and Max's problem behavior appeared to be maintained by social negative reinforcement in the form of escape from demands (Ben and Max) or walking (Bella). Sam's problem behavior was maintained by social positive reinforcement in the form of access to attention and tangible items. Connor's problem behavior was sensitive to escape from demands and access to tangible items. Treatment specific to just one function was targeted during the resurgence evaluation for Sam and Connor based on feasibility and teacher or care provider preference. The attention function was selected for Sam, and the tangible function was selected for Connor.

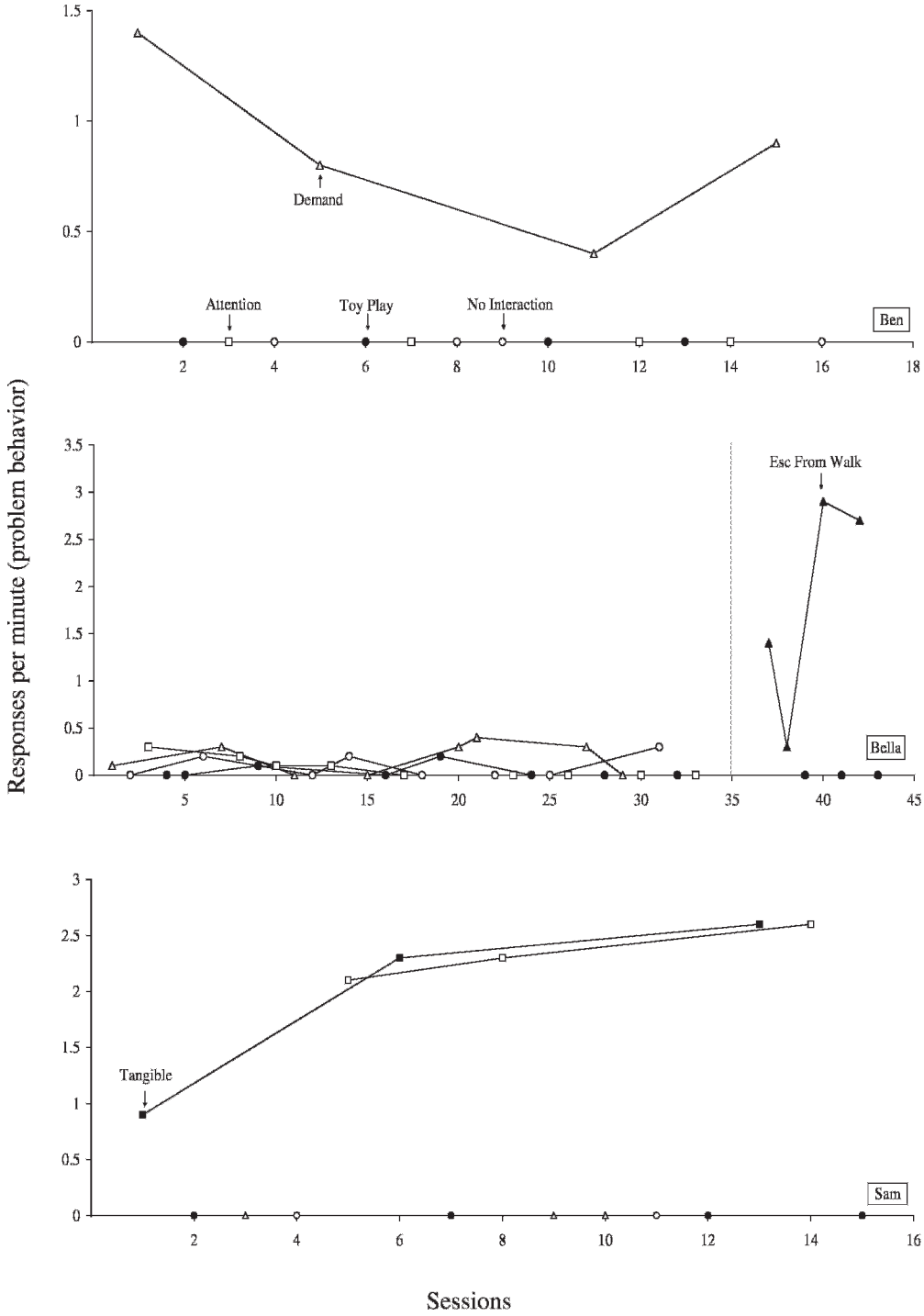

Figure 1. Responses per minute of problem behavior during the functional analysis for Ben, Bella, and Sam.

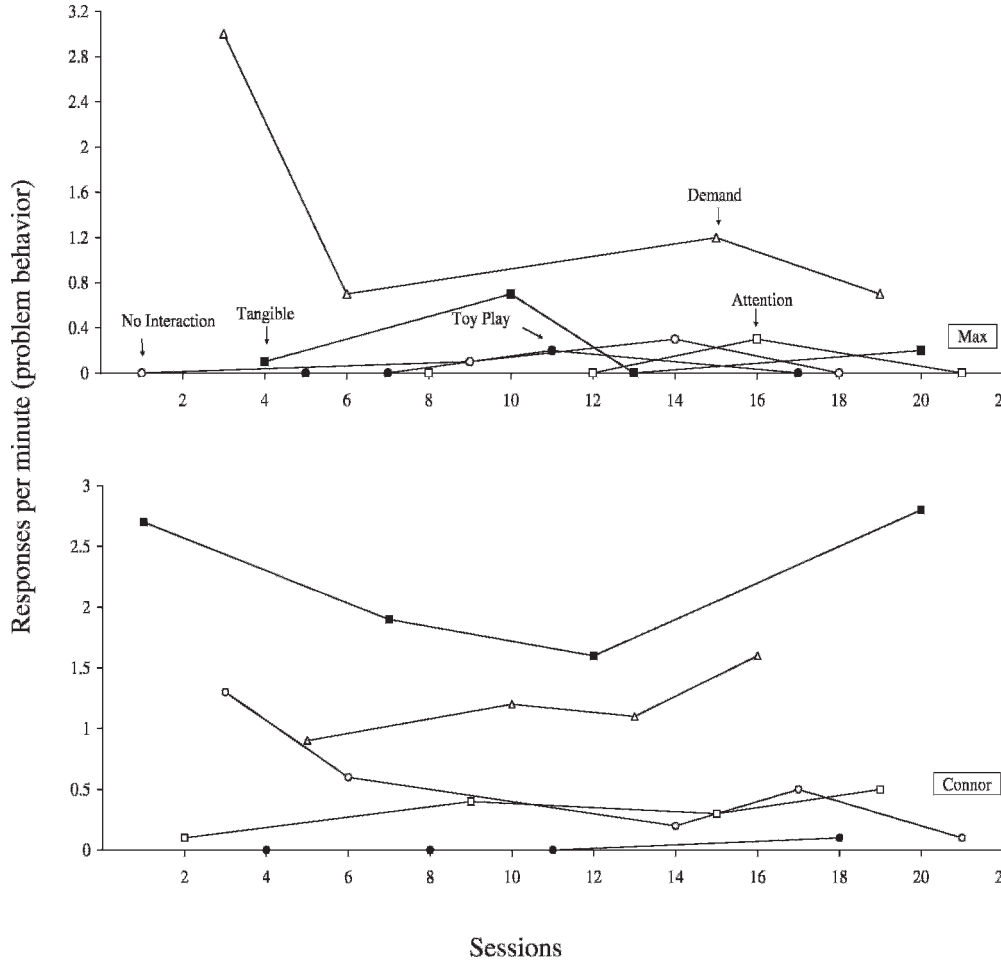

Figure 2. Responses per minute of problem behavior during the functional analysis for Max and Connor.

EXPERIMENT 1

Procedure

Ben, Bella, and Sam participated in Experiment 1. An ABCABC reversal design was used. For each participant, baseline (A), FCT and FCT maintenance (B), and extinction (C) conditions were conducted. These three conditions were then replicated. All sessions lasted for 10 min.

Baseline. Procedures were identical to those in the functional analysis condition associated with high rates of problem behavior. A brief multiple-stimulus without replacement preference assessment (DeLeon & Iwata, 1996) was conducted with Connor prior to every session to prevent satiation for the tangible items used. During baseline, no programmed consequences were provided for appropriate communicative responses. At least four sessions were conducted, and sessions continued until responding was stable as determined by visual inspection (i.e., either a stable or countertherapeutic trend). In addition, a changeover delay (COD) was implemented during this condition to avoid adventitious reinforcement of appropriate communicative responses in cases in which communication and problem behavior occurred in close temporal proximity. If the participant engaged in the appropriate communicative response, problem behavior was ineligible for reinforcement until 5 s had elapsed.

FCT. The participant was taught to request the functional reinforcer using the alternative communicative behavior identified earlier. A physical prompt with a progressive prompt delay was used for Ben and Bella to teach the alternative behavior. For Sam, a vocal model prompt with a progressive prompt delay was used to teach the alternative behavior. Initially, the controlling prompt was delivered after 10 s for Ben and Bella and 30 s for Sam. The delay was increased by 10 s each time an 80% reduction in problem behavior (relative to the mean rate of the last three baseline sessions) was observed for two consecutive training sessions. However, when Ben had not acquired the alternative response with a 1-min delay, the delay was increased to 2 min to capitalize on the establishing operation. It was hypothesized that 1 min of demands was not always aversive to Ben. Thus, increasing the length of time before physically prompting the alternative response may have increased the aversiveness of the instructions, increasing the likelihood that Ben would engage in the alternative behavior independently. Problem behavior was placed on extinction during this condition. A COD was also in effect during this condition to avoid adventitious reinforcement of problem behavior. That is, if the participant engaged in problem behavior, the appropriate communicative response was ineligible for reinforcement until 5 s had elapsed. The criteria for moving to the FCT maintenance condition were as follows: (a) The participant independently engaged in the alternative response (i.e., required no experimenter prompting) at a rate that was at least 50% of the mean rate of problem behavior during the last three sessions of baseline (e.g., if the mean rate of problem behavior was 1.0, then the alternative response would have had to occur at a rate equal to or greater than 0.5 per minute), and (b) there was an 80% reduction in the rate of problem behavior relative to the mean rate during the last three sessions of baseline. Both of these criteria had to be met across three consecutive sessions.

FCT maintenance. Procedures were identical to those in the previous FCT condition. However, no prompts were delivered for the communication response. At least 10 sessions were conducted, and sessions were continued until the rate of the alternative response was stable, as determined by visual inspection (i.e., either three consecutive data points with no evident trend or with an increasing trend). In addition, an 80% reduction in problem behavior (relative to the last three sessions of baseline) must have been observed for at least three consecutive sessions before moving to the next condition.

Extinction (test for resurgence). The procedures were similar to those in the FCT maintenance condition except that the functional reinforcer was no longer provided for either problem behavior or the alternative communicative response. This condition was in effect for 10 sessions. The purpose of this condition was to test for resurgence. *Resurgence* was defined as the occurrence of problem behavior at a rate exceeding levels observed during the FCT maintenance condition in at least one of these 10 sessions (this criterion was based on procedures used by Lieving & Lattal, 2003).

EXPERIMENT 2

In Experiment 4 of Lieving and Lattal (2003), the authors evaluated whether extinction-like conditions would produce resurgence. The authors hypothesized that the periods of nonreinforcement associated with very thin schedules of reinforcement for the alternative response (treadle press) would resemble extinction and produce resurgence of key pecks. Resurgence of key pecks was obtained with 2 of 3 pigeons when the thin schedule of reinforcement was implemented for treadle presses; however, the magnitude of the resurgence effect was smaller than that observed with traditional extinction.

In clinical applications of FCT, the schedule of reinforcement for the alternative response is

typically thinned to promote response maintenance and generalization and to enhance the practicality of the treatment (Hagopian et al., 2004). For example, if a child repeatedly requests breaks from an ongoing task, little work will be accomplished if each request is reinforced. Therefore, the break may be provided following every fifth request. Depending on how quickly the schedule of reinforcement is thinned, periods of nonreinforcement may be similar to extinction. Thus, it is important to determine whether problem behavior will resurge if the schedule of reinforcement for the alternative response is thinned or thinned too quickly. In Experiment 2, the procedures of Lieving and Lattal (2003, Experiment 4) were replicated with children who exhibited problem behavior and were taught to engage in alternative communicative responses to access the functional reinforcer (FCT).

Procedure

Ben, Max, and Connor participated in Experiment 2. An ABCABC reversal design was used. Baseline (A), FCT and FCT maintenance (B), and intermittent reinforcement (modified resurgence; C) conditions were conducted as described in Experiment 1, with two variations. During the intermittent reinforcement condition, the appropriate communicative response was exposed to a thin reinforcement schedule rather than to extinction. Also, when the alternative behavior was initially taught, the controlling prompt was delivered after 30 s for Ben. Although Ben participated in Experiment 1, he was retaught the alternative behavior to keep the procedures consistent across participants and to ensure that he could still engage in the correct alternative behavior. In Experiment 4 of Lieving and Lattal (2003), the schedule of reinforcement for the alternative behavior was increased from variable-interval (VI) 30 s (during the reinforcement condition) to VI 360 s (during the modified resurgence condition), an increase by a factor of 12. Therefore, the schedule of reinforcement in the current study was also increased by a factor of 12 by providing the functional reinforcer following 12 communicative responses (fixed-ratio [FR] 12 schedule) during the test for resurgence. An FR schedule was used in the current study rather than a VI schedule because FR schedules are more commonly used in clinical application (Hagopian et al., 1998; Shirley et al., 1997). The schedule was increased abruptly from FR 1 to FR 12 to replicate the procedures used by Lieving and Lattal.

RESULTS

Experiment 1

Responses per minute of problem and alternative behavior for each participant are shown in Figure 3. In general, rates of problem behavior were high, and rates of the alternative behavior were zero or near zero during baselines for all participants. However, it should be noted that very low levels of problem behavior were initially observed for Ben during the second baseline condition. It was hypothesized that the demands had lost their aversive properties, perhaps due to habituation. The rate of problem behavior increased when the task was replaced with a different one. Low levels of problem behavior and moderate to high levels of the alternative behavior were observed for each participant towards the end of FCT conditions.

During the first test for resurgence (extinction), Ben's problem behavior increased relative to the previous condition and then eventually decreased to zero. The alternative behavior decreased to near-zero levels immediately. Following a return to baseline and replication of the FCT phases, the rate of Ben's problem behavior during the second extinction exposure increased to levels that greatly exceeded those observed previously before rapidly decreasing to zero. An extinction burst was observed for the alternative behavior. During Bella's initial

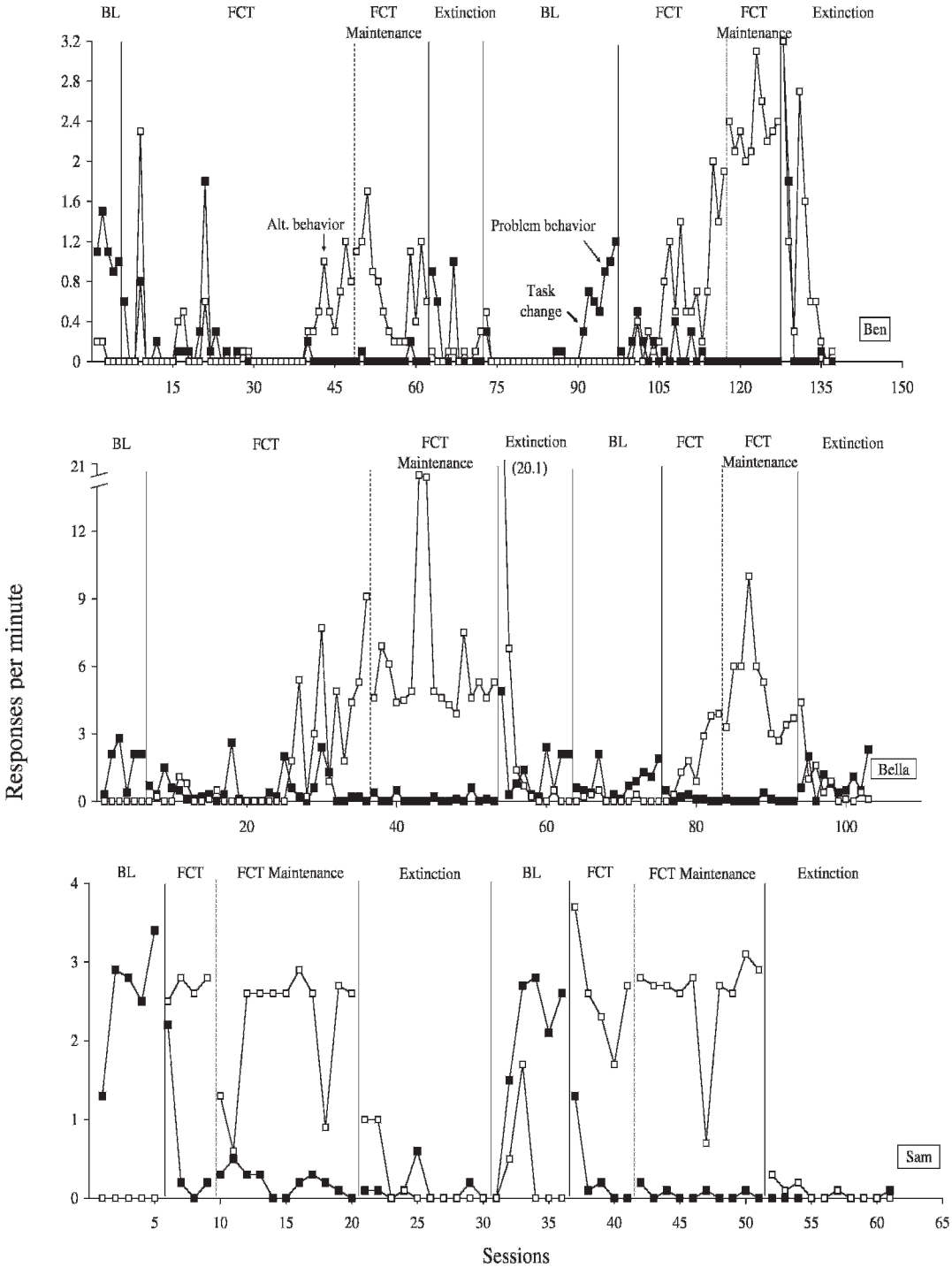

Figure 3. Responses per minute of problem behavior and alternative behavior during baseline, FCT, FCT maintenance, and extinction conditions for Ben, Bella, and Sam in Experiment 1.

exposure to extinction, rates of problem behavior increased relative to the FCT condition and then were maintained at baseline levels. Initially, the rate of alternative behavior increased substantially (consistent with an extinction burst), followed by a gradual decrease. During the second test for resurgence, problem behavior again increased relative to the second FCT condition. An extinction curve was observed for the alternative behavior. Unlike the other participants, Sam's rate of problem behavior did not increase relative to the FCT condition during either test for resurgence, remaining near zero throughout extinction. Rates of the alternative behavior decreased to zero fairly rapidly.

Experiment 2

Responses per minute of problem and alternative behavior for each participant in Experiment 2 are shown in Figure 4. Rates of responding for each participant during the baseline and FCT conditions were similar to those in Experiment 1. During the first intermittent reinforcement condition, Ben's rate of problem behavior increased over that in the immediately prior FCT condition, but the behavior rapidly extinguished. In addition, the alternative behavior decreased to low levels. Similar results were obtained for both responses during the replication phases. On average, Ben earned reinforcement for the alternative behavior 0.3 times during the intermittent reinforcement sessions. For Max, a large increase in problem behavior occurred during his first exposure to the intermittent reinforcement condition relative to the prior FCT condition. No reduction in problem behavior was observed across the 10 sessions of this phase. However, the alternative behavior decreased rapidly, reaching zero levels by the ninth session. During his second exposure to intermittent reinforcement, problem behavior again increased compared to the prior FCT condition but then decreased to near-zero levels by the end of the condition. The alternative behavior initially increased relative to the previous condition and then was maintained at moderate levels. Max earned a mean of 2.9 reinforcers for the alternative behavior during the intermittent reinforcement sessions. During Connor's first exposure to the intermittent reinforcement condition (test for resurgence), problem behavior increased compared to the prior FCT condition, reaching a level similar to that of the first baseline phase and then decreased to zero or near-zero levels for the remainder of the phase. The alternative behavior also rapidly decreased following an initial increase in responding that resembled an extinction burst. Problem behavior remained low for two sessions before gradually increasing to near-baseline levels during Connor's second exposure to intermittent reinforcement. Rates of the alternative behavior were variable but were maintained at moderate levels. During each intermittent reinforcement session, he earned a mean of 1.5 reinforcers for the alternative behavior.

DISCUSSION

Results provide preliminary evidence that extinction-induced resurgence may account for some instances of response recovery during treatments that involve differential reinforcement. Overall, results of both experiments show a robust recovery of problem behavior during the tests for resurgence, often above baseline rates. This high rate of recovery for problem behavior is cause for concern because problem behavior could very easily be restrengthened through accidental reinforcement provided by caregivers. Resurgence of problem behavior was observed with 2 of 3 participants in Experiment 1 and with all 3 participants in Experiment 2. Thus, results of Experiment 1 indicated that resurgence of problem behavior occurs in some instances, and that repeated exposure to extinction does not necessarily lessen the magnitude of the resurgence effect. In fact, Ben's problem behavior increased to higher

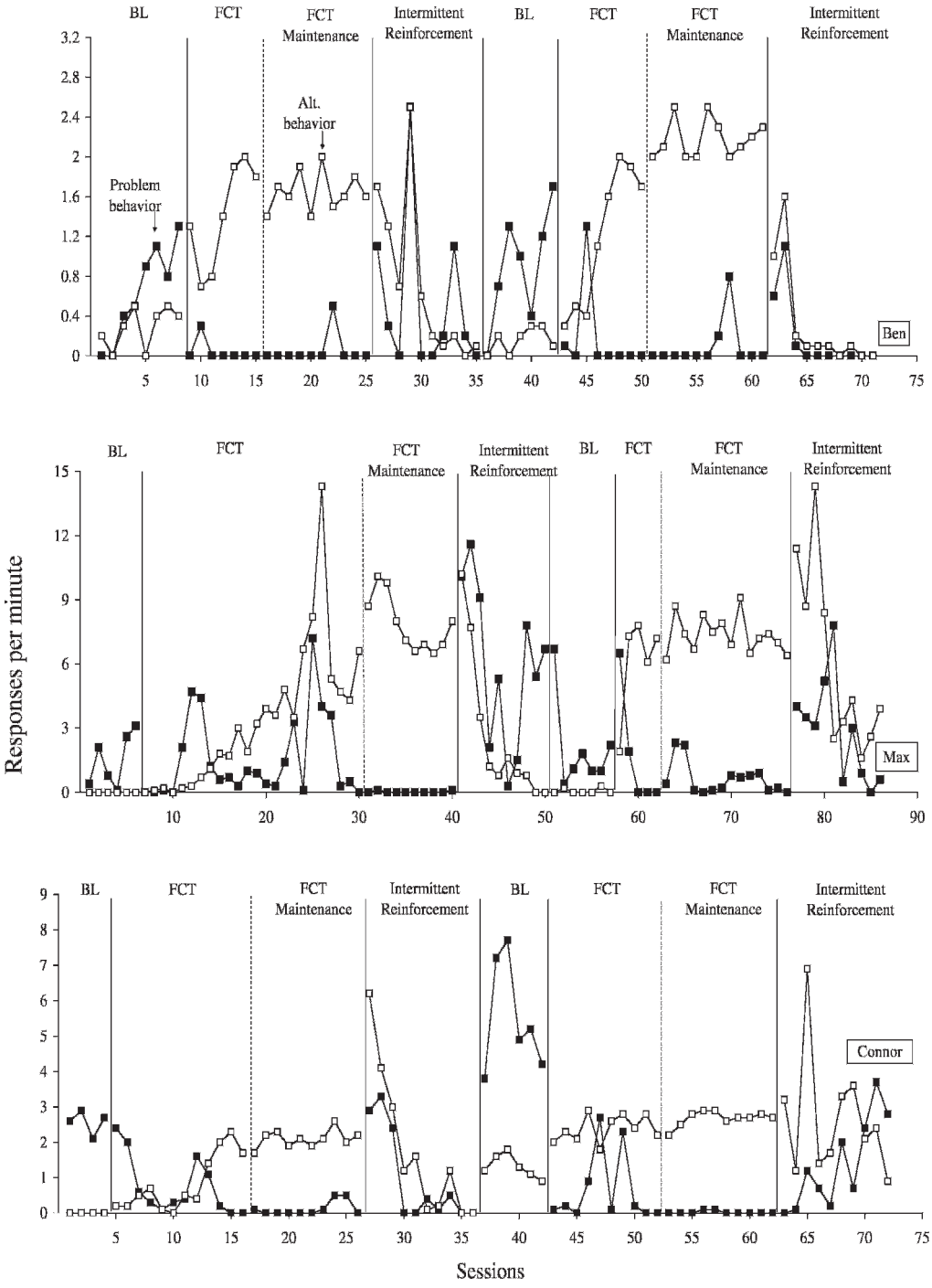

Figure 4. Responses per minute of problem behavior and alternative behavior during baseline, FCT, FCT maintenance, and extinction conditions for Ben, Max, and Connor in Experiment 2.

levels during his second exposure to extinction than during his first exposure in Experiment 1.

Results of Experiment 2 indicated that resurgence of problem behavior also can occur when an alternative response is reinforced on a thin schedule. Thus, if reinforcement for an alternative response is withheld for brief periods of time or thinned too rapidly during FCT treatments, problem behavior may resurge even if it remains on extinction. These results replicate those of Lieving and Lattal (2003) and extend them to human participants and clinical problems. In addition, the resurgence phenomenon was demonstrated with 3 participants whose problem behavior was maintained by negative reinforcement. Resurgence of escape and avoidance behavior has not been demonstrated in the basic literature and has not been explicitly evaluated in the applied literature until now.

One purpose of the current study was to evaluate a method for the further study of resurgence. Given that the phenomenon was reliably demonstrated via a within-participant design, this method may be useful for examining factors that influence resurgence for the purpose of identifying strategies to attenuate or prevent it.

The problem behavior of 1 participant (Sam) did not increase during the test for resurgence in Experiment 1, suggesting that brief periods of extinction of a newly trained alternative response may not be detrimental to the effectiveness of treatment, as long as reinforcement for problem behavior is also withheld. However, Sam's level of functioning was somewhat higher than that of the other participants. His more advanced verbal skills may have led to rule-governed behavior during the treatment evaluation (i.e., he may have generated his own rules), making his behavior more sensitive to changes in contingencies (Pierce & Cheney, 2004). In every condition of the experiment, his data showed rapid behavioral adaptation to transitions. This sensitivity may explain the lack of a resurgence effect.

This study contains limitations that warrant discussion. First, two methodological variations exist in the resurgence literature with respect to the implementation of extinction. In some previous studies, the first response was fully extinguished prior to reinforcement of the alternative response (Epstein, 1985; Lieving et al., 2004). In other investigations, the first response was extinguished while the second response was trained (Leitenberg et al., 1970, 1975; Lieving et al.). The latter method was used in the current study because, in clinical applications of FCT, problem behavior is usually extinguished as the communication response is taught and not prior to communication training. Nonetheless, it is possible that a phenomenon other than resurgence was obtained, such as a delayed extinction effect (Leitenberg et al., 1970, 1975). Problem behavior may not have fully contacted extinction, or was prevented from doing so, if the participant quickly acquired the alternative response. Once the alternative behavior was no longer reinforced, the participant may have allocated responding to the previously reinforced problem behavior, which subsequently underwent extinction. Cleland, Foster, and Temple (2000) referred to this as the prevention-of-extinction hypothesis. However, in the current investigation, extinction curves for problem behavior were observed for Ben and Bella in Experiment 1 and for Ben and Max (second FCT condition) in Experiment 2 as the alternative behavior was taught. In these cases, problem behavior did appear to contact extinction, which is inconsistent with the delayed extinction explanation.

Second, the reinforcement schedule (FR 12) for the alternative response was chosen somewhat arbitrarily and may have been functionally similar to extinction in Experiment 2. For the purpose of replication, the schedule selected was based on procedures described by Lieving and Lattal (2003) rather than on each participant's pattern of responding during the FCT condi-

tion. A denser schedule of reinforcement or gradual schedule thinning may have produced different results. However, it should be noted that all participants in Experiment 2 contacted reinforcement for the alternative response at least once under FR 12. In fact, the alternative behavior was maintained for Max and Connor during the second exposure to the intermittent reinforcement condition. Nonetheless, the generality of the findings may be limited because such abrupt schedule thinning is not typical or recommended in research and practice.

A third limitation was that the conditions designed to test resurgence (extinction and intermittent reinforcement) were conducted for only 10 sessions. Lengthier exposure to the resurgence test condition may have allowed a more complete examination of the long-term effects of extinction or intermittent reinforcement on levels of problem behavior. For example, Bella's problem behavior may have eventually been extinguished if more sessions had been conducted.

Fourth, all of the children who participated had been diagnosed with mild to severe developmental disabilities or autism. It is not clear whether the results of the study can be extended, for instance, to individuals with attention deficit hyperactivity disorder or those without a formal diagnosis. In addition, resurgence was demonstrated with only 4 of the 5 participants. To establish generality of results, replication of the current study with more participants is necessary.

A final limitation of the current investigation was that problem behavior continued to occur at baseline levels at the conclusion of the resurgence evaluation for 3 participants (Bella, Max, and Connor). In fact, Max's problem behavior often occurred at rates exceeding those in baseline during his first exposure to intermittent reinforcement, and his problem behavior never decreased to clinically acceptable levels. Integrity data collected throughout the study showed that reinforcement was never delivered contingent on problem behavior during the tests for resurgence for any of these participants. For Bella and Max, the school year was ending at the conclusion of the resurgence evaluation, and their parents and teachers were instructed on how to implement the FCT procedure so that it would be effective. For Connor, treatment evaluations to address the escape and possible attention functions of his problem behavior were conducted following the resurgence evaluation, and recommendations were given to his parents on how to manage his problem behavior across all situations.

The variables that control resurgence should be investigated further if additional research indicates that resurgence of problem behavior reliably occurs with human participants and in clinically relevant situations. When the variables that influence resurgence are known, its effect may be lessened or eliminated during treatments such as FCT. The potential research questions on this topic are myriad. One such question is whether different methods of introducing periods of extinction for the alternative response would affect the probability of resurgence. For instance, the schedule of reinforcement for the alternative response could be thinned more slowly or periods of extinction could be gradually lengthened and alternated with periods of continuous reinforcement. Results of Hanley et al. (2001) suggest that resurgence of problem behavior may still occur when reinforcement is gradually thinned using multiple schedules of reinforcement. Noncontingent reinforcement could also be introduced while the reinforcement schedule is thinned (Fisher et al., 2000). Exposing problem behavior to extinction prior to FCT also may reduce resurgence, although basic research suggests that this would not be the case if the exposure is relatively brief (Epstein, 1985).

Results of a recent basic study suggest that resurgence may be affected by the method used to eliminate problem behavior. Doughty, da Silva, and Lattal (2007) showed greater resurgence of key pecking and earlier onset of key

pecking when this response was eliminated in pigeons using differential reinforcement of other behavior rather than differential reinforcement of alternative behavior. Future investigations also could examine resurgence with multiple topographies of problem behavior that form a response-class hierarchy. Certain topographies may be more likely to recover when alternative behavior contacts periods of extinction (Richman, Wacker, Asmus, Casey, & Andelman, 1999). From a clinical standpoint, knowing whether more or less severe behaviors are likely to reemerge through resurgence could be important when treating problem behavior. Finally, to establish the generality of the resurgence phenomenon, it will be important to study resurgence of other types of behavior (e.g., button pressing, communication responses). For instance, a participant could be taught several communication responses, and resurgence of one of those responses could be evaluated.

Several authors have provided alternative names or descriptions for the patterns of responding observed in the current investigation. One possibility is that resurgence is a very specific form of extinction-induced behavioral variability (Lieving et al., 2004). When a behavior is exposed to extinction, responding in general sometimes becomes more variable (e.g., Antonitis, 1951; Millenson & Hurwitz, 1961). In the current investigation, it was unclear whether increases in behavior other than problem behavior would have occurred, because data were not collected on topographies other than the two responses in question (i.e., problem behavior and the alternative response). Future research should examine whether behavior becomes more variable in general during the extinction phase of the resurgence test.

Cleland, Foster, and Temple (2001) proposed that resurgence is related to spontaneous recovery. After extinction of a behavior has occurred, periods of rest alone are sometimes associated with increases in the extinguished behavior (Kimble, 1961). In terms of resurgence, when the second response (alternative behavior) is reinforced during the second condition, this may be a period of rest for the first response (problem behavior). More research is needed to determine if there is a relation between resurgence and spontaneous recovery.

Resurgence is a behavioral phenomenon that may occur in clinical applications if a newly taught alternative behavior contacts extinction. Determining the variables that influence resurgence now becomes imperative so that reduction and prevention of this effect can be achieved.

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Received August 16, 2007
Final acceptance May 9, 2007
Action Editor, Gregory Hanley