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AN EVALUATION OF RESURGENCE DURING FUNCTIONAL COMMUNICATION TRAINING

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Three children who displayed destructive behavior maintained by negative reinforcement received functional communication training (FCT). During FCT, the children were required to complete a demand and then to mand (touch a card attached to a microswitch, sign, or vocalize) to receive brief play breaks. Prior to and 1 to 3 times following the initiation of FCT, extinction probes were conducted to evaluate the resurgence of destructive behavior when the microswitch without the mand card was present or the microswitch and the mand card were absent to determine if different patterns of resurgence occurred when the microswitch was present or absent and, for 2 of the children, if changes in resurgence occurred at different points in treatment. Results showed that FCT led to relatively rapid reductions in destructive behavior. During all extinction sessions, resurgence of destructive behavior occurred with only minimal differences across the switch/no card and no-switch conditions.

Key words: functional communication training, resurgence, negative reinforcement

The interaction of current contingencies with an organism's behavioral history is an issue of increasing importance in applied behavior analysis (Lattal & St. Peter Pipkin, 2009; St. Peter Pipkin & Vollmer, 2009). The recurrence of previously established behavior has long been implicated in common clinical conditions, including autism (e.g., Miller & Neuringer, 2000) and depression (e.g., Seligman, 1975). History effects may also account for behavioral variability, such as treatment relapse, which is characteristic of many clinical complaints (Shahan & Chase, 2002; Shahan & Sweeney, 2011; St. Peter Pipkin, Vollmer, & Sloman, 2010; Volkert, Lerman, Call, & Trosclair-Lasserre, 2009). However, despite the applied implication of history effects, few studies have been conducted with socially meaningful behavior (cf. St. Peter Pipkin & Vollmer, 2009) or with persons with disabilities (cf. Lionello-DeNolf, Dube, & McIlvane, 2010; Wacker et al., 2011).

One such history effect is resurgence, the recurrence of previously reinforced behavior when another behavior is exposed to extinction (Cancado & Lattal, 2011; Lieving, Hagopian, Long, & O'Connor, 2004). To evaluate resurgence (Lattal & St. Peter Pipkin,

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2009), three conditions are typically assessed in sequential order. First, a response (A) is reinforced. Second, Response A is put on extinction while a second response (B) is reinforced. This may occur using simultaneous extinction/reinforcement schedules (e.g., Epstein, 1985; Lieving & Lattal, 2003, Experiments 2–4; Reed & Morgan, 2006, 2007), by extinguishing Response A prior to introducing reinforcement for Response B (e.g., Epstein, 1983; Lieving & Lattal, 2003, Experiment 1) or, more recently, by using differential reinforcement of other behavior for Response A in the second phase (e.g., Doughty, da Silva, & Lattal, 2007). Finally, both A and B are placed on extinction. Resurgence occurs if Response A, in the third condition, is observed at levels that exceed those observed in the prior condition. For example, Epstein (1983) first reinforced pigeons' key pecking (A), then extinguished key pecking and reinforced wing flapping (B), and then exposed wing flapping to extinction. In the final condition, key pecking resurged (i.e., occurred at levels greater than those observed in the prior phase) in the absence of reinforcement.

Resurgence has been reliably demonstrated in basic studies with non-humans (e.g., Bacha-Mendez, Reid, & Mendoza-Soylovna, 2007; Baron & Leinenweber, 1995; da Silva, Maxwell, & Lattal, 2008; Doughty et al., 2007; Epstein, 1983, 1985; Freeman & Lattal, 1992; Leitenberg, Rawson, & Mulick, 1975; Reed & Morgan, 2006, 2007; Tatham & Wanchisen, 1998). Resurgence as a trained experimental effect also has been shown with humans using extinction procedures for sequences of keystrokes (Mechner & Jones, 2001), relational responding (Wilson & Hayes, 1996), and rule following (Dixon & Hayes, 1998). Although such studies presented compelling initial evidence of history effects with humans, they did not examine behavior in the context of treatment. However, the applied implications of resurgence are extensive in that studies of resurgence may provide a basis for understanding the recurrence of previously treated problem behavior over the course of treatment (e.g., during problems of treatment integrity; St. Peter Pipkin et al., 2010; Volkert et al., 2009).

Three studies have investigated resurgence in relation to the treatment of problem behavior. First, Lieving et al. (2004) examined resurgence of problem behavior for two children who displayed multiple topographies of problem behavior maintained by access to tangibles (positive reinforcement). In a three-phase study, one topography of problem behavior (e.g., disruption) was first reinforced (Phase 1) and then placed on extinction while an alternative problem behavior (e.g., aggression) continued to be reinforced (Phase 2). In the third phase (Phase 3), both topographies of problem behavior were placed on extinction and the initial response (e.g., disruption) re-emerged. This study provided an initial translation of resurgence procedures to the treatment of problem behavior.

Second, Volkert et al. (2009) extended the applied literature by showing that resurgence can also occur with problem behavior maintained by negative reinforcement. These investigators examined resurgence during functional communication training (FCT), in which problem behavior was placed on extinction and alternative behavior (communication) was trained simultaneously. Participants were five children with problem behavior maintained by escape, avoidance, or both. In the first experiment, resurgence was observed with two of three participants by using a repeated ABC (baseline, treatment, extinction) design. The functional analysis condition associated with the highest rates of problem behavior served as the baseline condition in which problem behavior was reinforced. In a second experiment, similar levels of resurgence were demonstrated for all participants under thinned non-extinction schedules (i.e., fixed ratio [FR] 12). Volkert et al. also showed that resurgence continued to occur despite repeated exposures to extinction, replicating findings from basic research (da Silva, Maxwell, & Lattal, 2008; Lieving & Lattal, 2003). These results presented initial data on resurgence in applied settings and under treatment conditions that may be functionally similar to extinction (i.e., thin reinforcement schedules). Unlike basic studies, Volkert et al. used a functional analysis condition as the baseline and did not include a pretreatment exposure to extinction.

Third, St. Peter Pipkin et al. (2010; Experiment 3) reported similar findings in that resurgence of problem behavior occurred when reinforcement for an alternative response was provided with poor integrity following a differential reinforcement of alternative

behavior (DRA) treatment. They further showed possible sequence effects during treatment implementation, suggesting that patterns of resurgence may vary over the long-term course of treatment.

As described by Lattal and St. Peter Pipkin (2009), variables associated with response resurgence have not been investigated in terms of response maintenance during intervention programs. Although the basic phenomenon is well established and initial applications have been successful in documenting resurgence, it remains unclear to what extent resurgence is related to variables other than extinction, such as the presence of correlated stimuli associated with historical contingencies (St. Peter Pipkin & Vollmer, 2009). Attempts to examine the role of correlated stimuli have yielded mixed results. For example, Ono and Iwabuchi (1997) trained pigeons on schedules that resulted in either high (differential reinforcement of high rate behavior [DRH]) or low (differential reinforcement of low rate behavior [DRL]) rates of responding. Later, the pigeons continued to respond at higher rates in the presence of stimuli associated with the DRH schedule, even when training was interrupted by either new training (15 sessions of variable-interval schedules) or a 6-month time difference. The effect of stimulus control decreased gradually over time.

Similarly, Doughty et al. (2007; Experiment 2) trained three pigeons to peck colored keys corresponding to either variable-interval or extinction schedules. The resurgence procedure was then implemented twice for each pigeon. If resurgence were subject to stimulus control, it would occur in the presence of key colors previously associated with reinforcement. However, results were inconsistent for the presence of resurgence: Some pigeons showed resurgence during both sessions, whereas others showed resurgence during only the initial session. Taken together, these studies suggest that further analysis of the effects of stimuli correlated with reinforcement on resurgence (e.g., St. Peter Pipkin & Vollmer, 2009) is needed in applied contexts.

The purpose of the present study was to further extend applied analyses of response resurgence within the context of treatment of destructive behavior maintained, at least in part, by negative reinforcement. Three children received FCT to reduce destructive behavior. During FCT, a mand card attached to a microswitch signaled the availability of negative reinforcement in the form of enriched breaks from demands via manding. Prior to FCT and intermittently throughout treatment for two of three children, extinction conditions were conducted with and without the microswitch and/or the mand card to determine (a) if differential effects on both the resurgence of destructive behavior and the persistence of adaptive behavior (manding and task completion) occurred in the presence or absence of these stimuli used for manding during training and (b) if repeated exposure to extinction for two of the participants resulted in different patterns of resurgence. As mentioned previously, basic (Lieving & Lattal, 2003) and applied (Volkert et al., 2009) studies showed that multiple exposures to extinction did not affect resurgence. More recently, however, Wacker et al. (2011) showed that although repeated exposure to extinction, combined with reinforcement for alternative behavior, did not initially affect resurgence, long-term repeated exposures to extinction combined with reinforcement for alternative behaviors (manding and task completion) eventually reduced resurgence to zero or near-zero levels for young children with disabilities. Further evaluation of repeated exposure to extinction thus seemed warranted. For all three children in the present study, these effects were evaluated during long-term (6- to 9-month) FCT, and for two of three children, they were evaluated during demand fading within FCT.

Method

Participants and Settings

The participants in this investigation were three young children who were enrolled in a federally funded research project (Wacker, Berg, & Harding, 2004). Criteria for participation in the current study were that (a) the child be 6 years of age or younger,

(b) the child be diagnosed with a developmental disability, (c) the child's destructive behavior occur during the escape condition of a functional analysis, and (d) the child's parents provide informed consent. Rose was 3 years 4 months old and was diagnosed with mild intellectual disability. Kurt was 2 years 4 months old and was diagnosed with mild intellectual disability. Jasper was 1 year 8 months old and was diagnosed with developmental delays. Communication for all three children consisted primarily of single words (e.g., "Ma," "no"). All three children engaged in self-injury, aggression, and property destruction. All assessment and treatment procedures were conducted in the living room of the children's homes. The children's mothers served as therapists with coaching from the investigators during all procedures, with the exception of daily FCT practice sessions, during which the experimenters were not present. All sessions were videotaped for data collection and analysis during weekly to monthly 1-hr visits by investigators. All three children's functional and mand analysis results were presented in Schieltz et al. (2010). Rose's destructive behavior during the functional analysis and the proportions of baseline destructive behavior during extinction and FCT were presented in Wacker et al. (2011).

Response Definitions

A 6-s partial-interval recording system was used to measure child behavior. *Self-injury* was defined as any behavior that produced or could produce tissue damage on the child (e.g., head banging). *Aggression* was defined as any behavior that produced or could produce tissue damage on another person (e.g., hitting). *Property destruction* was defined as any behavior that damaged or could damage items in the home (e.g., throwing toys). For the purpose of this investigation, intervals of aggression, self-injury, and property destruction were combined and labeled as *destructive behavior. Independent target manding* was defined as saying "play," emitting the manual sign for "play," or touching a microswitch without physical assistance or a specific prompt instructing the child what to say or do. *Other independent manding* was defined as the child emitting a word or manual sign that indicated he or she wanted a break from the assigned task (e.g., saying, "Done") without physical assistance or a specific prompt instructing the child what to say or do. For the purpose of this investigation, intervals of target and other manding were combined and labeled as *independent manding*. Event recording was used to measure child task completion. *Independent task completion* was defined as the child's compliance with required work activities (e.g., picking up blocks) without physical guidance.

Materials

Parents were given a BIGmack® microswitch recording device and a 10.16 cm × 10.16 cm mand card created with BoardMaker® as an augmentative communication strategy during FCT. The card displayed the word *play* and a drawing of a child surrounded by toys. During all FCT sessions, the card was taped to the touch plate of the microswitch. The parents programmed the microswitch to say, "Play, please," when the card on the microswitch was touched. The card and microswitch were used as visual stimuli that signaled that reinforcement, in the form of an enriched break, was available for appropriate manding and also enabled the children to mand for reinforcement without vocalizing or manual signing.

Interobserver Agreement

Trained data collectors independently coded the occurrence of child behavior using a 6-s partial-interval recording system. Interobserver agreement for the occurrence of behavior was calculated based on exact interval-by-interval comparisons in which the number of agreements was divided by the number of agreements plus disagreements and multiplied by 100. Interobserver agreement for child behaviors was assessed for 30% of

each session (except for two sessions that were inadvertently erased) and averaged 96.9% (range: 90% to 100%). Data collectors coded the occurrence of task completion using an event-recording procedure in which the child's response to an adult task request was recorded as (a) independent task completion (no physical assistance), (b) task not completed, or (c) task completed with physical assistance. Interobserver agreement was calculated based on event-by-event comparisons in which the number of agreements was divided by the number of agreements plus disagreements and multiplied by 100. Interobserver agreement for task completion was assessed for 30% of each session and was 100%.

Interobserver agreement was also obtained for the independent variables manipulated by the parents (i.e., treatment integrity). Treatment integrity was analyzed on a trial-by-trial basis for the functional analysis, mand analysis, extinction analysis, and FCT. Procedures for analyzing treatment integrity for the functional analysis and mand analysis are reported in Schieltz et al. (2010). For extinction, treatment integrity was determined to occur when reinforcement was not provided contingently for the occurrence of destructive behavior, independent manding, or task completion. For FCT, treatment integrity was determined to occur based on two criteria: (a) Reinforcement was not provided contingently for the occurrence of destructive behavior and (b) reinforcement was provided contingently for the occurrence of a two-step chain that consisted of independent task completion followed by independent manding. Treatment integrity data for the functional and mand analyses are provided in Schieltz et al. (2010). For the extinction analysis and FCT conditions, treatment integrity across children was 100%.

Interobserver agreement was obtained for treatment integrity data. These data for the functional and mand analyses are provided in Schieltz et al. (2010). For the extinction and FCT conditions across children, treatment integrity was assessed for 100% and 31% of sessions, respectively, and averaged 100% and 99% (range: 99% to 100%).

Experimental Design

The investigation was conducted in three phases. During Phase 1, a functional analysis similar to that described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994) was conducted within a multielement design to identify the maintaining variables for destructive behavior. During Phase 2, a mand analysis was conducted within a multielement design. The conditions of the mand analysis were the same as for the escape and free-play conditions of the functional analysis, except that manding was reinforced on an FR 1 schedule and destructive behavior was placed on extinction during the escape condition. During Phase 3, extinction and FCT conditions were conducted within a reversal design to evaluate the occurrence of destructive behavior, manding, and task completion over the long-term course of treatment. Two extinction conditions (switch present or absent) were conducted initially within a multielement design to evaluate the occurrence of destructive and appropriate behavior in the absence of programmed contingencies. These same extinction conditions were repeated intermittently throughout treatment to evaluate whether changes in behavior occurred over the course of treatment. For two children (Rose and Jasper), demand fading occurred; that is, the number of tasks the child was required to complete increased from two to eight. Demand fading did not occur for Kurt because his participation in the investigation was discontinued.

Procedures

Phase 1: Functional analysis. Functional analyses were conducted by parents with investigator coaching and were completed over an average period of 4 weeks (range: 3 to 5 weeks). An average of 14 sessions (range: 13 to 16 sessions) was conducted for each child's analysis. During the functional analysis, four assessment conditions were conducted to identify the maintaining variables for destructive behavior. Please see Schieltz et al. (2010) for a more comprehensive description of these procedures. During the escape condition, the parent used a least-to-most restrictive prompt hierarchy to guide the child in completing

a task. The task was an activity with a nonpreferred toy identified during a free-operant preference assessment (Roane, Vollmer, Ringdahl, & Marcus, 1998). For Rose and Kurt, the task was picking up blocks. For Jasper, the task was placing puzzle pieces in a puzzle board. If the child engaged in destructive behavior following task instructions, then the task was removed for 20 s. The child received continuous access to attention during the escape condition. During the attention condition, the child had access to toys while the parent diverted her attention from the child (e.g., read a magazine). If the child engaged in destructive behavior, the parent provided attention in the form of reprimands (e.g., "Stop doing that") and redirected the child to play activities for 20 s. During the tangible condition, the child (a) was allowed to play with a preferred toy that was identified during the preference assessment and (b) had access to noncontingent attention. After a brief period of play, the preferred toy was removed and the child was given the same less preferred toy used in the escape condition. If the child engaged in destructive behavior, the preferred toy was returned for 20 s. During the free-play condition, the child had continuous access to parent attention and preferred toys, and the parent avoided making any demands. Sessions were counterbalanced and lasted 5 min.

Phase 2: Mand analysis. Following the functional analysis, an analysis of mands was conducted by each child's parent with investigator coaching (see Schieltz et al., 2010, for a complete description of this analysis). The mand analysis was conducted over an average period of 4 weeks. During the mand analysis, escape and free-play assessment conditions were conducted. Prior to the implementation of each escape session, the child was shown the microswitch with the word card and was directed to touch the device, which was followed by reinforcement. This was the only training provided to the child. The escape condition was conducted in the same manner as the functional analysis, except that independent manding resulted in negative reinforcement, whereas destructive behavior was placed on extinction. During the escape condition, the parent presented the microswitch with the word card and the task materials to the child and asked if the child wanted to work or play. Thus, the child could avoid all work. Independent manding resulted in play and the removal of the task materials for 20 s (i.e., enriched break). If the child did not mand, then he or she had to complete a task. During the free-play condition, touching the microswitch did not result in programmed consequences. The microswitch did not play a prerecorded message or have an attached word card indicating a relevant reinforcer. Sessions were counterbalanced and lasted 5 min.

Phase 3: Extinction conditions. Two extinction conditions (switch and no switch) were conducted by parents to evaluate the occurrence of destructive behavior, manding, and task completion prior to treatment (initial extinction) and during the course of treatment. The initial extinction condition also served as the first evaluation of resurgence given that extinction immediately followed the mand analysis in which participants' mands produced enriched breaks (i.e., breaks to play). We repeated the extinction condition over the course of FCT (a) to determine if resurgence of destructive behavior occurred or if compliance to parent requests and manding persisted during brief periods of extinction and (b) to determine if resurgence effects changed with repeated exposure to the extinction conditions.

During the switch condition, an unprogrammed microswitch without the word card (except for the first three sessions for Rose in which the word card was mistakenly left on the switch) was present with the child's task materials. If the child touched the switch, no sounds were emitted and no programmed consequences followed this response. Similarly, independent displays of other mands, such as vocal mands, produced no programmed consequences. During the no-switch condition, the microswitch and word card were both absent. All other components of the conditions were identical. The parent presented the same task demand that was related to destructive behavior during the functional analysis escape condition. Task demands were presented in a series of 30-s trials. The parent presented the task to the child (e.g., "Put the red block in the bucket") and modeled the appropriate response but did not provide additional physical assistance. If the child did not engage in the task, the parent repeated the instructions and kept the task in front of the

child. If the child completed the task, the parent provided praise. If the child did not complete the task within 30 s, the parent re-presented a version of the task (e.g., "Put the green block in the bucket"). Destructive behavior was blocked in a neutral fashion (i.e., no discussion or reprimands). Vocal manding or touching the microswitch produced no programmed consequences. During extinction, the children were asked to complete an average of 10 tasks per session (range: 8 to 11 tasks per session). All sessions lasted 5 min. The average mean duration between the last functional analysis session and the first extinction session was 3.6 months and ranged from 2 months (Rose) to almost 6 months (Kurt).

FCT. One to three FCT sessions were conducted during weekly visits. Overall, FCT sessions were conducted for an average of 8 months (range: 6 to 9 months) across children. The average number of FCT sessions conducted across children was 45 (range: 28 to 65 sessions). All FCT treatment sessions lasted 5 min.

Parents were asked to practice FCT using the card/microswitch for 10 to 15 min per day at a time that was convenient for them. However, no independent verification was conducted to confirm that these practice sessions occurred. The investigators provided written directions on conducting the procedure, demonstrated FCT procedures, and provided prescriptive feedback during and after FCT treatment sessions (Harding, Wacker, Berg, Lee, & Dolezal, 2009). Throughout FCT, the investigators reviewed graphic representations of the child's progress with the parent.

During FCT, the child was taught to comply with the parent's request and then to mand for a break to play with toys. Therefore, the child was required to complete a two-step chain in which compliance produced the microswitch with the card and manding produced a brief (1- to 2-min) enriched break with attention and preferred toys. Each FCT session began with the parent providing attention to the child while the parent and child played with preferred toys for 20 to 30 s. After a brief period of play, the parent showed the child a card presenting the word *work* and told the child, "Time to work. When we're done, you can play." Kurt and Jasper were directed to sit at a desk during their work tasks, whereas Rose completed her work task while sitting on the floor. If the child refused to stop playing and go to the work area, the parent physically guided the child. When the child was seated, the parent gave specific directions and modeled how to complete the task. If the child completed the task, he or she received praise and the microswitch was presented in front of the child. If the child did not attempt to complete the task or engaged in destructive behavior, the parent provided hand-over-hand physical guidance. The child was then given another task to complete without assistance. During initial sessions, each child was required to complete two tasks independently during each session (FCT 2). The requirements were divided into two trials (one task per trial). The objective was to reduce the response effort associated with compliance and provide a relatively quick opportunity for the child to mand for reinforcement. As the child's performance improved, work requirements were gradually increased for Rose and Jasper to completing four (two tasks per trial) and then eight (four tasks per trial) task requests during each session.

After the child completed the FR requirement independently, the parent presented the microswitch to the child and said, "More work or play?" If the child emitted the target mand or other functionally equivalent mand, the child received praise (e.g., "Thank you for telling me!"). If the child did not emit an appropriate mand but also did not emit destructive behavior, the parent provided a more specific prompt, such as, "Say, 'play'" or "Touch the switch if you want to play," or gave hand-over-hand assistance in touching the switch. After manding appropriately, the child received a 1- to 2-min break to play with toys with the parent. Mands that were displayed following physical assistance or specific verbal prompts were reinforced but were not included in calculations or graphic depictions of independent manding. An investigator cued the parent when the reinforcement period was over, and the parent again directed the child to the work task.

During FCT sessions, destructive behavior during work activities was blocked in a neutral fashion and the child was not allowed to escape from the work task. If the child

engaged in destructive behavior during break activities, the break ended and the child was required to return to work. Mild disruptive behavior such as crying or whining was ignored. Please see Harding et al. (2009) for a more comprehensive description of these procedures.

Return to extinction. Extinction conditions were reintroduced following FCT to evaluate the resurgence of destructive behavior and the persistence of previously reinforced behavior (manding and task completion). Extinction conditions were repeated following consistent reductions in destructive behavior and increases in task completion (from initial extinction sessions) for at least three sessions of FCT. Extinction conditions were repeated two times for Rose, three times for Jasper, and one time for Kurt during the course of FCT. During each return to extinction, the switch and no-switch conditions were each repeated at least three times to evaluate if differential results occurred for these two conditions.

Results

The results of the functional analyses are displayed in Figure 1. As shown in Figure 1, destructive behavior was maintained, at least in part, by escape from demands. However, for each participant, destructive behavior was also sensitive to positive reinforcement.

The results for the mand analysis (Phase 2) are provided in Figure 2. For Rose, independent manding averaged 10% of the intervals (range: 6% to 12%; 100% target mands) during the escape condition and 0% during free play. Thus, manding was responsive to the negative reinforcement contingency, and responding was differentiated between the escape and free-play conditions. Destructive behavior rarely occurred (M = 3.3% of intervals) and occurred during only the escape condition. For Jasper, independent manding averaged 19.3% (range: 18% to 20%; 100% target mands) during the escape condition and 0% during free play. Thus, similar to Rose, manding was responsive to the negative reinforcement contingency and occurred in a differentiated pattern between the escape and free-play conditions. Destructive behavior was at 0% during free play but occurred an average of 7.3% (range: 0% to 22%) during the escape condition. A decreasing trend occurred for destructive behavior such that destructive behavior did not occur during the final two escape sessions. For Kurt, independent manding averaged 13.3% (range: 10% to 20%; 100% target mands) during the escape condition and 1% (range: 0% to 4%; 100% target mands) during the free-play condition. Unlike the other two participants, Kurt continued to engage in destructive behavior (M = 17.3%) during the escape condition but rarely during the free-play condition (M = 1%).

Rose

The results for Phase 3 for Rose are shown in Figure 3. During the initial extinction conditions, destructive behavior (top panel) averaged 10% of the intervals (range: 4% to 14%) during the switch (with card) condition and 6.7% (range: 2% to 12%) during the no-switch condition. Thus, resurgence of destructive behavior occurred with both switch present and switch absent. Independent manding (middle panel) was at 0% during both the switch and the no-switch conditions. Independent task completion (bottom panel) averaged 67% of tasks presented (range: 10% to 100%) during the switch condition and was at 100% during the no-switch condition.

During FCT (2), in which two tasks were completed independently during each session, destructive behavior decreased, whereas manding increased (M = 4.6%; range: 4% to 6%; 100% target mands) and independent task completion became stable. After 6 to 7 weeks (48 days), we repeated the extinction conditions (Sessions 14 to 19). Rose's destructive behavior increased in an undifferentiated pattern during both the switch (without card) and the no-switch conditions. Manding was at 0% during the no-switch condition and showed an increasing trend during the switch condition (M = 4%; range: 0 to 10%; 100% target mands). Task completion remained relatively high across conditions. When we returned to FCT (2), destructive behavior immediately decreased, manding

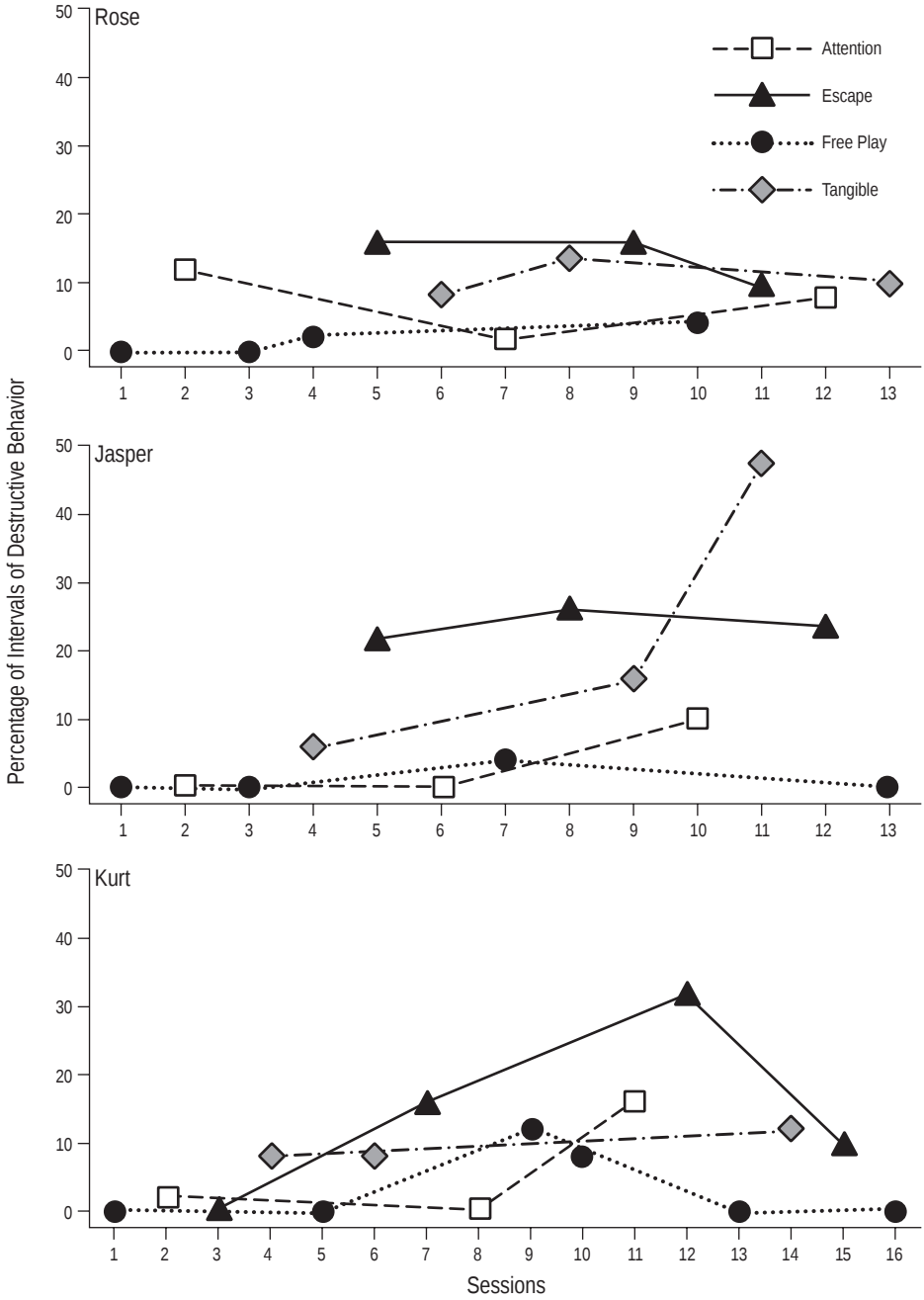

Figure 1. Percentage of intervals of destructive behavior for Rose (top panel), Jasper (middle panel), and Kurt (bottom panel) during the functional analysis.

became stable (*M* = 4%; 100% target mands), and task completion increased to 100%. Similar levels of problem behavior, independent manding, and task completion were observed when the FCT requirement was thinned to FCT (4) and FCT (8).

Approximately 5 months (165 days) after the beginning of treatment, we again repeated the extinction conditions with Rose. Destructive behavior again showed resurgence in an undifferentiated pattern during both the switch and the no-switch

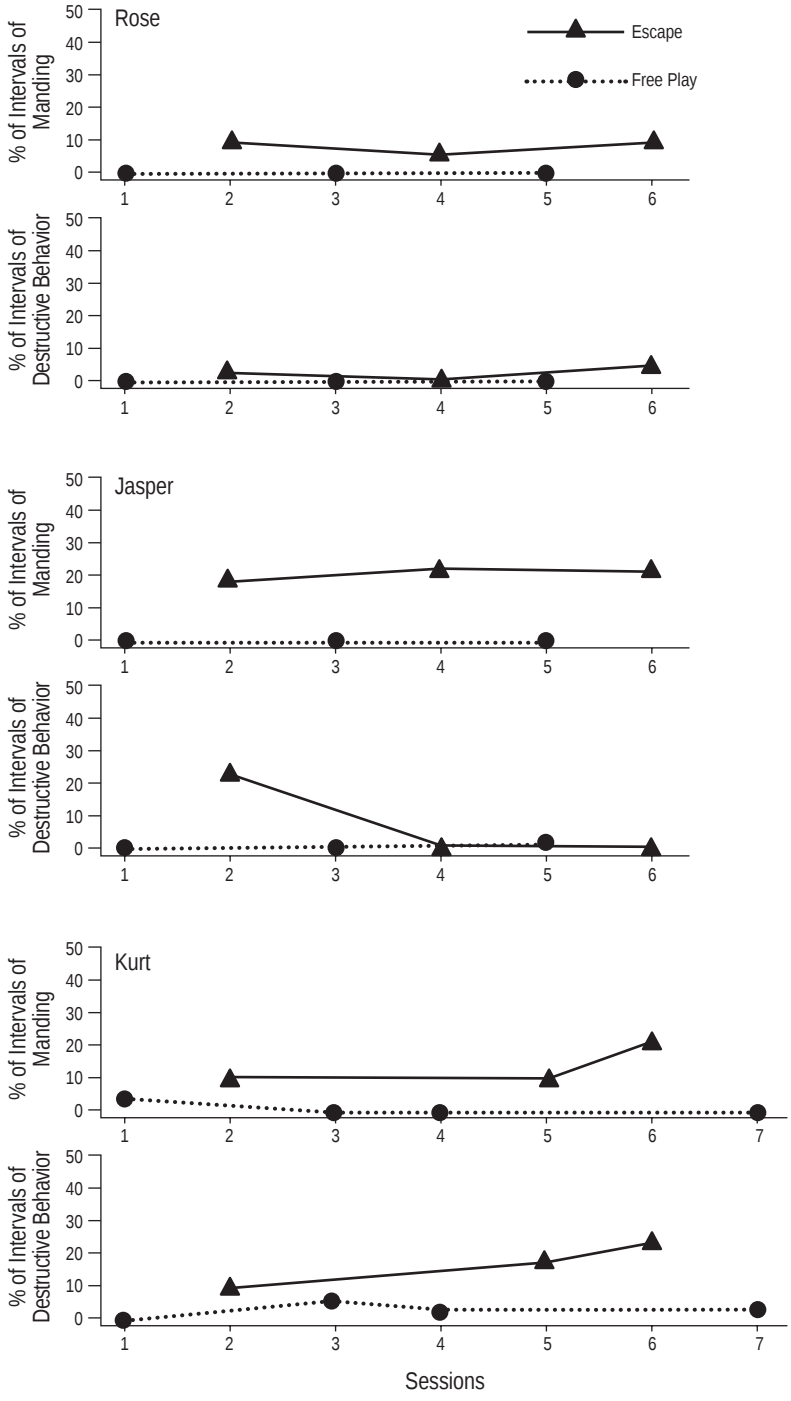

Figure 2. Percentage of intervals of independent manding and destructive behavior during the mand analysis for Rose (top panel), Jasper (middle panel), and Kurt (bottom panel).

conditions but at lower levels than during the previous extinction condition. Manding occurred once during the no-switch condition (Session 37; other mand) and once during the switch condition (Session 38; target mand). Task completion during both conditions

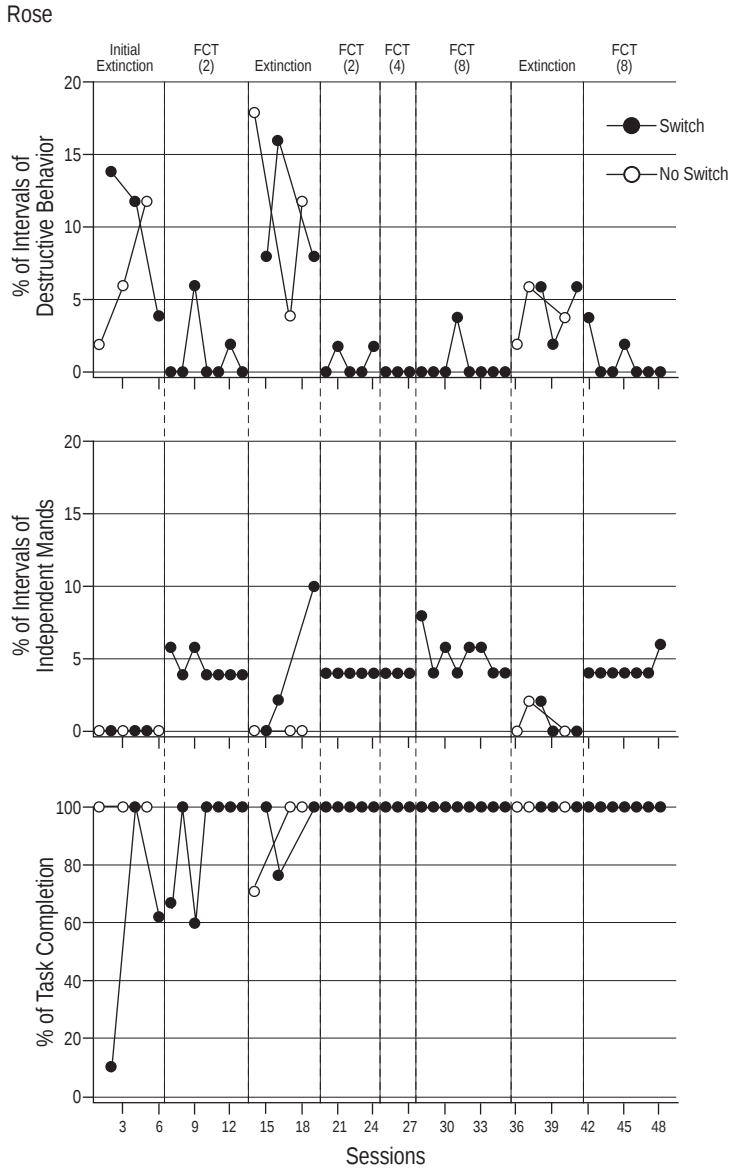

Figure 3. Percentage of intervals of destructive behavior (top panel), percentage of intervals of independent mands (middle panel), and percentage of task completion (bottom panel) during functional communication training (FCT) switch and no-switch conditions for Rose.

persisted at 100%. During the final return to FCT (8), destructive behavior decreased to zero and near-zero levels, manding increased to stable levels (M = 4.3%; range: 4% to 6%; 100% target mands), and task completion remained at 100%.

For Rose, each return to the extinction conditions resulted in the resurgence of destructive behavior and a decrease in manding (with the exception of Session 19). Independent task completion remained at 100% during both the no-switch conditions (with the exception of Session 14 at 71%) and the switch conditions (with the exception of Session 16 at 75%). Overall, no differences between the switch and no-switch conditions were discriminable throughout the investigation, but resurgence occurred at lower levels during the final return to extinction.

Jasper

The results for Jasper are shown in Figure 4. During the initial extinction conditions, destructive behavior (top panel) averaged 24% of the intervals (range: 18% to 42%) during the switch condition and 40.7% (range: 38% to 46%) during the no-switch condition. Similar to the pattern for Rose, resurgence of destructive behavior occurred in an undifferentiated pattern across the switch and no-switch conditions. Independent manding (middle panel) averaged 12.7% of the intervals (range: 2% to 18%; 68.4% target mands) during the switch condition and 10% (range: 6% to 16%; 0% target mands) during the no-switch condition. Independent task completion (bottom panel) averaged 36% of the tasks presented (range: 25% to 55%) during the switch condition and was at 0% during the no-switch condition.

During FCT (2), destructive behavior decreased to 0% during the final three sessions. Manding became relatively stable (M = 5.1%; range: 0% to 12%; 64.3% target mands), and independent task completion increased to 100%. Seven to eight weeks (55 days) after the beginning of FCT, we repeated the extinction conditions (Sessions 18 to 23). Jasper's destructive behavior increased during both the switch and the no-switch conditions but occurred more often during the no-switch condition. Manding occurred once during the switch (Session 18; target mand) and no-switch (Session 21; other mand) conditions. Task completion decreased substantially during the no-switch condition and to a lesser degree during the switch condition. During the return to FCT (2), destructive behavior immediately decreased to 0%, manding increased to stable levels (M = 6.7%; range: 4% to 8%; 100% target mands), and task completion increased to 100%. Like Rose, similar levels of problem behavior, independent manding, and task completion were observed when the FCT requirement was thinned to FCT (4) and FCT (8).

Approximately 5 months (151 days) after the beginning of treatment, we repeated the extinction conditions with Jasper. Destructive behavior again showed resurgence but in an undifferentiated pattern across the switch and the no-switch conditions. Manding increased during both the switch (M = 23.5%; range: 14% to 44%; 17% target mands) and the no-switch conditions (M = 12%; range: 6% to 18%; 0% target mands) from FCT levels. Task completion again decreased during both conditions, with a more substantial decrease evident during the switch condition.

During the return to FCT (8), destructive behavior decreased. Manding decreased to levels that were expected given the schedule of reinforcement (M = 8.4%; range: 4% to 14%; 86.8% target mands), and task completion increased to high levels (80% to 100%).

A final return to the extinction condition was conducted approximately 7 months (220 days) after the beginning of treatment. In a manner similar to the previous extinction conditions, Jasper displayed an overall increase in destructive behavior from the previous FCT condition but at lower levels than the initial extinction condition, and responding was undifferentiated between the switch and no-switch conditions. Manding again increased from prior FCT levels during the switch condition (M = 18.7%; range: 0% to 36%; 7.1% target mands) and was comparable during the no-switch condition (M = 14.7%; range: 2% to 36%; 9.1% target mands). Task completion was variable (M = 58%; range: 18% to 100%) during the switch condition and showed an increasing trend during the no-switch condition (M = 51.7%; range: 0% to 91%).

During the final return to FCT (8), Jasper displayed a decrease in destructive behavior with the exception of Sessions 64 and 65. Manding remained at relatively stable levels (M = 7.3%; range: 4% to 14%; 90% target mands), and task completion increased to 100% (with the exception of Session 65).

For Jasper, each return to the extinction conditions resulted in the resurgence of destructive behavior. Initially, discriminable differences occurred between the switch and no-switch conditions, but the pattern of responding was undifferentiated during the final two returns to extinction. Overall reductions in destructive behavior occurred from the initial to the final extinction conditions, and task completion increased during both the switch and the no-switch conditions.

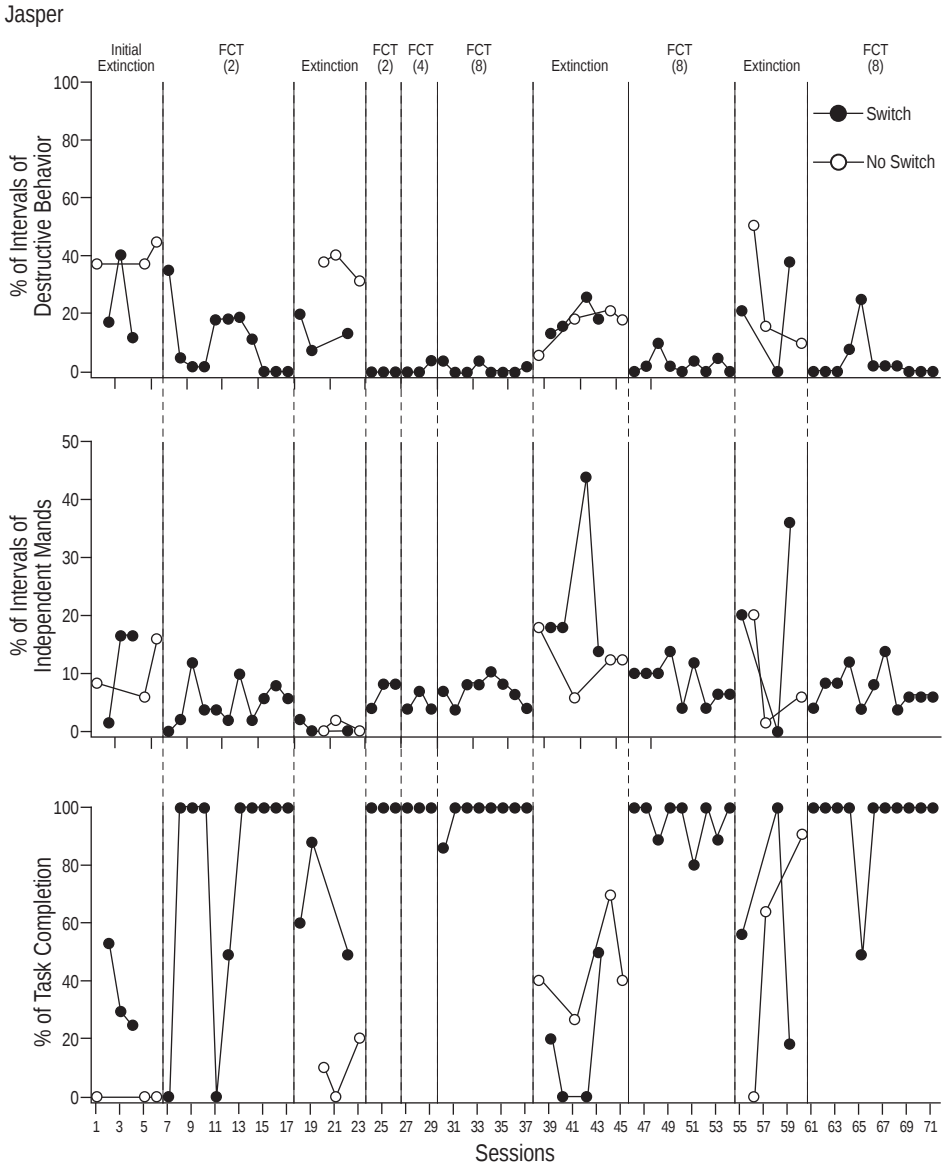

Figure 4. Percentage of intervals of destructive behavior (top panel), percentage of intervals of independent mands (middle panel), and percentage of task completion (bottom panel) during functional communication training (FCT) switch and no-switch conditions for Jasper.

Kurt

The results for Kurt are shown in Figure 5. During the initial extinction conditions, destructive behavior (top panel) averaged 34% of the intervals (range: 26% to 42%) during the switch condition and 34.5% (range: 20% to 40%) during the no-switch condition and occurred in an undifferentiated pattern. Independent manding (middle panel) was at 0% during both the switch and the no-switch conditions. Independent task completion (bottom panel) averaged 17.7% of the intervals (range: 0% to 33%) during the switch condition and 36% (0% to 100%) during the no-switch condition.

During FCT (2), destructive behavior decreased, whereas manding (100% target mands) and independent task completion increased. After 9 weeks (64 days), we repeated

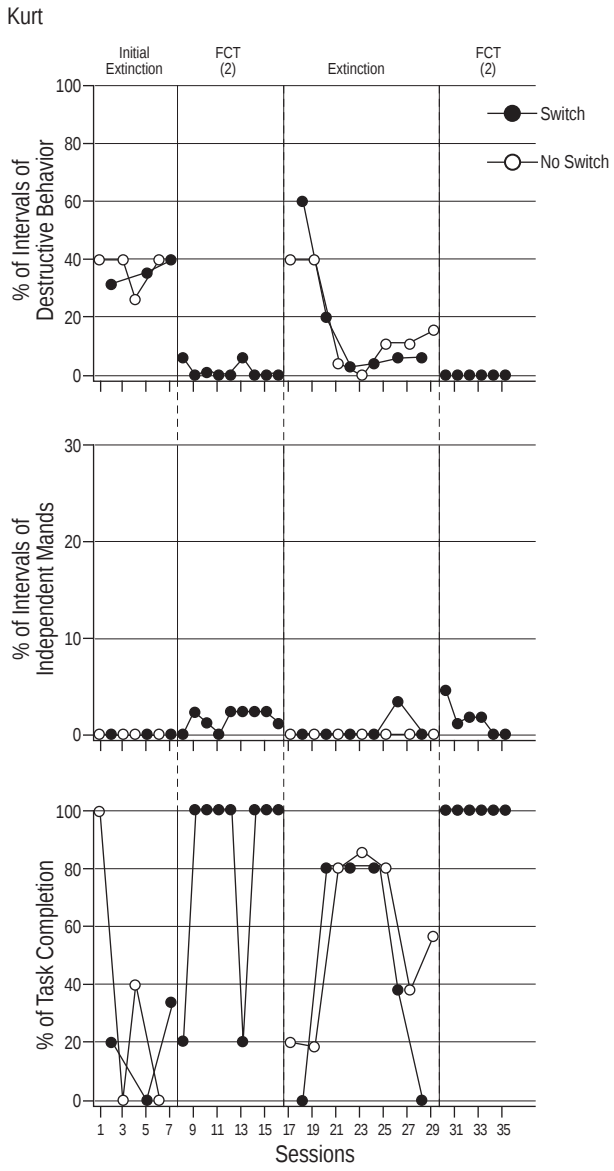

Figure 5. Percentage of intervals of destructive behavior (top panel), percentage of intervals of independent mands (middle panel), and percentage of task completion (bottom panel) during functional communication training (FCT) switch and no-switch conditions for Kurt.

the extinction conditions (Sessions 17 to 29). Kurt's destructive behavior increased initially during both the switch and the no-switch conditions, displayed a downward trend, and then showed an increasing trend in the no-switch condition. Independent manding was at 0% during the no-switch condition. Independent manding occurred at 0% during the switch condition, except for Session 26 (0% target mands). Task completion was variable across conditions but lower on average than during FCT (2). When we returned to FCT (2), destructive behavior immediately decreased, manding (100% target mands) showed a decreasing trend across sessions, and task completion increased to 100%.

Kurt's results were similar to those of Rose and Jasper in that destructive behavior occurred in an undifferentiated pattern across the switch and no-switch conditions. This

undifferentiated pattern occurred during extinction prior to and following FCT treatment, with similarly undifferentiated results occurring for both manding and task completion.

Discussion

The current results support previous findings (e.g., Volkert et al., 2009; Wacker et al., 2011) by showing that resurgence of negatively reinforced problem behavior does occur in treatment contexts with a DRA procedure and that the results may often occur over long-term treatment. In addition to showing the effects of extinction during the long-term course of treatment, the results extend the applied literature by showing that resurgence did not occur differentially in the presence of a correlated stimulus, the microswitch, and that resurgence of destructive behavior was not always correlated with the lack of persistence of adaptive behavior.

The current results are similar to those reported by Doughty et al. (2007), who showed resurgence under both (a) stimulus conditions that were previously paired with reinforcement and (b) stimulus conditions that were not paired with reinforcement. Although these results were inconsistent in Doughty et al.'s study across subjects, they were consistent across participants in the current study. All three children showed increased destructive behavior during the return to extinction conditions, regardless of the presence or absence of the microswitch. Resurgence of problem behavior continued to occur during the repeated returns to extinction for the two children exposed to those conditions. Although levels of destructive behavior were reduced during the final extinction conditions relative to the initial extinction conditions, resurgence continued to occur in an undifferentiated fashion across the switch and no-switch conditions. Thus, in the current study, resurgence appeared to be related to extinction and not to the antecedent stimuli paired with reinforcement. These results are consistent with Wacker et al. (2011) by showing that long-term treatment is often needed with DRA procedures to reduce the resurgence of destructive behavior during challenges to treatment. These results are consistent with the model of resurgence based on behavioral momentum proposed by Shahan and Sweeney (2011). As described by Nevin and Wacker (2013), and further shown by Mace et al. (2010), target behavior appears to persist in the reinforcement context within which it has historically been maintained. Following successful differential reinforcement treatment, even brief exposures to extinction often occasion increases in target behavior, and this persistence can continue for a very long time. As shown by Lieving et al. (2004), this may occur because the original target behavior and the alternative behavior are in the same response class. Thus, reinforcement of the alternative behavior has the unintended effect of reinforcing or strengthening the target behavior.

In the current study, participants received treatment in a context (at home with parent) that was likely related to a long history of reinforcement for problem behavior. Because we are not certain what parents were doing in between sessions, we also cannot rule out that ongoing reinforcement of problem behavior was occurring. Thus, our evaluation of resurgence may have been affected by these uncontrolled variables.

Other procedural changes across phases of the investigation may have affected our findings. For example, the microswitch with mand card was continuously available during Phase 2 but was presented following task compliance during Phase 3. The microswitch and card were always available during Phase 2 but only the microswitch was available during Phase 3. These procedural changes may have influenced the results in unknown ways. The focus of our study was on the microswitch itself, and even after relatively long periods of reinforced trials using the switch, no differentiated findings occurred during extinction.

Highly individualistic findings occurred relative to the relations of destructive behavior with manding and task completion. For Rose, resurgence continued to occur for destructive behavior during the second return to extinction conditions, task completion remained at 100%, and manding rarely occurred. Thus, only task completion persisted at

treatment levels during the second extinction conditions. For Jasper, resurgence of destructive behavior continued to occur, and neither manding nor task completion remained stable during the final two returns to extinction. Similar results occurred for Kurt during his return to extinction.

As mentioned previously, all three participants' destructive behavior was sensitive to both positive and negative reinforcement. Although our focus was on behavior maintained by escape from demands, the participants' behavior was multiply controlled, and during FCT, manding resulted in enriched breaks that included both preferred tangible stimuli and attention. It is unknown if similar levels of resurgence would have occurred with, for example, destructive behavior that was only sensitive to negative reinforcement or breaks that did not contain positive reinforcers.

The results of the current study and those of Wacker et al. (2011) support Mace et al. (2010) in showing that DRA treatments, such as FCT, can have the unintended effect of increasing the resistance of destructive behavior to extinction. For example, in the case example provided in Nevin and Wacker (2013), the participant's destructive behavior required substantial time in FCT before it failed to show resurgence. In contrast, task completion often showed the most persistence later in treatment when challenged by brief periods of extinction (Wacker et al., 2011) or changes in antecedent stimuli (Berg, Wacker, Harding, Ganzer, & Barretto, 2007).

Resurgence has been documented to be a potential problem for differential reinforcement treatment programs used to reduce the occurrence of problem behavior (e.g., Lieving et al., 2004; Mace et al., 2010; St. Peter Pipkin et al., 2010; Volkert et al., 2009; Wacker et al., 2011). As discussed by Lattal and St. Peter Pipkin (2009) and St. Peter Pipkin and Vollmer (2009), studies are needed on variables that are correlated with resurgence. In addition to studies of antecedent variables such as discriminative stimuli, studies comparing different schedules of reinforcement (Lieving & Lattal, 2003), durations of reinforcement history (Bruzek, Thompson, & Peters, 2009), and changes in stimulus context within which alternative behaviors are trained (Mace et al., 2010) might be conducted. The current study replicates previous studies in showing that resurgence can be a robust effect that is not always sensitive to either repeated exposures to extinction or changes in antecedent stimuli correlated with reinforcement.

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