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RENEWAL DURING FUNCTIONAL COMMUNICATION TRAINING

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Functional communication training (FCT) is one of the most commonly prescribed interventions for the treatment of severe destructive behavior exhibited by individuals with intellectual disabilities. Although highly effective, FCT has been shown to fail in some cases when treatment is introduced into the child's typical environment. Basic and translational research on renewal provides a model for studying the relapse of destructive behavior following successful response to treatment in clinic settings using FCT. In the present study, we evaluated whether relapse of destructive behavior could be attributed to the discriminative control of the home context, which was historically correlated with reinforcement for destructive behavior. We implemented baseline contingencies in the home setting with caregivers acting as interventionists (i.e., Context A). We then implemented FCT in a treatment clinic with trained therapists (i.e., Context B). Finally, we introduced FCT in the home setting with caregivers implementing the treatment procedures (i.e., return to Context A). For three of four participants we observed the relapse of destructive behavior consistent with operant renewal. We discuss the implications of these findings with respect to strategies designed to promote generalization of FCT across settings during the treatment of severe destructive behavior.

Key words: context, functional communication training, relapse, renewal

Functional communication training (FCT) is one of the most commonly prescribed treatments for severe destructive behavior exhibited by children with intellectual disabilities and autism spectrum disorder (ASD; Falcomata & Wacker, 2013; Tiger, Hanley, & Bruzek, 2008). When results of a functional analysis (FA) indicate that destructive behavior is maintained by social reinforcement, FCT typically involves withholding the reinforcer maintaining destructive behavior and providing it contingent upon a socially appropriate alternative response, termed the functional communication response (FCR). For example, if a child's destructive behavior is found to be maintained by escape from academic instructions, FCT might involve preventing escape for destructive behavior and teaching the child to request breaks vocally or through picture-exchange. This intervention has shown to be a highly effective (Kurtz et al., 2003; Matson, Dixon, & Matson, 2005), and reductions in destructive behavior from baseline have averaged 91%-94% when FCT is combined with reinforcement-schedule thinning (Greer, Fisher, Saini, Owen, & Jones, 2016; Jessel, Ingvarsson, Metras, Kirk, & Whipple, 2018).

Although FCT is highly effective, destructive behavior has shown to relapse in some cases following initial success (e.g., Volkert, Lerman, Call, & Trosclair-Lasserre, 2009; Wacker et al., 2013), and previous reports have suggested that low rates of behavior do not always maintain when FCT is implemented by caregivers in the typical environment (Schindler & Horner, 2005). Therefore, treatment relapse in FCT can be viewed as the failure to maintain treatment effects, or considerably diminished treatment effects, when environmental conditions change. That is, relapse during FCT could be regarded as the failure to generalize treatment gains across time, settings, situations, or individuals (Pritchard, Hoerger, & Mace, 2014). Indeed,

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difficulty in treatment generalization across settings has been demonstrated previously when FCT has been prescribed (Luczynski, Hanley, & Rodriguez, 2014; Schindler & Horner, 2005). As a result, the failure of FCT to transfer to other contexts or individuals has led to questions regarding the generality of intervention (Fisher, Greer, Fuhrman, & Querim, 2015).

Previous research has suggested that degradation in treatment integrity may be responsible for treatment relapse with caregivers (St. Peter Pipkin, Vollmer, & Sloman, 2010; Whitworth, Harris, & Jones, 1999). However, in other cases, destructive behavior appears to relapse even when treatment integrity is kept relatively high (Schindler & Horner, 2005). This finding suggests that the failure of FCT to generalize to other settings or situations may not simply be due to treatment integrity but could be due to other variables associated with treatment and nontreatment settings. One such variable is the context in which FCT is introduced versus the contexts in which destructive behavior has been historically reinforced. That is, it is possible that contextual and discriminative control play an important role in the relapse of severe destructive behavior.

Renewal is a model of recurrent behavior that has been studied extensively in the basic animal laboratory (Berry, Sweeney, & Odum, 2014; Bouton, Todd, Vurbic, & Winterbauer, 2011; Bouton, Winterbauer, & Todd, 2012; Crombag & Shaham, 2002; Kelley, Liddon, Ribeiro, Greif, & Podlesnik, 2015; Nakajima, Tanaka, Urushihara, & Imada, 2000; Podlesnik & Shahan, 2009; Todd, Vurbic, & Bouton, 2014). Operant renewal is typically evaluated in three phases. First, a target response (e.g., pressing a lever) is reinforced in the presence of one set of environmental contextual stimuli (i.e., Context A). Next, the target response is extinguished in the presence of a different set of environmental contextual stimuli (i.e., Context B). Finally, extinction is introduced into the training context (i.e., Context A), or a novel context (i.e., Context C). Recurrence of the target response when the initial training context is reintroduced (ABA) or a novel context is introduced (ABC) has been termed *renewal* and appears to occur despite previous response elimination. Thus, experimental control in renewal studies is not demonstrated with changes in behavior as a function of changes in reinforcement contingencies, but instead with changes in stimulus contexts (Bouton, 2002).

In applied settings, renewal could be viewed as a model of treatment relapse, which suggests that a change in the stimulus conditions or context is sufficient to produce the relapse of previously eliminated destructive behavior. The implication for treatments such as FCT from basic research is that destructive behavior learned in one context (e.g., aggression towards caregivers in the home setting) and eliminated through intervention in an alternative context (e.g., FCT with trained therapists in a clinic setting) could relapse upon returning to the original context (e.g., home setting), or entering a novel context (e.g., with teachers in a school setting), even when treatment integrity remains high. If the recurrence of behavior depends in part on the training context, as observed in basic studies of operant renewal, the effectiveness and generalization of behavioral treatments such as FCT might also depend on context.

Renewal of destructive behavior could have implications for the present understanding of treatment failure as it relates to generalization of behavior change (Johnston, 1979). That is, renewal during FCT could be highly relevant when considering generalization of treatment effects in a new or former context. Therefore, studies of operant renewal could promote a more nuanced understanding of the conditions under which the effects of behavioral interventions such as FCT generalize across contexts.

Recently, Kelley et al. (2015) described a three-pronged translational approach to the study of operant renewal relevant to applied

clinical practice. First, the process or concept is demonstrated in the nonhuman animal laboratory. Second, findings from the basic laboratory are translated to a human population under highly controlled conditions using simple response forms and primary reinforcers. Finally, the generality of findings from the first two prongs are evaluated in a third translation to target behaviors of social significance. Kelley et al. accomplished the first two goals of this approach by demonstrating renewal effects with both pigeons and children with ASD using the ABA renewal design. That is, recurrence was observed with both nonhuman animals and children when the context associated with reinforcement was reintroduced following extinction in an alternative context. In the Kelley et al. study, context was defined by different colored task materials and therapist clothing (e.g., yellow versus green); however, all sessions were conducted in an early behavioral intervention clinic, representing a consistent, larger environmental context.

Podlesnik and Kelley (2014, 2015) have suggested that relapse during the treatment of severe destructive behavior could be due to renewal because the individual is reexposed to contexts correlated with reinforcement of destructive behavior (see also Kelley et al., 2015; Podlesnik, Kelley, Jimenez-Gomez, & Bouton, 2017). Some results from the extant literature on severe destructive behavior appear to be consistent with this hypothesis in that transitory relapse of severe destructive behavior is sometimes observed when a setting correlated with reinforcement for destructive behavior is reintroduced (Fisher et al., 2015; Piazza, Hanley, & Fisher, 1996). For example, Schindler and Horner (2005) implemented FCT to reduce destructive behavior for three children diagnosed with ASD. Functional communication training was effective at reducing destructive behavior in the initial teaching setting (i.e., working one-on-one with a therapist at school), but not initially effective at producing generalized treatment effects in secondary settings (e.g., during a routine activity with caregivers at home).

Despite response patterns consistent with renewal reported in the treatment of severe destructive behavior, no studies have attributed relapse effects primarily to changes in stimulus contexts, and thus the validity of this claim has yet to be examined. Although renewal is typically studied using extinction during response elimination, extinction is seldom used alone as an intervention for severe destructive behavior. By contrast, FCT combined with extinction is prescribed abundantly (Tiger et al., 2008), is more effective at reducing destructive behavior than extinction alone (Shukla & Albin, 1996), and may be the optimal intervention to assess the generality of (i.e., translate) findings from the basic literature to areas of social significance. In fact, Volkert et al. (2009) used FCT to translate and demonstrate an alternative relapse phenomenon known as response resurgence from the basic laboratory to treatment for children who engage in severe destructive behavior. Therefore, the most appropriate clinical translation of renewal would be one in which FCT is used as an intervention for severe destructive behavior, high treatment integrity is maintained when FCT is implemented by caregivers, target behaviors are evaluated across socially meaningful contexts, and outcomes are consistent with basic and translational research on operant renewal. Relapse observed under these circumstances would strengthen the findings obtained by Kelley et al. (2015) and other human-laboratory preparations of renewal (e.g., Collins & Brandon, 2002; Vansteenwegen et al., 2006; Vervliet, Baeyens, van den Bergh, & Hermans, 2013).

The present study is translational in nature. We attempted to extend the findings of basic and translational research on renewal to the treatment of severe destructive behavior by replicating the effect with humans with clinically significant behavior in the context of a common

intervention for destructive behavior. Specifically, we implemented FCT as an intervention for destructive behavior and attempted to provide a systematic demonstration of treatment relapse that could be attributable to contextual control. We taught caregivers to implement baseline reinforcement contingencies in their home environment, implemented FCT in a clinic setting with trained therapists, and then introduced FCT into the home environment with caregivers acting as interventionists. We maintained high treatment integrity throughout to ensure that any relapse of destructive behaviors was most likely due to context.

METHOD

Participants

Four children referred to a university-based severe behavior disorders clinic participated. Sarah, an 8-year-old girl, Harry, an 8-year-old boy, Zack, an 8-year-old boy, and Mario, a 7-year-old boy were diagnosed with ASD. Sarah was also diagnosed with Down syndrome, and Zack was also diagnosed with attention-deficit/hyperactivity disorder. All participants were referred for the assessment and treatment of aggressive and disruptive behavior. Sarah, Harry, and Mario were also referred for the treatment of self-injurious behavior (SIB). Sarah communicated using sign language. Harry communicated using unintelligible vocal approximations, pointing, gesturing, or guiding others. Zack and Mario communicated using augmentative and alternative communication systems (e.g., Proloquo2Go, picture-exchange).

No participants had exposure to the clinic context prior to the onset of the study. For all participants for whom renewed behavior was observed, additional treatment components were added to FCT following study completion.

Setting and Materials

Functional analysis and baseline reinforcement contingencies were conducted in the home of each participant. Functional communication training was evaluated in both an outpatient clinic for severe destructive behavior and the home setting.

Home. Sessions were conducted in common living spaces in the child's home. The living spaces often contained couches, coffee tables, chairs, and occasionally other unrelated items (e.g., desk, television, desktop computer). The participant was confined to the room in which sessions were being conducted by closing entrance and exit doors but was otherwise able to move around the room freely. No participants engaged in destructive behavior as a result of this procedure. For participants for whom destructive behavior was maintained by access to tangible items, toys relevant to the child's home environment were placed in the room (e.g., Zack's favorite racing car as identified by his caregiver). For participants for whom destructive behavior was maintained by escape from instructions, materials relevant to demands that were typically delivered by caregivers (e.g., academic work materials or materials for household chores) were included in the room.

Clinic. Sessions took place in 3-m x 3-m therapy rooms equipped with a one-way intercom system and a one-way observation panel. Session rooms were padded on the walls and floors to minimize the risk of injury associated with destructive behavior. Furniture (e.g., table, chairs) was present in session rooms for all participants. The same tangible and instructional materials were used across both the home setting and clinic contexts.

Response Measurement

In the home setting, trained observers collected data on laptop computers in the same room in which experimental sessions were conducted. In the clinic, observers collected data on laptop computers behind the observation panel. In both settings, sessions were 4 min for Sarah, Harry, and Mario, and 3 min for Zack.

Short session durations were used to minimize caregiver exposure to baseline reinforcement contingencies. One method to ensure caregiver safety was to reduce the overall duration of each session and to minimize caregiver subjection to aggressive, disruptive, and self-injurious behavior in the home (consistent with the logic described by Jessel, Hanley, & Ghaemmaghami, 2016).

The primary dependent variable was destructive behavior, which included SIB, aggression, and disruptions. We also collected data on the secondary dependent variable, FCRs. *Self-injurious behavior* included self-biting, body slamming, self-hitting, self-scratching, and head banging. *Aggression* included hitting, kicking, pushing, pinching, scratching, or throwing objects at the caregiver or therapist. *Disruptions* included hitting, kicking, or throwing objects, tearing clothing, swiping materials off of furniture, and turning over furniture. *Functional communication responses* were defined as the child touching an FCR card. The total count of each response per session was divided by the duration of the session to obtain responses per minute.

Treatment Integrity and Interobserver Agreement

Treatment integrity measures were taken on caregiver implementation of baseline and FCT contingencies (measures were adapted from Schieltz et al., 2010, and Wacker et al., 2013). That is, caregivers were trained to a proficiency criterion before they conducted any sessions with their child. An independent observer collected treatment integrity data for all participants on the following caregiver behaviors: withholding the reinforcer at the beginning of the session and at the end of the reinforcement interval, providing 20-s access to the reinforcer following destructive behavior (during baseline) or an FCR (during FCT), delivering the reinforcer within 3 s of the occurrence of destructive behavior (during baseline) or an FCR (during FCT), removing the reinforcer within 3 s of the end of the reinforcement interval, ignoring all nontargeted appropriate and inappropriate behavior, not delivering the reinforcer at an inappropriate time (i.e., no errors of commission), and providing the reinforcer after each instance of destructive behavior (during baseline) or an FCR (during FCT; i.e., no errors of omission). Each occurrence of the relevant child behavior produced an opportunity for a component to be scored (e.g., each FCR represented an opportunity for the caregiver to implement reinforcement correctly). Using a datasheet that presented each of these criteria in a dichotomous (yes/no) checkbox format, we recorded each occurrence of the caregiver's behavior as correctly or incorrectly implemented (e.g., delivering the reinforcer more than 3 s after an FCR was emitted was scored as incorrect). If there was no opportunity for the caregiver to engage in a given behavior, the observer recorded the behavior as not applicable. Treatment integrity was summarized as the percentage of components implemented correctly and was calculated by dividing the total number of components implemented correctly by the total number of components applicable and converting the result to a percentage. Treatment integrity was collected for 50% of sessions for Sarah, 37% of sessions for Harry, 40% of sessions for Zack, and 28% of sessions for Mario. Mean treatment integrity scores were 100% for Sarah, Harry, and Mario, and 92% (range, 80%-100%) for Zack.

Ensuring high treatment integrity during the final phase (return to home context with caregivers) is crucial to understanding relapse of severe destructive behavior from a renewal perspective. That is, if treatment integrity is not perfect (especially if the caregiver committed errors of commission), there could be potential alternative explanations for the occurrence of relapse (St. Peter Pipkin et al., 2010). However, treatment integrity for the first three sessions of the final phase for all participants was

100%, ruling out potential alternative explanations related to integrity errors. High levels of treatment integrity were maintained due to the extensive training procedures we implemented with caregivers in the home (described below). Interobserver agreement was not collected on the treatment integrity measures.

Interobserver agreement for destructive behavior and FCRs was obtained by having two observers independently and simultaneously collect data, or was obtained from video recordings of sessions. Sessions were divided into 10-s intervals, and an agreement was recorded for each interval in which both observers measured the same number of each type of response. We summed the number of agreement intervals and then divided the number of agreement intervals by the total number of intervals within the session. Each quotient was then converted to a percentage. Interobserver agreement was collected for 33% of sessions for Sarah, 50% of sessions for Harry, 61% of sessions for Zack, and 67% of sessions for Mario. Agreement averaged 90% (range, 87%-100%) for Sarah, 99% (range, 97%-100%) for Harry, 97% (range, 90%-100%) for Zack, and 98% (range, 95%-100%) for Mario.

Functional Analysis

To develop the appropriate test and control conditions, we used the interview-informed process described by Jessel et al. (2016). Based on this process, a single test and single control condition was designed for each child.

The FCR card, which was present during all sessions, was shown to the participant prior to each session; however, occurrences of the FCR produced no programmed consequences. We ensured that the FCR card was positioned in the same place during all sessions that occurred in the home context (i.e., it was placed immediately in front of Sarah and Zack at a table, and it was placed near tangible items for Mario and Harry).

All FA sessions were conducted by caregivers in the home setting. Using behavioral skills training (BST), therapists trained caregivers on how to implement the FA condition-specific reinforcement contingencies (Wacker et al., 2005). That is, (a) caregivers were provided vocal instructions on how to respond during instances of, or absence of, destructive behavior; (b) therapists then modeled destructive behaviors and associated contingencies for test and control conditions (the FCR was not modeled); (c) the caregiver role played with a therapist who modeled the participant's destructive behavior; and (d) an additional therapist provided feedback during the role play if the caregiver did not respond appropriately. All training occurred in the home environment in the absence of the participant.

Sarah and Zack. Caregivers for Sarah and Zack each reported that destructive behavior typically occurred when they were asked to complete a parental request, which involved relinquishing or removing a preferred item. In the *escape to tangible condition*, the caregiver provided access to highly preferred items (iPad for Sarah and toy cars for Zack) for 30 s prior to the start of the session. The session began when the caregiver removed the tangible item from the participant and began delivering instructions (e.g., academic or household instructions) with the use of a least-to-most (i.e., verbal, model, physical) prompting procedure. Contingent on the occurrence of destructive behavior, the caregiver removed all instructions and task materials and provided a 20-s break from instructions. During this break, the participant regained access to the highly preferred items. Sarah's caregiver interacted with Sarah during the break by watching the iPad with her. In the *control condition*, the participant had continuous access to the highly preferred items and instructions were never delivered. Sarah's caregiver interacted with her in a manner identical to the test condition.

Harry and Mario. Caregivers for Harry and Mario each reported that destructive behavior typically occurred to gain access to a preferred item (Mario) or television show (Harry). In the *tangible condition*, the caregiver provided access to a highly preferred item (favorite television show for Harry and iPad for Mario) for 30 s prior to the start of the session. The session began when the caregiver changed the television channel (Harry) or removed the iPad (Mario). The caregiver provided 20-s access to the highly -preferred item contingent on the occurrence of destructive behavior. After this reinforcement interval, the caregiver changed the television channel (Harry) or removed the iPad (Mario). In the *control condition*, the participant had continuous access to the highly preferred item throughout.

Procedure

We conceptualized caregivers as part of the home environment, which collectively defined the initial context. When children are referred to a severe behavior program for treatment, they often work with trained therapists. Therefore, the combination of the clinic setting with trained therapists defined the second context. Similar to the logic described by Kelley et al. (2015), participants in the present study were exposed to the different contexts in an ABA design (i.e., A = the home with caregivers and B = the clinic with therapists), and to the contingencies in an ABB design (i.e., A = reinforcement for destructive behavior and B = FCT). Experimental control in renewal studies is demonstrated with behavior changes in relation to context changes instead of contingency changes (Bouton, 2002).

Baseline (home/caregiver). Responding during the test condition of the FA was used as the baseline from which renewal was evaluated.

Functional communication pretraining (clinic/therapists; not displayed). Destructive behavior produced no consequences (i.e., extinction), and a progressive-prompt delay (0 s, 2 s, 5 s, 10 s) modeled from Charlop, Schreibman, and Thibodeau (1985) was used to teach each participant to emit an FCR to gain access to the functional reinforcer. Each session consisted of 10 trials during which the establishing operation for destructive behavior was presented and FCRs were reinforced on a fixed ratio (FR)-1 schedule with 20-s access to the functional reinforcer. The FCR for all participants consisted of touching a card that contained a picture of the functional reinforcer (e.g., a picture of toys). The prompt delay increased after every two consecutive sessions with zero levels of destructive behavior. Pretraining was terminated after two consecutive sessions with no destructive behavior and greater than 80% independent FCRs. We conducted 21, 10, 5, and 10 pretraining sessions for Sarah, Harry, Zack, and Mario, respectively.

Functional communication training evaluation (clinic/therapists). During these sessions, reinforcement was delivered following FCRs according to an FR-1 schedule. Card placement was kept consistent with the home context (i.e., it was placed immediately in front of Sarah and Zack at a table, and it was placed near tangible items for Mario and Harry). Prompting strategies used to occasion the FCR during pretraining were terminated at the onset of this phase. Sessions during this phase continued until (a) we observed a 90% or greater reduction in destructive behavior relative to baseline for at least two consecutive sessions, and (b) we observed high and stable levels of FCRs. Caregivers observed all therapist-conducted FCT sessions behind the one-way observation panel in the clinic.

Caregiver training on FCT (home/caregiver; not displayed). Caregivers were trained by therapists on how to implement FCT in the home setting using BST procedures similar to those used for the FA. Specifically, we (a) provided vocal instructions on how to respond during instances of, or absence of, destructive behavior, as well as instances of, or absence of, FCRs;

(b) therapists modeled what an FCT session would look like by repeatedly demonstrating acceptable FCRs and associated contingencies; (c) the caregiver role played with a therapist who behaved how the participant might with respect to destructive behavior and FCRs; and (d) an additional therapist provided feedback during the role play to indicate to the caregiver which responses were reinforced (i.e., FCRs) and which were placed on extinction (i.e., destructive behavior). All training occurred in the home environment in the absence of the participant. Training was terminated when caregivers met 100% of training components according to our treatment integrity checklist.

Functional communication training (home/caregiver). Sessions were identical to those that occurred during the FCT evaluation with therapists in the clinic, except that the treatment was implemented by caregivers in the home setting. That is, the environmental context was arranged identically to that which occurred during baseline; however, the contingencies were arranged according to FCT. The FCR card was shown to the participant prior to each session. No prompts to engage in the FCR were provided.

Approach

We adapted a number of strategies from basic studies of renewal (e.g., Balooch & Neumann, 2011; Todd, Winterbauer, & Bouton, 2012; Trask & Bouton, 2016) to ensure that contexts were kept isolated and context-specific discriminative stimuli were separated throughout. As the current study was translational in its attempt to extend basic laboratory findings to more natural behaviors and contexts, we purposely excluded a number of procedures that are common to routine clinical practice in the treatment of destructive behavior (e.g., ensuring sustained treatment effects across days). However, we did this to allow for a reasonable evaluation of renewal by preventing any cross-context contamination that could occur from stimuli transferring across contexts (i.e., from the home to the clinic or vice versa). Without such a strategy it would be possible for generalized responding to occur as a result of contextual cues (i.e., signals from one context that have altered a subsequent context), which could preclude the observation of renewed behavior and prevent firm conclusions regarding variables responsible for treatment relapse.

First, the therapists who conducted in-home parent training and in-home observations were never associated with the child's treatment in the clinic setting. That is, the therapists associated with treatment in the clinic never entered the home context. Had the same therapists conducted in-clinic treatment and subsequently gone into the participant's home, the presence of those individuals could have served as a contextual cue or discriminative stimulus that may have mitigated renewal. Therefore, we associated different therapists with home and clinic contexts.

Second, caregivers never implemented any treatment components or received any training with their child within the clinic setting because caregivers were considered part of the home context. That is, caregivers were always associated with the home setting and never the treatment components until the final phase when FCT was implemented in the original (home) context. From the perspective of an operant renewal account, training caregivers in the clinic setting with their child is problematic for at least two reasons. First, elements of the baseline context (i.e., home/caregiver) would inadvertently enter the FCT context (i.e., clinic/therapists), which could affect performance during FCT. Second, clinic training could lead to generalized responding in the final FCT phase (i.e., return to the baseline context) because a reinforcement history for appropriate behavior in the presence of caregivers could be established prior to returning to the home context. This could inadvertently prevent renewed behavior in the final

context. Therefore, caregivers were always associated with the home context.

Third, the FCR card was present in the home setting from the onset of the FA and was present during every session conducted by caregivers (including baseline). Had we introduced the FCR card into the home context only following in-clinic evaluation of FCT, this would have (a) altered the baseline context, which previously did not have the FCR card (potentially producing a Context C), and (b) could have served as a contextual cue (i.e., transferred element of the clinic context to the home context), which could prevent the occurrence of renewed behavior. Therefore, the FCR card was present in all phases of this study such that the presence of the FCR card in the final phase (i.e., home/caregivers) did not alter the baseline context.

To control for response effort across settings, each participant, the communication materials, and tangible items were all positioned in the same place at the start of the session (e.g., at home and in the clinic, Zack was seated at a table with the communication card placed in front of him and the tangible items several feet away but visible). However, within session the participant was free to move around the room without restriction. Experimenters ensured correct positioning of the card across phases/contexts.

Fourth, all sessions for each participant, beginning with the first session of the FA and ending with the final session of the caregiver-implemented FCT phase, were conducted within close temporal proximity. We did this to prevent the development of novel conditioning histories in each context that could occur due to maturation or extraneous variables. For Harry, Zack, and Mario, all FCT sessions were conducted on the same day (that is, we conducted FCT in the clinic, then conducted FCT in the home later that day). However, baseline sessions were conducted 1-3 days prior. For Sarah, baseline, FCT in the clinic, and FCT in the home were conducted on different days. There were 5 days between the end of the clinic/therapist-conducted FCT and beginning of the home/caregiver FCT phase (due to participant illness).

Finally, the same tangible items and academic materials were used throughout the study, across phases and conditions. This was to prevent any changes to the antecedent context or to the consequences that followed destructive behavior or FCRs.

RESULTS

During the FA, all participants engaged in differentially higher levels of destructive behavior during the test condition relative to the control condition (Figure 1, first phase).

Figure 1 displays levels of destructive behavior and functional communication across the three phases of the renewal evaluation. Sarah (top panel) engaged in increasing levels of destructive behavior when baseline contingencies were implemented by her caregiver at home (M = 1.5 responses per minute; range, 1.0-2.0). When FCT was introduced in the clinic setting and conducted by trained therapists, destructive behavior immediately reduced to near-zero levels, and FCRs occurred at moderate levels (M = 1.0 responses per minute; range, 0-1.7). However, when FCT was introduced into the home context, and Sarah's caregiver implemented the treatment procedure, destructive behavior relapsed (M = 0.6 responses per minute; range, 0.0-1.2) with a concomitant initial decrease in FCRs. However, FCRs steadily increased across subsequent sessions (M = 1.2 responses per minute; range, 0-2.2).

Harry (Figure 1, second panel) engaged in steadily increasing levels of destructive behavior during baseline when his caregiver restricted access to the television at home (M = 2.2 responses per minute; range, 1.2-3.2). Functional communication training was effective at decreasing destructive behavior when implemented by

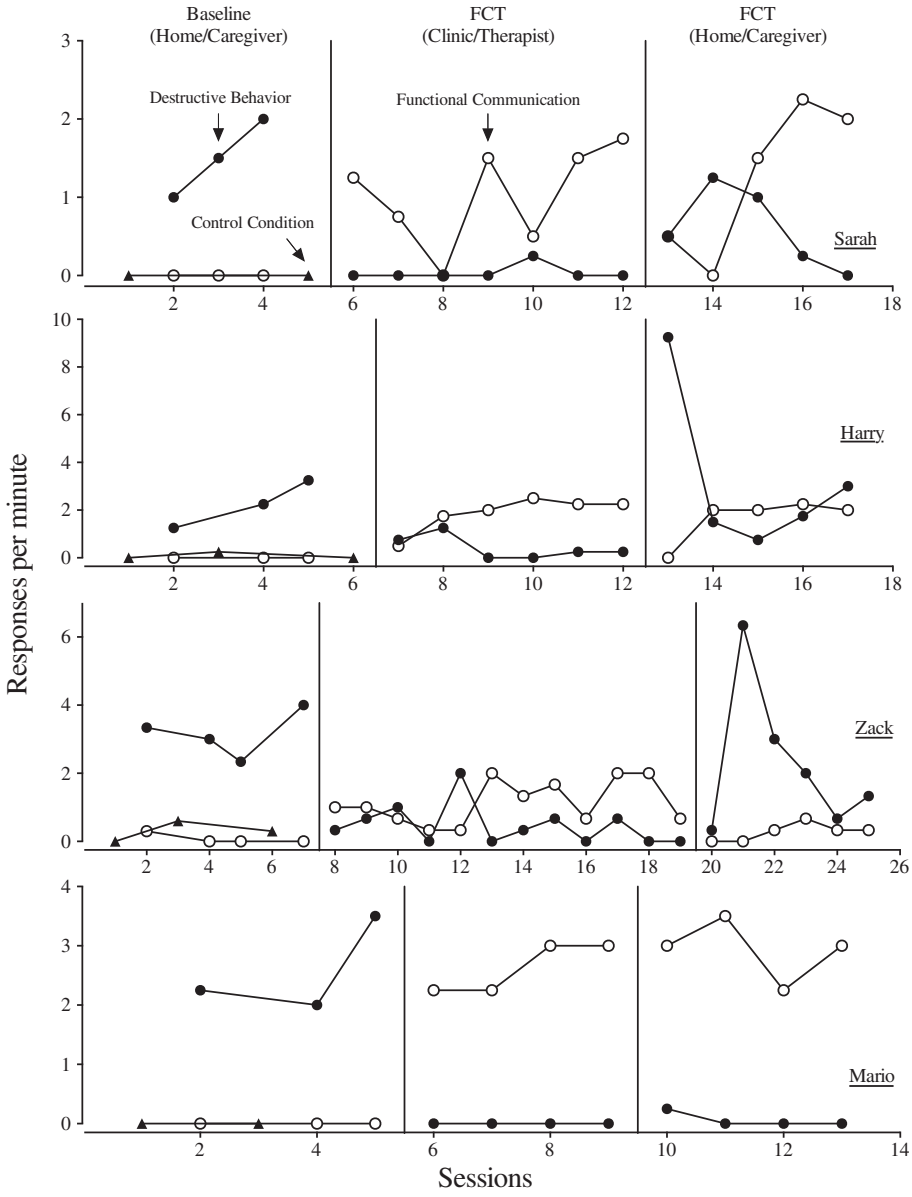

Figure 1. Rates of destructive behavior and functional communication across home/caregiver-implemented baseline (Phase 1), clinic/therapist-implemented FCT (Phase 2), and home/caregiver-implemented FCT (Phase 3) for each participant. Closed triangles indicate destructive behavior during the functional analysis control condition.

trained therapists in the clinic context with instances of destructive behavior occurring at near-zero levels at the end of the initial FCT phase (M = 0.4 responses per minute; range, 0-1.2) and FCRs occurring at a high and stable rate (M = 1.8 responses per minute; range, 0.5-2.2). However, destructive behavior relapsed when caregivers implemented FCT in the home context and approximated baseline levels at the end of the caregiver-conducted FCT phase

(M = 3.2 responses per minute; range, 0.7-9.2). Although rates of FCRs were high overall when FCT was conducted by caregivers in the home context (M = 1.6 responses per minute; range, 0-2.2), there was an initial decrease in FCRs (session 13) when the treatment was first transferred to the home/caregiver context, as was also observed in Sarah's case Throughout the final phase, Harry engaged in both destructive behavior and FCRs.

Zack (Figure 1, third panel) engaged in high and stable levels of destructive behavior when baseline was conducted in the home setting with caregivers mediating contingencies (M = 3.1 responses per minute; range, 2.3-4.0). Destructive behavior decreased to low levels during the FCT phase when treatment was implemented by trained therapists in the clinic setting, with zero rates of destructive behavior in the final two sessions (M = 0.4 responses per minute; range, 0-2.0). Independent FCRs increased and were reliably occurring at the end of the therapist-conducted FCT evaluation (M = 1.1 responses per minute; range, 0.3-2.0). When FCT was introduced in the home setting with caregivers acting as interventionists, destructive behavior relapsed (M = 2.6 responses per minute; range, 0.3-6.3), and FCRs degraded to near-zero levels (M = 0.2 responses per minute; range, 0-0.6). That is, along with renewed destructive behavior, there was a concomitant decrease in functional communication as a result of returning to the home context.

Mario (Figure 1, bottom panel) engaged in high and stable levels of destructive behavior when baseline was conducted by caregivers in the home setting (M = 2.5 responses per minute; range, 2.0-3.5). During the FCT evaluation conducted in the clinic by trained therapists, destructive behavior immediately reduced to zero levels in all sessions. Negligible levels of renewal were observed, and treatment effects were maintained, when FCT was transferred to the home context with caregivers implementing the intervention. Likewise, high levels of FCRs observed in the clinic context (M = 2.6 responses per minute; range, 2.2-3.0) also maintained in the home context (M = 2.9 responses per minute; range, 2.2-3.5). Unlike the other participants, neither renewal of destructive behavior nor a degradation of FCRs was observed with Mario.

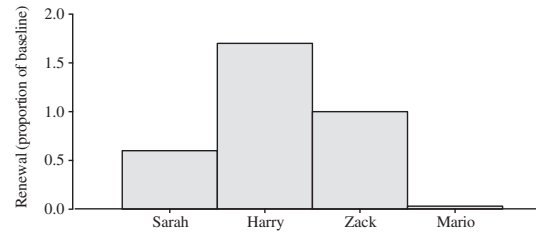

Figure 2. Amount of renewed destructive behavior in the first three sessions of home/caregiver-implemented FCT expressed as a proportion of the final three home/caregiver-implemented baseline sessions (i.e., FA test condition).

We attempted to quantify the amount of renewal observed when FCT was initially conducted by caregivers in the home setting. We calculated the mean rate of destructive behavior in the first three in-home sessions of FCT and divided the obtained value by the mean rate of destructive behavior in the final three in-home baseline sessions (i.e., FA test condition). Figure 2 displays renewal as a proportion of baseline responding, and a value of 1.0 indicates that renewed behavior in the final context approximated baseline levels of destructive behavior. Zack's level of destructive behavior at home, when FCT was conducted by caregivers, was similar to his level of destructive behavior when no treatment was in place. Relative to baseline levels, Harry engaged in higher levels of destructive behavior when FCT was implemented by his caregiver at home. However, this value was likely affected by the high level of renewed behavior observed in the first in-home FCT session. For Sarah, the amount of renewed behavior was of a lesser magnitude than for Harry and Zack. Near-zero levels of renewal were observed for Mario.

DISCUSSION

We attempted to demonstrate the generality of the renewal effect by translating basic research findings to a clinical population using a common intervention for destructive behavior. That is, we evaluated whether the relapse of destructive behavior during FCT when implemented by caregivers in their homes could be attributed to an operant renewal account of treatment relapse. For three of four participants, findings were consistent with basic and translational research on renewal and provide initial evidence that the environmental context may account for some instances of treatment relapse during FCT. However, FCT in the present study was implemented in a highly controlled manner in an austere environment, not in a manner wholly consistent with clinical practice. Thus, the results of the present study should be considered preliminary and strictly translational in nature, as we did not seek to promote a generalized treatment effect.

We observed an initial degradation in functional communication for three participants, suggesting that the original context not only resulted in renewed destructive behavior but also impacted rates of a newly learned response (i.e., the FCR). Although FCRs eventually recovered for Sarah and Harry to levels observed in the clinic, destructive behavior persisted. This result is especially relevant to treatment maintenance and generalization of interventions for severe destructive behavior specifically, and for the longevity of behavior change broadly (Bouton, 2014).

Although FCT is highly effective in controlled clinic settings, it is possible for destructive behavior to renew when treatment is transferred to socially meaningful contexts, if additional procedures designed to promote the durability of a newly established FCR are not used. For example, the present study is limited by the fact that participants had only a brief history of accessing putative reinforcers through use of the FCR (i.e., for Harry, Mario, and Zack, all FCT pretraining and FCT evaluation sessions were conducted in the same day). One method to potentially mitigate the renewal effect is to conduct extended FCT sessions (e.g., across days) to strengthen the probability of the FCR relative to destructive behavior prior to transferring FCT to new contexts.

Results obtained with Sarah, Harry, and Zack provide initial evidence that renewal is a relapse phenomenon that could be relevant to the treatment of severe destructive behavior and should receive greater attention in the assessment and treatment process. Given that the goal of intervention is to transfer treatment to more typical environments following effective reduction of destructive behavior in a clinic setting, operant renewal poses a potential challenge to treatment generalization and maintenance. However, generalization procedures that are commonly used in the treatment of severe destructive behavior may likely mitigate renewal and should continue to be leveraged to improve the long-term effects of FCT across contexts (see Falcomata & Wacker, 2013, for a review).

Potential renewal mitigation strategies that are likely to increase the durability of FCT in the typical environment have been demonstrated in prior applied research and include: (a) pairing therapists and caregivers during the treatment process and having caregivers implement treatments alongside therapists as a part of clinic-based intervention (Durand & Kishi, 1987; Moes & Frea, 2002; Peterson, Derby, Berg, & Horner, 2002; Wacker et al., 2005), (b) using salient physical stimuli to establish discriminative control over FCRs and transporting those stimuli to novel contexts (Fisher et al., 2015), (c) increasing the similarity between the context in which destructive behavior historically occurs and the context in which it is treated by transferring treatment stimuli across contexts (Durand, 1999), (d) introducing FCT into multiple different contexts prior to implementing FCT in the

target generalization context (Tiger et al., 2008) and (e) introducing FCT directly into the context in which destructive behavior typically occurs (Harding, Wacker, Berg, Lee, & Dolezal, 2009). These strategies are largely based on Stokes and Baer's (1977) notions of training sufficient exemplars, training diversely, programming common stimuli, and the incorporation of common mediators.

It should be noted that many of the aforementioned strategies that could potentially mitigate renewal were purposely excluded in the present study to evaluate renewal in a controlled manner. That is, the sequence of phases arranged in the present study was selected in large part to replicate previous basic and translational research. Although the decision to exclude generalization procedures in the present study limits the external validity of the results from a clinical perspective, our study was aimed to isolate the effects of contextual control in the relapse of severe destructive behavior to the greatest extent possible. Indeed, we were able to replicate the effect with a clinical population (children with ASD), with operant behavior (severe destructive behavior), and using a common intervention for the treatment of destructive behavior (FCT). As a result, one advantage of the present translation relative to other studies of renewal using human participants is that renewal is usually studied with extinction, whereas we were able to demonstrate the effect using differential reinforcement, which more closely approximates typical interventions for destructive behavior.

It is important to acknowledge that when generalization strategies are incorporated, FCT is a robust intervention that can be implemented successfully by parents and teachers in the typical environment such as in the home, in schools, and in community settings (Berg, Wacker, Harding, Ganzer, & Barretto, 2007; Durand & Carr, 1991; Harding et al., 2009; Northup et al., 1994; Wacker et al., 2005). Therefore, renewal during FCT may depend on the specific history of reinforcement that destructive behavior has in a given setting or with specific individuals in the absence of such generalization strategies (Todd et al., 2012).

In the present study, Context A was the combination of caregivers and the home environment. However, it is possible that only one component of this context would be sufficient to precipitate renewed behavior. That is, it is possible that caregivers implementing baseline and treatment contingences in the clinic context or therapists implementing all contingencies across clinic and home environments could result in renewed behavior. It is also possible that caregiver presence alone, irrespective of setting, could be responsible for the return of destructive behavior, because caregivers are the specific individuals with a history of delivering putative reinforcers for destructive behavior. As a result, the present study is limited by the fact that we included the behavior change agent as part of the context and thus the individual contributions of the behavior change agent versus the setting for renewal are unknown. This might be important in understanding the variables that contribute to relapse, because it is possible that the presence of individuals who have a history of reinforcing destructive behavior could evoke undesirable behavior independent of setting influences. Future researchers might consider conducting a component analysis to determine if one or all of the components in a given context are necessary to observe renewed behavior.

We included the FCR card in the initial baseline sessions to avoid introducing new stimuli into the original context during the in-home FCT phase. However, this could have been problematic from a generalization perspective, because each participant's destructive behavior contacted reinforcement in the presence of the card during baseline. This history may have decreased the likelihood that participants emitted the FCR and may have increased the likelihood of observing destructive behavior

during the in-home FCT phase, because the stimulus conditions looked identical to the in-home baseline sessions from the participant's perspective. By contrast, we did not observe significant levels of renewal with Mario, and it is possible that the FCR card established discriminative control over appropriate responding in the clinic context such that when caregiver-implemented FCT was introduced, the presence of the FCR card continued to facilitate appropriate communication and mitigate the renewal of destructive behavior.

The delayed renewal effect for Zack emphasizes the competition between treatment-related contingencies and stimulus control governing destructive behavior that could occur in the typical environment during the generalization phases of intervention. Zack's destructive behavior and appropriate behavior were low in the first session of the final phase, and this may have been a result of the competition between the recent history of reinforcement for the FCR and the change in stimulus conditions that historically evoked destructive behavior. Although the mechanisms responsible for renewal continue to be explored (Bouton & Todd, 2014; Pritchard et al., 2016), it is possible that during FCT the child learns to make a specific response (i.e., FCR) in a specific context (e.g., clinic). Bouton and Todd (2014) have suggested that the context can control behavior by either evoking it directly (Thrailkill & Bouton, 2015) or by hierarchically setting the occasion for the response–reinforcer relation (Trask & Bouton, 2014). Certainly, further research is warranted to determine the direct implications of these theories for applied practice and interventions for destructive behavior such as FCT (see also Podlesnik et al., 2017).

Our translation of the renewal effect using FCT suggests that operant renewal could be responsible for relapse during the treatment of severe destructive behavior in some cases, and the results of the present study are consistent with basic and translational research on renewal. That is, the relapse of undesirable behavior in settings that have historically been correlated with reinforcement for those behaviors may be due to contextual and discriminative control rather than failures in treatment integrity (St. Peter Pipken et al., 2010) or side effects of extinction during FCT (Lerman, Iwata, & Wallace, 1999). Given that relapse phenomena pose a significant threat to the longevity of treatments for severe destructive behavior, future researchers should consider additional strategies to mitigate operant renewal in the typical environment.

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