USING ESTABLISHING OPERATION MANIPULATIONS TO IMPROVE
FUNCTIONAL COMMUNICATION TRAINING

By

Nicole M. DeRosa
B.A. Western New England College, 2004
M.S. University of Southern Maine, 2009

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Advisory Committee:
Mark W. Steege, Ph.D., BCBA-D, Professor of School Psychology, Advisor
Rachel Brown-Chidsey, Ph.D., NCSP, Associate Professor of School Psychology
Wayne W. Fisher, Ph.D., BCBA-D, Professor of Behavioral Research
Michael E. Kelley, Ph.D., BCBA-D, Associate Professor of Behavioral Research
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Date:
Extinction is a common component in the treatment for destructive behaviors. However, when implemented in isolation, extinction is associated with several negative side effects (i.e., bursting behavior, emotional responding). To mitigate these negative side effects, differential reinforcement of alternative behavior (DRA) procedures are often used in conjunction with extinction. However, extinction, when used alone, does not consistently induce extinction bursts, and the addition of a DRA does not consistently prevent bursting. The current study evaluated the effects of establishing operation (EO) manipulations on the destructive behavior of children during extinction using functional communication training (FCT). Participants were exposed to two FCT intervention conditions (i.e., FCT-card; FCT-vocal) within a multi-element design. Results indicated that the FCT-card intervention more consistently and effectively removed the EO for destructive behavior, was less likely to produce extinction bursts and related side effects, and was more effective than the FCT-vocal intervention. A subsequent noncontingent reinforcement (NCR) comparison was implemented in which exposure to the EO for problem behavior was yoked to the FCT-card and FCT-vocal conditions to provide a direct test of differential exposure to the EO on problem behavior. Results indicated that the EO condition that was yoked to the FCT-card condition was more effective and less likely to produce extinction bursts than the NCR condition that was yoked to the FCT-vocal condition. Taken together, these analyses indicated that controlling exposure to the EO for problem behavior can have a large influence on the effectiveness of FCT as a treatment for problem behavior.
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Introduction and Literature Review

Extinction is a well-established procedure used in the treatment of destructive behavior. During extinction, the reinforcement contingency known to maintain a response is discontinued (Cooper, Heron, & Heward, 2007). However, both applied and basic studies have identified several limitations associated with the use of extinction in isolation, such as extinction bursts, emotional responding, and extinction-induced aggression (e.g., Goh & Iwata, 1994; Lerman & Iwata, 1996; Terrace, 1974). Gradual, rather than immediate, decreases in the rate of the target behavior are also sometimes associated with extinction procedures (Goh & Iwata). Despite these limitations, the use of extinction can play a significant role in the development and generalization of socially acceptable alternative behavior, particularly when used in combination with differential reinforcement (Lerman & Iwata, 1995).

Noncontingent reinforcement (NCR) and differential reinforcement of alternative behavior (DRA) are two reinforcement-based procedures that have been shown to eliminate or diminish the negative effects of extinction (Fisher, Deleon, Rodriguez-Catter, & Keeney, 2004; Lerman & Iwata, 1995). NCR involves the response-independent delivery of the reinforcer responsible for maintaining the target response (Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993). NCR is usually combined with extinction, in that the reinforcer is no longer delivered contingent on the target response. Typically, when NCR is first introduced, the functional reinforcer is delivered on a dense (sometimes continuous) schedule, which may account for the attenuation of extinction-induced destructive behavior. However, one limitation of NCR is that it does not promote the acquisition of appropriate, alternative behavior. The inclusion of teaching a replacement behavior that is functionally equivalent to the target behavior, as in a DRA treatment, allows for the child to have a socially appropriate means for requesting the desired
reinforcer. Another potential advantage of DRA is that children generally prefer contingent reinforcement over noncontingent reinforcement (Hanley, Piazza, Fisher, Contrucci, and Maglieri, 1997; Luczenski & Hanley, 2010).

As previously stated, adding DRA (e.g., functional communication training-FCT) to extinction of destructive behavior can mitigate extinction bursts and other negative side effects (e.g., negative emotional behavior) that are sometimes observed when extinction is implemented alone (Leitenberg, Rawson, & Bath, 1970; Lerman & Iwata, 1996; Timmons, 1962; Vyse, Reig, & Smith, 1985). However, extinction, when used alone, does not consistently induce bursting, and the addition of a DRA contingency does not consistently prevent extinction bursts (Lerman & Iwata, 1995). One factor that may account for at least some of this variability (or inconsistent occurrences of bursting and negative side effects) is the strength of the motivating operation (MO), or more specifically the establishing operation (EO), that is present during extinction of destructive behavior. An EO is an environmental event that produces two effects: (a) it increases the effectiveness of a reinforcer; and (b) it evokes (or increases the probability of) responses that have produced that reinforcer in the past (Michael, 1982). Thus, if the EO for destructive behavior is present and strong during extinction of destructive behavior, then bursting behavior may be more probable because a strong EO is more likely to evoke destructive behavior that historically produced the recently discontinued reinforcer (i.e., the reinforcer discontinued during extinction). Conversely, if the strength of the EO is weakened, then bursting and negative side effects associated with extinction should be less probable because a relatively weak EO is less likely to evoke responses that produced the reinforcer in the past. Reinforcement-based procedures are likely to lessen the strength of the EO during extinction by providing access to the functional reinforcer, and thus decreasing reinforcer deprivation. Fisher and colleagues have
shown that dense schedules of NCR are more effective than lean NCR schedules (presumably because they alter the EO more) and that dense schedules of NCR can enhance the effects of extinction and prevent bursting (Fisher et al., 2004; Hagopian, Fisher, & Legacy, 2004). However, a review of the literature did not identify any applied studies that have examined the effects of EO manipulations on extinction bursts when extinction is combined with DRA.

FCT is a well-established and effective DRA procedure used to teach children a socially-appropriate, functionally equivalent alternative behavior to replace destructive behavior (Carr & Durand, 1985). FCT typically involves three general components: (a) implementation of a functional analysis (FA) to determine the maintaining variable(s) for destructive behavior, (b) the selection and training of a functionally equivalent, alternative response, and (c) the maintenance and generalization of the alternative response (Tiger, Hanley, & Bruzek, 2008). FCT is most often used for problem behavior reinforced by social consequences (e.g., attention, escape, tangible items; Betz, Fisher, et al., in press).

Following identification of a social function for destructive behavior, a child is then taught to emit an alternative, functionally equivalent, response or mand. Several mand topographies have been successfully taught during the implementation of FCT, such as word or picture cards (e.g., Lalli, Casey, & Kates, 1995), vocal responses (e.g., Marcus & Vollmer, 1995), manual signs or gestures (e.g., Derby et al. 1997; Shirley, Iwata, Kahng, Mazaleski, & Lerman, 1997), and microswitch responses (e.g., Steege et al., 1990; Wacker et al., 1990). Although the training components for the success of teaching the alternative response during FCT are the use of extinction (see below for further details) and differential reinforcement, there are a number of other procedural variables that influence the effectiveness and efficiency of this treatment, such as selection of the alternative response and the teaching method utilized (see...
Tiger et al., 2008).

Unfortunately, there are few empirically validated procedures for choosing the alternative response for FCT, and it is therefore often an arbitrary selection process (see Horner & Day, 1991 discussed subsequently for a notable exception). Nevertheless, Tiger et al. (2008) discussed three factors that should be considered when selecting a target functional communication response (FCR). These include: response effort, the potential for the response to be recognized by novel people within the natural environment, and the child’s current behavioral repertoire. Additional variables that may also be relevant to the selection process are the history of a mand in relation to destructive behavior and the competing reinforcement schedules between destructive behavior and the communicative response (Derby, Fisher, Piazza, Wilke, & Johnson, 1998; Kelley, Lerman, Van Camp, 2002).

Tiger et al. (2008) suggest that the alternative response should, at least initially, be less effortful to emit than destructive behavior. However, it remains unclear as to how one determines the relative effort of a given response topography in relation to destructive behavior. Linguistic researchers have identified that children with developmental disabilities demonstrate greater proficiency with topography-based responding rather than selection-based responding (Sundberg & Sundberg, 1990; Wraikat, Sundberg, & Michael, 1991; as cited in Tiger et al., 2008). The form of a response differentiates one response from another with topography-based responding (i.e., vocalizations or sign-language), where-as with selection-based responding the stimulus selected is what differentiates one response from another (i.e., selecting the card with “break” typed on it versus the blank card). However, as discussed by Tiger et al. selection-based responses may be easier to teach to children with developmental disabilities given that prompts can be physically guided, thus ensuring the emission of the FCR and subsequent access to the
Horner and Day (1991) examined response effort across two topographically similar FCRs, a full-sentence (high effort) versus a one word response (low-effort). Results indicated that low rates of destructive behavior were only observed under the low-effort condition. Richman, Walker, and Winborn (2001) extended this research further by directly examining the response effort of concurrently available responses. In Phase I, emission of a communicative response (e.g., card exchange) was compared to that of concurrently available destructive behavior and results indicated that response allocation favored the communicative response. Phase II included a direct examination of differences in response effort, in relation to the reduction of destructive behavior, between two topographically dissimilar responses, the communicative response from Phase I (e.g., card exchange) and a new response (e.g., sign language). Results indicated that response allocation primarily favored the new response topography, sign language, rather than the previous response topography despite the card exchange effectively competing with destructive behavior in Phase I. The authors concluded that both reinforcement and mand properties influence allocation of responding and that the emission of a mand is likely to decrease across time if it is as, or more effortful than destructive behavior.

Although, Richman et al. (2001) extended Horner and Day’s (1991) research by examining differences in response topographies (e.g., topography-based vs. selection-based), the authors did not implement any formal teaching procedures, which may have provided evidence of the influence of other variables, such as duration of exposure to the relevant EO, on both the efficiency of FCR acquisition and reduction of destructive behavior.

In addition to being low-effort, communicative responses that unambiguously identify the functional reinforcer are more desirable given that novel individuals are more likely to respond
to such behavior. Durand & Carr (1991) suggested that the reinforcement of a mand in the natural environment may increase the long-term effectiveness of FCT. Viewed from this perspective, spoken words would tend to be the preferred topography for an alternative communication response because they are readily used by speakers and reinforced by listeners in most natural environments. However, motor responses (i.e., card exchange, sign language) may be more appropriate and efficient, particularly for children with limited vocal behavior and/or fluency. That is, for children with limited vocal repertoires, training an understandable and consistently emitted vocal response may be tedious and time-consuming, thus hindering the efficient acquisition of an alternative response (Tiger et al., 2008). Additionally, vocal responses cannot be as readily prompted as motor responses, regardless of a child’s vocal repertoire, which may influence whether or not the alternative response contacts the contingent relationship with the functional reinforcer.

Once the communication response is selected (arbitrarily or based on the above considerations), the next step involves teaching the child to emit the selected FCT response in order to gain access to the functional reinforcer. Similar to the selection of the response, the teaching method is often arbitrarily selected. The most common, general teaching methods utilized during functional communication training are Least-to-Most (LTM) prompting or Most-to-Least (MTL) prompting.

LTM prompting procedures typically arrange for the presence of the relevant EO, such as removal of attention, followed by a pre-specified period of time with continued exposure to the EO providing the child with an opportunity to independently emit the alternative communication response. If the child does not emit the target response following the pre-specified period of time, the therapist delivers a prompt for the child to engage in the correct response after which
the functional reinforcer is delivered. Initially, the pre-specified period of time prior to the delivery of the prompt is small (i.e., 5 s) and is then gradually increased across successive sessions in order to eliminate the child’s prompt dependency (Tiger et al., 2008).

MTL prompting procedures also present the relevant EO, but this is generally immediately (e.g., 0 s delay) followed by the delivery of a prompt for the child to engage in the response. The amount of time before the prompt is delivered is then gradually increased across successive sessions until the child emits the target response independently at some pre-specified criterion level. There have been several variations of MTL prompting procedures used during FCT. For example, Carr and Durand (1985) systematically decreased the volume of a vocal prompt across successive sessions and Fisher et al. (1993) gradually decreased the intensity of a physical prompt until the participant engaged in the target response independently.

Despite successful outcomes given both LTM and MTL prompting procedures during FCT, each method has unique advantages and disadvantages. LTM procedures inherently expose destructive behavior to extinction during the initial stages of FCT, which may assist in decreasing the subsequent occurrence of destructive behavior. However, destructive behavior may be exposed to adventitious reinforcement if it precedes either an independent or prompted FCR, resulting in unfavorable response chains. The MTL procedure decreases the opportunity for undesirable response chains and arranges for the occurrence of the FCR immediately following exposure to the relevant EO (Fisher et al., 1993). Despite this obvious advantage of the MTL procedure, destructive behavior may not have the opportunity to be exposed to extinction, which may result in difficulties following successful communication training (i.e., when schedule thinning is introduced).

A problem which may be encountered given either prompting procedure may be thinning
the frequency of prompts too rapidly. Johnson, McComas, Thompson, and Symons (2004) examined programmed versus obtained reinforcement when reinforcement for both destructive behavior and an alternative mand were concurrently available. Observations indicated, given the concurrent arrangement, that destructive behavior was a free operant where-as the functionally equivalent mand was not, due to removal of the communicative card following the FCR. In other words, the FCR was not available during the reinforcement interval but destructive behavior could still occur. Johnson et al. (2004) initially delivered prompts for mands on a lean schedule and low rates of manding and sustained rates of aggression were observed. Although both manding and destructive behavior had programmed FR1 schedules of reinforcement, the obtained schedule of reinforcement was greater for destructive behavior. However, when the rate of prompts for manding increased, the authors observed an increase in manding and a decrease in destructive behavior. Therefore, it may be that initially the FCR should be prompted on a dense schedule in order to facilitate increased independent manding and diminish occurrences of target destructive behavior (Johnson et al.). Additionally, it may be that a dense schedule of prompting results in decreased exposure to the EO given increased opportunity to gain access to the functional reinforcer, particularly during the acquisition stage of the FCR.

A final variable to consider when selecting a teaching procedure appropriate for the efficient acquisition of the FCR is the consequence for destructive behavior. Typically three consequences are considered for destructive behavior: reinforcement, extinction, and/or punishment (Tiger et al., 2008). Although reinforcement of destructive behavior cannot always be extinguished (i.e., due to attention from peers in a classroom; difficulty or inability to ignore severe aggression or self-injurious behavior), there are several studies that have shown the limited effectiveness of FCT in the absence of extinction (Kelley et al., 2002; Shirley, Iwata,
Kahng, Mazaleski, & Lerman, 1997). Thus, if reinforcement for destructive behavior must remain in place, it has been suggested that reinforcement associated with the FCR occur for longer durations of time, more immediately, or at a higher rate or quality than that programmed for destructive behavior (Tiger et al.).

Studies also indicate that for a sub-group of individuals extinction is not effective and the addition of a punishment contingency may be needed to effectively diminish the occurrence of destructive behavior (Fisher et al., 1993; Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998; Wacker et al., 1990). The addition of punishment should only be considered if extinction proves ineffective.

Much, if not most, of the applied literature on FCT has focused on the conditions under which the FCR is likely to maintain and/or generalize. In contrast, the conditions that may influence the initial acquisition of the FCR, the selection of the alternative response and the teaching procedure, have not been well examined (Grow, Kelley, Roane, & Shillingsburg, 2008; Winborn, Wacker, Richman, Asmus, & Geier, 2002). Given this apparent gap in the literature, applied researchers have begun to shift focus toward the variables that influence the efficient and effective acquisition of FCRs.

Winborn et al. (2002) measured the allocation of responding and levels of destructive behavior present during FCT with one novel and one existing mand that were available concurrently. Results indicated that the participants emitted the existing mand more frequently than the novel mand, but the existing mand was also associated with higher levels of destructive behavior and therefore may not have been the most effective FCR. It may be that participants selected the existing mand over the novel mand due to (a) the reinforcement history associated with the existing mand, and/or (b) an increase in response effort associated with the novel mand.
Grow et al. (2008) placed destructive behavior on extinction during baseline in order to evoke response variability for selecting a target mand for treatment. In other words, this study examined the behavior (e.g., vocal or gestural responses) that participants engaged in to gain access to the functional reinforcer when destructive behavior no longer produced reinforcement. The first appropriate, alternative response that a participant emitted during baseline sessions was identified as the target FCR during subsequent treatment sessions. These studies provide an initial look at procedures that may provide an effective, non-arbitrary selection of the most efficient FCR to replace destructive behavior. However, other information such as FCR acquisition data and the technological details of teaching procedures continues to be lacking within the FCT literature, and thus the conditions under which communicative responses can be efficiently acquired requires additional study (Grow et al.).

One variable that potentially influences the effectiveness and efficiency of FCT, but has received little attention in the research literature, is duration of exposure to the relevant EO. In other words, it is unclear how manipulations to the exposure of the relevant EO influence the effectiveness of FCT, especially during initial training of the FCR, before the response is well learned. Brown et al. (2000) examined the conditions under which existing mands successfully replaced destructive behavior given exposure to relevant and irrelevant EO conditions. Two mands were identified for each participant, one mand that was functionally equivalent to destructive behavior and another mand that was not. The participants were exposed to two conditions. The first condition involved exposure to the EO relevant to the function of destructive behavior and the other condition was irrelevant to the function of destructive behavior. Results indicated that the functionally equivalent mand occurred frequently in the EO relevant condition and minimally in the EO irrelevant condition, where-as the functionally
unrelated mand was rarely observed in either condition. Although this study showed that the presence or absence of the relevant EO influenced the success of FCT in relation to manding and the occurrence of destructive behavior, additional research is needed to understand how variations in the strength of the relevant EO may influence acquisition of the FCR and reductions in destructive behavior during FCT. For example, it may be that long durations of exposure to the relevant EO may result in slower acquisition and slower reduction in destructive behavior compared to conditions in which the duration of the exposure to the relevant EO is minimized.

**Hypothesis**

Therefore, in the current study I examined the influence of manipulations to the relevant EO for destructive behavior on the effectiveness of FCT in terms of (a) acquisition of the FCR, (b) reductions in destructive behavior, and (b) the emergence of negative side effects associated with extinction (e.g., bursting behavior). I evaluated the effects of EO manipulations within an FCT treatment comparison using a MTL teaching procedure (e.g., progressive time-delay-PTD) across two novel and topographically different mands (card touch versus vocal response) for children with limited vocal abilities. I hypothesized that I could more tightly control exposure to the EO for problem behavior during the initial FCR training for the FCT-card condition relative to the FCT-vocal condition because it is possible to physically guide the card-touch response but not the vocal response. I further hypothesized that the FCT-card condition would produce more rapid reductions in problem behavior and fewer extinction bursts than the FCT-vocal condition because the I could more tightly control (and limit) exposure to the EO for problem behavior. Finally, I tested the effects of EO exposure on problem behavior directly by comparing two NCR schedules, one in which exposure to the EO for problem behavior was yoked to the FCT-card condition and the other in which it was yoked to the FCT-vocal. I hypothesized that the NCR
condition that was yoked to the FCT-card condition would produce more rapid reductions in problem behavior and fewer extinction bursts than the NCR condition that was yoked to the FCT-vocal condition. If this set of hypotheses were supported by the results of the analyses described in the Method section, the results would indicate that controlling exposure to the EO for problem behavior can have a large influence on the effectiveness of FCT as a treatment for problem behavior.

**Method**

**Participants and Setting**

Three individuals admitted to the Munroe-Meyer Institute’s Center for Autism Spectrum Disorder’s Severe Behavior Clinic for the assessment and treatment of destructive behavior participated in this investigation. All participants engaged in socially maintained destructive behavior, as identified via a functional analysis similar to that described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994). Additionally, all participants presented with an echoic repertoire, in that each participant was observed to imitate a vocal response (i.e., at least a single-syllable sound or word) that was first modeled by a therapist.

“John” was a four-year-old male diagnosed with Autistic Disorder and Disruptive Behavior Disorder, NOS. John attended the Severe Behavior Clinic five days per week, for one-and-a-half hours per day, for the treatment of aggression and disruption. Prior to treatment, John communicated primarily via single word requests and occasional three-to-four word utterances.

“Frank” was a five-year-old male diagnosed with Autistic Disorder and Impulse Control Disorder, NOS. Frank attended the Severe Behavior Clinic five days per week, for one-and-a-half hours per day, for the treatment of aggression and disruption. Prior to treatment, Frank

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1 All participant names are pseudonyms.
primarily communicated via gestures and several single word approximations (e.g., “heh” for head). “Henry” was a nine-year old male diagnosed with Autistic Disorder, Impulse Control Disorder, NOS, Attention Deficit/Hyperactivity Disorder NOS, and Anxiety Disorder. Henry attended the Severe Behavior Clinic five days per week, for three-hours per day, for the treatment of aggression, disruption, and negative vocalizations (e.g., screaming). Prior to treatment, Henry primarily communicated via one-to-two word responses and a limited number of requests that consisted of restricted three-to-four word phrases.

Sessions lasted 5 min each and were conducted in a therapy room located within the Severe Behavior Clinic equipped with one-way mirrors that allowed unobtrusive observation. Between 2 and 14 sessions were conducted per clinic visit across participants. Materials included a desk, two chairs, and materials appropriate for each session type (described subsequently).

John’s session materials included: (a) a small blue bin containing small objects (e.g., action figure, toy cars, small balls, rubber animal figures, toy dishes), which were used for gross motor imitation with object demands; and (b) a 2 X 4 card (for FCT-card sessions) with a white background and the word ‘break’ typed on it in all capital black letters. Frank’s session materials consisted of: (a) a large toy truck that made noise when pressed; (b) a DVD player with a movie; and (c) a 3 X 4 card (for FCT-card sessions) with a white background and an animated picture of a child playing with toys. Henry’s session materials consisted of: (a) cards with a white background and a single capital letter printed in black on the center of the card that were used for single-step instructions (e.g., “Touch the letter ‘K’.”) and; for FCT-card sessions, (b) a blank red 2 X 4 break card.

Data Collection and Operational Definitions
Second-by-second data were collected using a computer-based data collection program, DataPal. I examined the following child responses (i.e., dependent measures) during baseline and the NCR comparison: (a) problem behavior and (b) compliance with requests if the child displayed destructive behavior maintained by escape from instructional demands. I collected data on the following child dependent measures during the FCT comparison: (a) independent functional communication responses, (b) prompted functional communication responses, (c) incorrect functional communication responses, (d) destructive behavior, and (e) compliance with requests if the child displayed destructive behavior maintained by escape from instructional demands.

I defined the child dependent measures as follows:

1. Independent *FCR*: the participant touched or exchanged the picture card or emitted the vocal response in the absence of the delivery of a prompt from the therapist (i.e., no prompt for at least 5 s);

2. Prompted FCR: the therapist physically guided the participant to touch or exchange the picture card (FCT-card) or the participant emitted the vocal response within 5 s following the echoic prompt delivered by the therapist (FCT-vocal);

3. Incorrect FCR: the participant emitted the vocal response during FCT-card.

Participants did not have the opportunity to emit a card touch or exchange during FCT-vocal as the stimulus was not present.

*Problem behavior* for John, Frank, and Henry included aggression and disruption. For all participants, *aggression* was defined as forceful pushing or striking others with body parts (e.g., pushing, hitting, kicking, head-buttng); hitting others with objects (person is hit or moves to avoid being hit); or biting. *Disruption* was defined as banging, throwing, overturning, tearing, or
climbing on objects not made for that purpose; running away out-or indoors; or repetitively turning equipment on and off (e.g., lights, TV, etc.). Additionally, Frank’s problem behavior also included the following topographies: lifting up therapist’s articles of clothing, exposing one-inch or more of therapist skin (e.g., the bottom of a shirt, a shirt sleeve, and pant legs), untying and/or attempting to tie together therapist shoe laces, tapping or grabbing and pulling on the DVD player held by the therapist, and pushing or attempting to push buttons on the DVD player. Henry’s problem behavior also included negative vocalizations in the form of discrete screams or yelling, which was defined as any vocalization above conversational level.

*Compliance* was defined as completing an instructed response within 5-s of a verbal instruction/prompt or within 5-s of a model prompt. For example, if a therapist said “John, clap your hands” and John did so within 5-s of this instruction compliance was scored. If John did not clap his hands within 5-s following the instruction the therapist said “John, clap your hands like this” while modeling clapping hands. Compliance was also scored if John engaged in hand clapping within 5-s following the delivery of the modeled prompt. However, if John did not complete the clapping response within 5-s of the model prompt, the therapist physically guided John to clap his hands and compliance was not scored.

In order to monitor procedural integrity during baseline and the NCR comparison, I also collected data on the following therapist behaviors: (a) correct delivery of the functional reinforcer, and (b) correct delivery of instructions and the three-step prompting procedure if the child displayed destructive behavior maintained by escape from instructional demands. In addition, I also collected data on the following therapist behaviors during the FCT comparison: (a) correct delivery of the discriminative stimulus (Sd), (b) correct delivery of the controlling prompt (i.e., an echoic prompt in FCT-vocal; a physical prompt in FCT-card), (c) correct
delivery of the functional reinforcer and (d) correct delivery of instructions and the three-step prompting procedure if the child displayed destructive behavior reinforced by escape from instructional demands.

I defined the following as therapist dependent measures for baseline:

1. Correct delivery of the functional reinforcer: the therapist provided immediate (within 1-s) access to the functional reinforcer (e.g., escape from demands, high-quality attention) contingent on problem behavior and delivered the functional reinforcer for the entire duration of the reinforcement interval (e.g., 20-s).

2. Correct delivery of instructions and the three-step prompting procedure: the therapist provided the initial instruction (e.g., verbal prompt) immediately (within 1-s) following (a) praise for compliance with the previous instruction, (b) physically guided completion of the previously instructed response, or (c) completion of a reinforcement interval, which was signaled by a data collector, as well as the therapist delivered each prompt within 5-s of the previous prompt, completed the appropriate model or physical prompt with the redelivery of the verbal instruction, and discontinued the procedure contingent on compliance or target destructive behavior.

I also defined the following therapist dependent measures for the FCT comparison:

1. Correct delivery of the Sd: the therapist delivered the specified Sd immediately (within 1-s) following removal of the maintaining reinforcer or at the beginning of a new trial interval and, in the FCT-card condition, not before the card was available (i.e., within arms-reach) to the participant.

2. Correct delivery of the controlling prompt: (a) during the FCT-card condition, the therapist physically guided the participant to touch or exchange the card at the end of the specified time-delay interval and, (b) during the FCT-vocal condition, the therapist provided the echoic prompt
at the end of the specified time-delay interval.

3. Correct delivery of the reinforcer: the therapist provided immediate (within 1-s) access to the functional reinforcer contingent on either an independent or prompted FCR, and delivered the functional reinforcer for the duration of the reinforcement interval (e.g., 20 s).

4. Correct delivery of instructions and the three-step prompting procedure (during FCT-vocal only): the therapist provided an instruction only following 5-s of no responding after the echoic prompt and delivered each three-step prompt within 5-s of the previous prompt, completed the appropriate model or physical prompt with the redelivery of the verbal instruction, and discontinued the procedure contingent on compliance or the participant emitting the appropriate FCR.

**Interobserver Agreement**

In order to verify data accuracy (inter-observer agreement; IOA), a second observer independently collected data during John’s FCT treatment analysis for 66.7% of sessions during the first baseline, 47.6% of sessions during the FCT comparison, 35.3% of sessions during the second baseline, and 60% of sessions during the final FCT phase.

IOA data for Frank’s FCT treatment analysis were collected for 53.8% of sessions during the first baseline, 60% of sessions during the FCT treatment comparison phase, 43.5% of sessions during the second baseline, and 71.4% of sessions during the final FCT treatment phase. IOA data for Frank’s NCR analysis were collected for 80% of baseline sessions and 55% of sessions during the NCR comparison phase.

IOA data were collected during Henry’s FCT treatment analysis for 44.4% of the first baseline sessions, 69.2% of the FCT comparison sessions, 100% of the second baseline sessions, and 66.7% of the final FCT phase sessions.
The percentages of agreement for each dependent variable were calculated by partitioning the sessions into 10-s intervals, dividing the number of agreements by the number of agreements plus disagreements, and multiplying by 100%. An agreement was defined as two observers scoring an occurrence of target behavior within the same 10-s interval. A disagreement was defined as one observer scoring the occurrence of a behavior and the other observer not scoring the occurrence of that behavior within the same interval.

Percentages of agreement for John across the FCT analysis phases were: 100% for independent FCR, 98.6% for prompted FCR, 100% for incorrect FCR, 98.9% for aggression, and 91.2% for disruption. Therapist integrity data were not collected during John’s assessment, as this data collection procedure began following John’s assessment.

Percentages of agreement for Frank across the FCT analysis phases were: 100% for independent FCR, 93.4% for prompted FCR, 91.9% for aggression, and 92.3% for disruption. Therapist integrity data were not collected during Frank’s FCT assessment for the same reason noted above. Percentages of agreement for Frank across NCR assessment phases were: 90.5% for aggression and 91.8% for disruption. Therapists correctly implemented procedures 85% of opportunities during the NCR baseline. Correct procedures occurred 100% of opportunities during the NCR comparison phase. Percentages of agreement for therapist integrity during Frank’s NCR assessment were: 92.4% for correct therapist behavior and 99.4% for incorrect therapist behavior.

Percentages of agreement for Henry across FCT analysis phases were: 98.7% for independent FCR, 96.6% for prompted FCR, 98.1% for incorrect FCR, 93.3% for aggression, 97.3% for disruption, and 97.5% for negative vocalizations. Percentages of agreement for therapist integrity during Henry’s FCT assessment were: 80.7% for correct therapist behavior...
and 99.7% for incorrect therapist behavior. Therapists correctly implemented procedures 96.7%, 97.0%, 98.8%, and 100%, of opportunities during baseline, the FCT comparison, the second baseline, and the final FCT treatment phase of the FCT treatment analysis, respectively.

Therapists correctly implemented procedures 91.9% of opportunities during all baseline phases of Henry’s NCR comparison. Therapists correctly implemented procedures 97.5% of opportunities during all NCR comparison phases. Percentages of agreement for Henry across NCR assessment phases were: 96% for aggression, 99.4% for disruption, and 92.3% for negative vocalizations. Percentages of agreement for therapist integrity across Henry’s NCR assessment phases were: 88.8% for correct therapist behavior and 98.8% for incorrect therapist behavior.

**Experimental Procedures**

**Experimental design.** I used a within-subject experimental design that included components of both a multi-element and a reversal design (see below for descriptions). Following a baseline phase (Phase I), I compared the two functional communication training conditions, FCT-vocal and FCT-card, (Phase II) using a multi-element design. A return to baseline (Phase III) was followed by reintroduction of the more effective treatment (Phase IV). Phases five and six included components of either an AB (Frank) or reversal (Henry) and multi-element design. John was not exposed to the NCR comparison (Phases V and VI). Phase five was a return to baseline, with the inclusion of two-novel therapists in order to control for carry-over effects from the FCT assessment. In Phase six the two NCR conditions were compared using a multi-element design. For Henry there were two replications of the NCR analysis (preceded by a new baseline each time) to demonstrate experimental control, as well as to control for order effects (see below for details).

**Pre-experimental assessments.** Prior to the implementation of the current experimental
procedures, a preference assessment was conducted with each participant to identify a hierarchy of preferred items. John took part in a paired-choice preference assessment that consisted of 11 stimuli (i.e., a combination of leisure items and edibles), identified via caregiver report, presented in pairs. Each stimulus was paired with every other stimulus once and presented in a randomized order. The stimulus pairs were held in a therapist’s hand an equal distance from John. Contingent on an approach response (e.g., the participant touched the item) John either consumed the edible or had access to the leisure item for 30-ss. Attempts to approach both stimuli were blocked. If John did not engage in a single approach response within 5-s, the items were removed briefly and re-presented. If John still did not engage in an approach response following the second presentation the trial was scored as “no choice” for that stimulus pair. A hierarchy of preference was determined by calculating the percentage of selection for each item (Fisher, Piazza, Bowman, Hagopian, Owens, & Slevin, 1992).

Frank and Henry were initially exposed to a paired-choice preference assessment (see above for a description), but due to instances of destructive behavior, including negative vocalizations and throwing objects at the therapist, a free-operant preference assessment was implemented (Roane, Vollmer, Ringdahl, & Marcus, 1998). Two free-operant conditions were presented in Frank’s preference assessment. One condition consisted of six edible items and the second condition consisted of six leisure items. The edible items were arranged on a tray (two items per tray) on three separate tables. The leisure items were arranged in a circle on the floor. During 5 min sessions, Frank was able to freely access any, all, or none of the items. Items were not removed during the 5 min sessions, and food items were not replenished upon full consumption. Frank’s hierarchy of preferences was based on the percentage of intervals Frank spent manipulating or consuming each item. Additionally, the order in which Frank consumed
the edibles was considered. Henry’s free operant preference assessment consisted of one five-minute session in which four edible items and three leisure items were concurrently available. Henry’s hierarchy of preferences was based on the percentage of his interactions with each edible or leisure item.

Following completion of the preference assessment, each participant participated in a functional analysis in order to identify the variable(s) maintaining destructive behavior (Iwata et al., 1982/1994). Each participant was exposed to the following conditions: attention, escape (demand), tangible, ignore, and toy play.

Frank and Henry participated in a pairwise functional analysis in which a test condition was randomly alternated with the control (toy play) condition. Frank’s pairwise functional analysis consisted of the attention and toy play conditions. Henry’s first pairwise functional analysis included the tangible and toy play conditions. Henry’s second pairwise functional analysis included the escape (demand) and toy play conditions. Following the pairwise functional analyses, Henry participated in additional assessment conditions that included variations of the escape (demand) condition. Henry’s final assessment was a series of escape (demand) conditions alternated with a series of toy play conditions within a reversal (ABABA) design, where Phase A included escape (demand) and Phase B included toy play. All conditions are described below.

**Attention.** A therapist entered the therapy room containing a magazine or DVD player (Frank only), a low-preferred toy (identified via the aforementioned preference assessment) and a table with two chairs. Frank’s attention session consisted of a DVD player with a movie playing instead of a magazine due to caregiver report regarding destructive behavior occurring while others are engaged in watching television. Prior to the start of the session, the therapist
provided high quality attention to each participant for 1-minute. For John, high quality attention consisted of tickles and chase. For Frank, high quality attention consisted of singing children’s songs (e.g., If you’re Happy and You Know it, Head, Shoulders, Knees, and Toes) and tickling. For Henry, high quality attention included tickling and neutral statements. At the start of the session the therapist informed each participant that he/she had work to do (or had to watch TV during Frank’s analysis) and that the participant could play with the available toy. The therapist sat or stood across the room from the participant and assumed the appearance of reading or watching TV. Contingent on the occurrence of problem behavior (e.g., aggression and disruption for John & Frank; aggression, disruption, and screaming/yelling for Henry) the therapist delivered attention in the form of verbal reprimands (e.g., “Don’t do that.”, “I don’t like that.” etc.) for 20-s. If possible, the verbal reprimands resembled those that each participant typically received in their natural environment, based on either reported or observed parent/child interactions. All other behavior, appropriate or inappropriate, was ignored.

Escape (demand). A therapist entered the therapy room containing appropriate demand materials (see above for details), and a table with two chairs. Throughout the session, the therapist presented demands to the participant. John and Frank’s sessions consisted of gross motor (e.g. “Touch your head.”) and object motor (e.g., “Push the car.”) instructions. Henry’s sessions consisted of single-step instructions (e.g., “Knock on the wall.” Or “Touch the letter ‘K’.”) A three-step guided compliance procedure (i.e., verbal prompt, model prompt, and physical prompt presented) was implemented contingent on noncompliance with instructions. If the participant did not engage in the response following the modeled response by the therapist, the therapist physically guided the participant to complete the response while repeating the verbal instruction. Contingent on the occurrence of problem behavior the therapist provided the
statement “OK, you don’t have to.”, discontinued the delivery of demands, and removed demand materials for 20-s. All other behavior, appropriate or inappropriate, was ignored.

**Tangible.** A therapist entered the therapy room containing a high-preferred toy (Chomper toy for John, a CD player with a personal music CD for Frank, and Legos for Henry), identified via the aforementioned preference assessment, and a table with two chairs. Prior to the start of the session, the participant was allowed access to the preferred toy for 1-m. At the start of the session the therapist removed the toy from the participant and held it within sight but out of the participants reach. Contingent on the occurrence of problem behavior the therapist provided access to the toy for 20-s by handing the toy to the participant without engaging in any vocalizations. All other behavior, appropriate or inappropriate, was ignored.

**Ignore.** A therapist entered the therapy room containing a table and two chairs. The therapist sat or stood on the other side of the room from the participant and ignored all behavior, appropriate or inappropriate (including problem behavior) throughout the duration of the session.

**Toy play.** A therapist entered the therapy room containing the same high-preference toy used during the tangible condition (see above), and a table with two chairs. The participant had free access to the preferred toy throughout the duration of the session. The therapist interacted with the participant throughout the duration of the session and provided noncontingent attention, in the form of descriptive praise (e.g., “I really like how you’re sitting in your chair.”) every 30 s in the absence of destructive behavior. All problem behavior was ignored.

I depict results from the functional analysis for John in Figure 1, Frank in Figure 4, and Henry in Figure 8. Prior to the start of the treatment comparison described below, each participant participated in informal probe trials to determine whether he could emit the target vocal response (e.g., “puh” or “break”). At least ten, nonformal probe trials occurred (in the
absence of the relevant EO) and evidence of echoic ability was determined based on the response being emitted within 5-s following an echoic prompt on at least 80% of opportunities.

**Experimental Conditions.** The phase conditions for the FCT treatment analysis and NCR analysis are described below.

**Phase I: baseline.** The baseline condition was identical to the condition of the functional analysis with the highest rates of destructive behavior. For John and Henry baseline sessions were identical to the escape condition described above. Baseline sessions for Frank were similar to the attention condition described above.

**Phase II: FCT treatment comparison.** During this phase a PTD prompting procedure (with delays of 0, 2, 5, 10 s) was used to teach the participant to emit the FCR in each treatment condition starting with an immediate 0-s delay. Prior to the start of each session a therapist stated the rule for the current condition followed by providing a practice opportunity. For example, if behavior was found to be maintained by attention the therapist said “I have to watch my movie now, but you can play with your blue truck. If you want me to play with you (say “puh”) or (touch the card like this)”. This was followed by a practice trial during which the therapist delivered the relevant Sd (e.g., “I have to watch my movie now, you can play with your blue truck”) immediately followed by the controlling prompt (card touch/exchange or vocal response). If the child emitted the appropriate prompted response, reinforcement was delivered (e.g., 20-s access to high quality attention). Given that it was unlikely that the participants would emit the vocal response during the FCT-vocal practice sessions, three opportunities for the child to engage in the correct response were provided. Sessions were initiated following the emission of a prompted FCR and completion of the subsequent reinforcement interval or after three practice opportunities without the emission of the FCR.
For teaching purposes (of the FCR), FCT treatment sessions (attention only) were divided into successive 30-s intervals and each 30-s interval was a teaching trial. This was done in order to have a systematic procedure for providing additional prompt opportunities during the FCT-vocal condition in case the child did not emit the correct response following the echoic prompt. During each teaching trial the EO for destructive behavior (e.g., the delivery of the Sd and the removal of attention) was presented. This was followed by the child either emitting the target FCR independently within the prescribed period of time or the therapist prompting the correct response. When the child emitted the target FCR either independently or after the prompt, the therapist delivered the reinforcer for the remainder of the 30-s trial (e.g., delivered high quality social attention). During FCT-vocal sessions if the child did not emit the target FCR following the echoic prompt, exposure to the EO for destructive behavior continued until the child emitted the target FCR or until the end of the 30 s teaching trial. For example, if a child did not emit the correct response following the echoic prompt until second 25 of the 30 s trial, then the child received 5-s access to the functional reinforcer prior to the next trial being initiated. If the child did not emit the correct response within a 30 s teaching trial, the next 30 s teaching trial was initiated by the therapist delivering the Sd.

During the escape or demand condition, teaching trials consisted of the delivery of the Sd (e.g., “It’s time to do some work.”) followed by the child either emitting the target FCR independently within the prescribed period of time or the experimenter prompting the correct response. The emission of an independent or prompted FCR resulted in the initiation of the reinforcement interval and the end of a trial. FCT-vocal teaching trials continued with the delivery of a specific demand (e.g., “Touch your head.”) if the child did not emit the target FCR following (within 5 s) the echoic prompt. The trial ended following compliance with this
specific instruction, following the correct response to the specific instruction being physically
guided, or if the child emitted the target FCR. Teaching trials during escape conditions were not
time based because exposure to the relevant EO had a discrete beginning and end.

During the initial sessions, the time delay was set at 0 s, meaning that the controlling
prompt (e.g., a physically guided card touch during FCT-card and the echoic prompt during
FCT-vocal) was delivered as soon as the EO was introduced (e.g., “It’s time to do some work.
Break”). The length of the time delay to the next longer interval occurred after two consecutive
sessions in which (a) destructive behavior was at least 85% lower than baseline and (b) the
participant emitted the correct FCR response either independently or following the prompt
during at least 85% of the opportunities. This phase ended when at least one of the treatments
had reached the following two treatment targets: (a) destructive behavior was at least 85% lower
than baseline and (b) the participant emitted the correct FCR response independently during at
least 85% of the opportunities for three consecutive sessions. However, criteria for increasing
the time-delay and ending the FCT comparison phase were not present during John and Frank’s
assessment. Thus, for these two participants visual analysis of the data was used to determine
when to increase the time-delay in each condition and when to end the phase and return to
baseline.

For FCT-Card, the prompt consisted of the experimenter guiding the child’s hand to
touch or exchange the picture card depicting the reinforcer (e.g., touching the ‘break’ card for
John). For the FCT-vocal condition, the prompt consisted of the experimenter modeling the
target vocalization (e.g., “Puh” for Frank; “Break” for John; “Break, please” or “Break” for
Henry).

Seven subphases were implemented (see Figures 9 and 10) during Henry’s FCT
intervention comparison phase. Subphases one, three, and six included access to negative reinforcement only (SR-; e.g., a break). Subphases two, four, and seven included access to negative r and positive reinforcement (SR+ - SR-; e.g., break and a preferred activity). Subphase five included an 8-trial probe session similar to FCT-vocal (SR-) with a 5-s time delay to the controlling prompt.

**Phase III: return to baseline.** This condition was identical to the baseline condition implemented in Phase I. Target vocal FCRs, if they occurred during this phase, were placed on extinction. The participants did not have the opportunity to engage in the card response because this stimulus was not present during baseline sessions.

**Phase IV: replication of more efficient FCT treatment.** The most efficacious treatment for each participant during Phase II was reintroduced. This phase ended when the treatment reached the following two targets: (a) destructive behavior was at least 85% lower than the previous baseline and (b) the participant emitted the correct FCR independently during at least 85% of the opportunities across three consecutive sessions.

**Phase V: return to baseline.** Phase V was identical to the baseline condition implemented in Phases I and III with the following caveats. To limit carry-over effects from the prior treatment phases, this baseline was conducted in a novel treatment room with two novel therapists.

**Phase VI: non-contingent reinforcement (NCR) comparison.** One NCR schedule (NCR-card) was yoked to the schedule of reinforcement present during the FCT-card condition described above and the other NCR schedule (NCR-vocal) was yoked to the schedule of reinforcement present during the FCT-vocal condition. The alternative FCR involving a card touch or exchange was not available during this phase and all vocal FCRs were placed on
extinction.

During both NCR conditions (NCR-card and NCR-vocal) destructive behaviors were followed by extinction and the EO for destructive behavior was present continuously throughout the sessions except for during periods of reinforcement. Reinforcement was delivered noncontingently based on the observed durations of exposure to the EO and schedules of reinforcement present during the training conditions within Phase II. Initially during Henry’s NCR comparison phase, reinforcement during the first NCR-card session was delivered at the same times and for the same durations as in the first FCT-card session. Similarly, in the first NCR-vocal session reinforcement was delivered at the same times and for the same durations as in the first FCT-vocal session. Each subsequent NCR-card and NCR-vocal session was likewise yoked to the corresponding FCT session from Phase II.

In order to control for order effects, during replications with Henry and during Frank’s NCR comparison, the same yoked sessions described above (NCR-card and NCR-vocal) were counterbalanced across the NCR comparison phase. More specifically, instead of being implemented in the same order as during the FCT analysis, for every two sessions an NCR-vocal schedule and an NCR-card schedule were randomly selected and which condition occurred first was randomly selected. This randomization was used to ensure that the first two sessions of the NCR comparison phase included one vocal and one card, and so that no more than two sessions of one condition occurred back-to-back. Additionally, counterbalancing the order of the sessions across the NCR phase allowed for experimenter control over which condition occurred first across participants and phases. The NCR comparison phase ended when there were no more sessions to be implemented or when at least one of the conditions reached the treatment target of destructive behavior being at least 85% lower than baseline across three consecutive sessions.
During the NCR-comparison for destructive behavior maintained by access to social attention, the therapist delivered a statement at the start of each session (e.g., “I have to watch my movie now; you can play with your blue truck.”). The therapist then removed attention and engaged in an activity until signaled by a data collector (e.g., a white piece of paper held up to the mirror) at which point he/she delivered high quality social attention for 20-s.

For destructive behavior maintained by escape from demands, NCR-card sessions included the delivery of the same statement used as the Sd statement during FCT-card (e.g., “It’s time to do some work”). This statement was delivered at the same times in the NCR comparison sessions as the Sd statements were delivered in previous FCT-card sessions. For example, if the Sd statement was delivered at second 29 during the FCT treatment condition, then the Sd statement was delivered at second 29 during the corresponding NCR condition. This was followed by a statement indicating access to a break from demands (e.g., “OK, you don’t have to.”) and a 20-s reinforcement interval. NCR-vocal conditions for destructive behavior maintained by escape from demands occurred similarly to NCR-card with one exception. If a reinforcement interval did not occur during the corresponding FCT-vocal condition (e.g., if the child did not emit the target FCR) then the therapist continued to deliver specific demands (i.e., “Put the car in the box.”) following the delivery of the statement “it’s time to do some work” until he/she was signaled to deliver the statement again. It should be noted that although the three-step prompting procedure was implemented during this condition the sequence was interrupted contingent on the delivery of a new Sd statement.

Following completion of this phase, each participant was again exposed to sessions involving the more efficient FCT treatment (Phase IV) to ensure stability of the FCR. However, these data are not relevant to the current study and are therefore not discussed.
Results

Participant 1: John

Results from the functional analysis completed with John indicated that destructive behavior was maintained by escape from demands (see Figure 1). Destructive behavior occurred at high and stable rates during demand relative to the control (toy play) condition.

I depict John’s destructive behavior across the four FCT analysis phases (e.g., baseline, FCT-comparison, a second baseline, and the more efficient FCT treatment) in the top panel of Figure 2. During the initial baseline (sessions 1-9) John engages in moderate and relatively stable rates (range per minute, 0.87 to 2; mean=1.63) of aggressive and disruptive behavior. Upon implementation of the FCT-card condition, rates of destructive behavior immediately dropped below baseline levels. Destructive behavior occurred at moderately low rates (0.8 responses per minute) during the first two FCT-card sessions (sessions 10 and 12) and then dropped to near zero or zero throughout the remainder of the phase.

In contrast, John’s rates of destructive behavior during the first FCT-vocal condition (session 11) immediately increased above baseline levels (5 responses per minute) resulting in an extinction burst (as defined by Lerman and Iwata, 1995). Destructive responses decreased to a moderate level (1.2 responses per minute) during the third FCT-vocal condition (session 14). However, there was a spike in destructive responses (4.8 responses per minute) during the fourth FCT-vocal condition (session 17), which corresponded with an increase from a 0-s to a 2-s time delay in the controlling prompt. Following this increase in destructive behavior, rates during FCT-vocal dropped to zero and remained there for three consecutive sessions (sessions 19, 22, and 23). A third spike in destructive behavior was observed during the eighth FCT-vocal
condition (session 25). However, the rate was less than that of the previous two increases in destructive behavior (e.g. 2.2 responses per minute). Destructive responses again dropped to zero during the final two FCT-vocal sessions (sessions 27 and 29) of the FCT treatment analysis phase.

John’s combined independent and prompted FCRs during both FCT conditions are shown in the bottom panel of Figure 2. The data for John’s independent (top panel) and prompted (bottom panel) FCRs are shown separately in Figure 3. During the first two sessions of FCT-card, prompted responses occurred 100% of opportunities when a 0-s time delay was in place. However, when the time delay increased to 2-s (session 16), prompted responses immediately dropped to zero as John began to independently emit the target FCR (e.g., card touch) 100% of opportunities. This pattern of responding remained stable as the time delay increased to 4-s (session 20). An increase in the time delay to 10-s (session 24) resulted in John emitting independent responses 90% of opportunities for two of the four sessions at this time delay.

During the first FCT-vocal session John engaged in one prompted response and zero independent responses. John emitted prompted responses 100% of opportunities during the second and third FCT-vocal sessions (sessions 13 and 14). John emitted only two independent responses and one prompted response when the time delay increased to 2-s (session 17) during the fourth FCT-vocal session. During the fifth, sixth and seventh FCT-vocal sessions (sessions 19, 22, and 23), which were associated with zero rates of destructive behavior, combined prompted and independent responding was approximately 84%, 100%, and 78% respectively. John emitted prompted responses approximately 17% of opportunities and independent responses 0% of opportunities during session eight of FCT-vocal, which corresponded with an increase in rates of destructive behavior (session 25). During the final two FCT-vocal sessions
of the treatment analysis phase, John emitted the FCR on 90% and 100% of opportunities.

John’s FCT treatment analysis occurred prior to treatment criteria being established for increasing the time-delay to the controlling prompt and for ending a phase. These criteria were established based on findings from John’s analysis. Therefore, the decision to end John’s FCT treatment analysis phase was determined solely on visual analysis of the data. However, posthoc analysis of the data indicated that John met treatment criteria following four FCT-card conditions (met at session 16). Treatment criteria were also met during the final two FCT-vocal conditions of the phase.

During John’s FCT analysis, destructive responses diminished rapidly during the FCT-card condition. An 85% reduction in destructive behavior from baseline occurred during the third FCT-card condition (session 15) and responding remained below this criterion line for the remainder of the treatment analysis. Although destructive behavior began to decrease following the first FCT-vocal session, the fourth session was associated with high rates of destructive responding. An 85% reduction in destructive behavior from baseline did not occur during the FCT-vocal condition until session 19 (the fifth FCT-vocal session). However, after a period of time with stable, zero rates of responding destructive responses again increased for this condition.

Additionally, the time-delay increased from 0 to 10 s across the FCT-card condition due to low rates of destructive behavior and high levels of prompted and/or independent engagement in emitting the FCR. The time-delay did not increase beyond 2 s during FCT-vocal despite a similar number of sessions across the phase relative to FCT-card. Therefore, due to the steady, low to zero rates of destructive behavior and high levels of prompted and/or independent FCRs during FCT-card and the variable levels of appropriate responding, as well as spikes in rates of
destructive behavior during FCT-vocal, it was determined that FCT-card was the more effective treatment for John.

During the return to baseline (Phase III) John engaged in variable rates of destructive behavior. However, his responding stabilized and maintained at moderate levels during the final four sessions of this phase (sessions 44-47). Although John emitted independent FCRs at least 90% of opportunities across all sessions in Phase IV (replication of the more effective FCT treatment), he was observed to engage in lower rates of destructive behavior during the first four sessions of this final phase (sessions 48-51). However, destructive behavior decreased and John met the treatment criteria for ending the phase due to destructive behavior occurring at least 85% below baseline rates, as well as independent FCRs occurring during at least 85% of opportunities (refer to Figures 2 and 3).

**Participant 2: Frank**

Results for Frank’s standard functional analysis are shown in Figure 4. Undifferentiated rates of destructive behavior (e.g., aggression and disruption) are observed across all test conditions relative to the control condition (toy play) resulting in the need for additional assessment. Based on anecdotal information provided by Frank’s mother, a pairwise functional analysis (see the bottom panel of Figure 2) was completed. Rates of destructive behavior are observed to be variable during the attention condition; however, rates are higher relative to those that are observed during the control condition. Therefore, results from the pairwise functional analysis indicated that Frank’s destructive behavior was maintained by access to social attention.

Following completion of the pairwise functional analysis, Frank participated in the FCT treatment comparison. During FCT-card the FCR was initially a card exchange, but due to destructive behavior corresponding with the exchange (e.g., swiping the card, refusing to release
the card into the therapists hand), which made it difficult to efficiently complete the physically guided response, the target FCR was changed to a card touch beginning in the fourth FCR-card condition (session 16).

Frank’s destructive behavior during all phases of the FCT comparison is shown in the top panel of Figure 5. During the initial baseline (Phase I) Frank engaged in variable rates of destructive behavior. Thus, all sessions during the FCT treatment comparison phase (Phase II) occurred at a 0-s time delay to ensure that low, stable rates of destructive behavior maintained, as well as to ensure that sufficient exposure to the functional reinforcer occurred following emission of the FCR. Initially, low rates of destructive behavior occurred during the FCT-card condition (session 15). An increase in the rates of destructive behavior was observed during the second FCT-card session (session 17). Rates of destructive behavior decreased following this session. Following the change in the FCR, destructive behavior remained at zero or near zero rates across all FCT-card sessions for the remainder of the phase.

Rates of destructive behavior were also initially low during the first FCT-vocal session (session 14). Gradual increases in destructive behavior were observed across the subsequent two sessions (sessions 16 and 18). However, a rapid increase in destructive behavior occurred during the fourth FCT-vocal condition, which followed the change in the FCR during the FCT-card condition. During the fifth, sixth and seventh FCT-vocal sessions, rates of destructive behavior were variable. Destructive behavior decreased and remained near zero during the FCT-vocal condition across the final three sessions of the phase.

Frank’s combined independent and prompted FCRs are shown in the bottom panel of Figure 5. Frank’s independent (top panel) and prompted (bottom panel) FCRs are shown separately in Figure 6. Given that the PTD remained at 0 s throughout the entire phase,
prompted responses occurred 100% of opportunities during the FCT-card condition. Prompted FCRs during the FCT-vocal condition occurred at zero to moderate rates (e.g., ranging from 0% to 60%) across all sessions. Frank was not observed to engage in independent FCRs during the FCT-vocal condition. Visual analysis of the data indicated that sessions during which Frank emitted the FCR more frequently were associated with decreased rates of destructive behavior.

Treatment decisions for Frank were also made via visual analysis of the data. Low, stable rates of destructive behavior maintained across several sessions (e.g., six sessions) during FCT-card, where-as rates were variable during FCT-vocal and low rates were only observed during the final three sessions of this condition. Additionally, Frank engaged in zero to moderate levels of prompted FCRs during FCT-vocal where-as prompted responses occurred 100% of opportunities during FCT-card. Thus, given the low, steady rates of destructive behavior and high levels of prompted FCRs during FCT-card, relative to the variable rates of destructive behavior and low to moderate levels of prompted responses during FCT-vocal, it was determined that FCT-card was the most effective treatment for Frank.

During the return to baseline (Phase III), Frank engaged in variable rates (refer to the top panel of Figure 5) of destructive behavior. The time-delay remained at 0-s across the first two sessions (sessions 57 and 58) during Phase IV (a return to the more effective treatment). During these two sessions 100% prompted responses and zero rates of destructive behavior were observed. Therefore, the time-delay to the controlling prompt was increased to 2-s beginning with the third session of the final phase (session 59). During the first session at a 2-s time delay, zero occurrences of destructive behavior, as well as 100% independent FCRs, were observed. Independent responding decreased to moderate levels (e.g. 70% of opportunities), where-as destructive behavior remained at zero during the next session. Low to zero rates of destructive
behavior and 100% independent FCRs were observed across the final three sessions.

Frank participated in the NCR comparison following the conclusion of the FCT treatment analysis. Two novel therapists were introduced during baseline and each assigned to one condition (NCR-card or NCR-vocal) during the comparison phase. Data for the NCR comparison are shown in Figure 7. The top panel shows overall responding and the bottom panel shows responding across therapists separately. Overall, a slight increasing trend in the data path, with variability in destructive behavior, occurred within the baseline phase (top panel). However, a difference in responding across therapists was observed (bottom panel). Destructive behavior occurred at a slightly increasing, yet steady rate with Therapist 1 and variable rates were observed with Therapist 2. Mean rates of destructive responding were 3.95 with Therapist 1 and 4.36 with Therapist 2. Thus, given that decreased rates of destructive behavior were expected to occur during NCR-card relative to NCR-vocal, Therapist 2 (associated with a higher baseline mean) was selected as the therapist to implement NCR-card sessions and Therapist 1 implemented NCR-vocal sessions.

During Phase VI, the NCR comparison, Frank engaged in variable responding during the NCR-card condition. Low to moderate rates of destructive behavior were observed across NCR-card sessions. During the first NCR-vocal session (session 21) an extinction burst was observed. Destructive behavior decreased across several sessions following the extinction burst during the NCR-vocal condition. However, overall variable rates of destructive behavior, more-so than in the NCR-card condition, were observed during the NCR-vocal condition. NCR-vocal was associated with higher rates of destructive behavior in all but two sessions (sessions 25 and 29) relative to NCR-card. Additionally, when looking at the NCR-vocal and NCR-card pairs (i.e., isolating every two sessions: one NCR-vocal and one NCR-card) across the phase, destructive
behavior occurred at higher rates within NCR-vocal for each pair except one (e.g., sessions 25 and 26) regardless of which condition was presented first. Treatment criterion was not met in either condition.

**Participant 3: Henry**

Results for Henry’s standard functional analysis are shown in the top panel of Figure 8. Findings from Henry’s functional analysis are inconclusive resulting in the need for additional assessment. Thus, Henry participated in two pairwise functional analyses that were also inconclusive. Henry then participated in an assessment during which he was exposed to series of escape conditions. Although results of this assessment are not shown, findings indicated that Henry’s destructive behavior was maintained by escape from demands. However, given the multiple assessments conducted to conclude a social function for destructive behavior a final assessment was implemented with Henry. Henry participated in an ABABAB reversal (see the bottom panel of Figure 8) with the demand and toy play conditions to ensure stability in baseline rates of destructive behavior. Results from this assessment, which verified an escape function for Henry’s destructive behavior, are shown in the bottom panel of Figure 8.

Prior to the FCT analysis, Henry was observed to engage in card exchanges, thus this response topography was selected as the target FCR. However, following an increase in observed rates of destructive behavior and anecdotal information indicating that the physical effort to complete the exchange may have competed with the efficiency of the response (Henry often lied on the ground, face down with his hands tucked underneath his body), the FCR was changed to a card touch. The vocal FCR was initially “break, please” as Henry had a requesting repertoire that included three-to-four word phrases. However, given the relative decrease in response effort within FCT-card the relative response effort during the FCR-vocal condition was
Data for Henry’s destructive behavior during all phases of the FCT treatment analysis are shown in the top panel of Figure 9. Seven subphases were implemented throughout Henry’s FCT analysis. During the first subphase (negative reinforcement only; SR-) Henry initially engaged in low to moderate rates of destructive behavior across the first five sessions of the FCT-card condition (sessions 11, 13, 14, 16, and 19). An increase in destructive behavior was observed during the sixth FCT-card session and although rates decreased slightly during the session that followed, rates were still moderately elevated. The change in FCR occurred during the eighth session of FCT-card (session 24). However, high stable rates of destructive behavior were observed during the final two FCT-card sessions (sessions 24 and 27) of the first subphase.

Elevated rates of destructive behavior, meeting the definition of an extinction burst, were observed across the first three FCT-vocal sessions during subphase I. Destructive behavior dropped to moderate rates during the fourth FCT-vocal session (session 18), but remained variable throughout the remainder of the phase. During the first session (session 25), in which the relative response effort of the FCR was decreased, a spike in destructive behavior was observed. Detailed analysis of the data indicated that increased rates of destructive behavior occurred during the reinforcement intervals across successive sessions. This suggested that removal of demands alone was not sufficiently competing with destructive behavior. Thus, it was determined that a positive reinforcer may be needed to increase the value of Henry’s breaks.

Subphase II consisted of access to negative (SR-; breaks from demands) and positive (SR+; access to Legos) reinforcement contingent on the emission of an FCR. Legos were selected as the preferred stimulus based on data from Henry’s preference assessment. Destructive behavior decreased during the first FCT-card condition (session 29) within subphase
II relative to the previous subphase; however rates continued to be moderately high. No occurrences of destructive behavior were observed during the second FCT-card condition (session 30), but rates dramatically increased during the final FCT-card session (session 32) of subphase II. Steady, elevated rates of destructive behavior were observed during FCT-vocal across subphase II (sessions 28, 31, and 33). Based on the maintenance of moderate to high rates of destructive behavior, as well as anecdotal observation of the sessions, it was determined that a change in the preferred activity was necessary. Henry engaged in disruptions with the Lego pieces making it difficult for the therapist to with-hold all Lego pieces from Henry outside of the reinforcement intervals.

Subphase III included a return to the SR- FCT conditions. Moderately high rates of destructive behavior were observed during the FCT-card sessions (sessions 35 and 36). Additionally, during FCT-vocal elevated rates of destructive behavior were observed during the first session and high rates also occurred during the second session (sessions 34 and 37). Only two sessions of each FCT condition were implemented given the maintenance of high rates of destructive behavior.

A new positive reinforcer, a Spiderman cartoon played on a hand-held DVD player, was included in subphase IV (SR+ - SR-). Henry selected this cartoon from an array of two available movie options. Destructive behavior immediately dropped to zero during FCT-card sessions and remained at zero for the duration of subphase IV (sessions 38, 41, 43, and 44). During the first FCT-vocal session (session 39) destructive behavior occurred at an elevated rates. However, during all subsequent FCT-vocal sessions zero occurrences of destructive behavior were observed across the subphase.

In order to discern if the positive reinforcer was a necessary treatment component or if
destructive responses would remain at zero to low rates in the absence of the positive reinforcer (given the recent history of the FCRs with access to the functional reinforcer) Henry participated in an 8-trial SR-probe session (session 47). This probe session was identical to the SR- FCT-vocal condition. An increase in destructive behavior was immediately observed within the probe session indicating that the positive reinforcer may be a necessary component for an effective treatment package. Demonstration of experimental control and the need to maintain the availability of the positive reinforcer within the escape interval was shown during a reversal to the SR-phase (subphase VI) followed by a return to the SR+ - SR-phase (subphase VII).

Subphase VI consisted of a return to SR-break intervals. Destructive behavior occurred at moderately high rates during FCT-card sessions. However, destructive responding gradually decreased across the first four FCT-card sessions (sessions 48, 49, 51, and 54), with zero occurrences being observed during the fifth session (session 55). The last five FCT-card sessions of subphase VI were at or below the 85% reduction from baseline criterion. Rates of destructive behavior were variable across the first four FCT-vocal sessions (sessions 50, 52, 53, and 56). Destructive responses began to decrease during the fifth FCT-vocal session (session 57). The final three FCT-vocal sessions were associated with destructive behavior below the 85% reduction criterion.

Henry’s combined independent and prompted FCR data are shown in the bottom panel of Figure 9. Independent (top panel) and prompted (bottom panel) FCRs are displayed separately in Figure 10. A 0-s time delay was in place across subphases I, II, and III. Thus, prompted responses occurred 100% of opportunities during the FCT-card condition. During the FCT-vocal condition, across the first three subphases, independent FCRs were not observed and prompted responses only occurred approximately 20% of opportunities during the second FCT-vocal
session (session 12; during subphase I). There were no other occurrences of prompted FCRs during FCT-vocal across the first three subphases.

Subphase IV (SR+ - SR-) began with a 0-s time delay across the first two FCT-card sessions (sessions 38 and 41) and the first three FCT-vocal sessions (sessions 39, 40, and 42). Prompted responses occurred 100% of opportunities during FCT-card sessions 38 and 41. During FCT-vocal zero occurrences of prompted FCRs occurred during session 39. However, prompted responses occurred 100% of opportunities during FCT-vocal sessions 40 and 42. An increase in the time delay to 2-s resulted in 100% independent emission of the FCR during FCT-card (sessions 43 and 44). Moderate (78%) to high (86%) levels of independent responding were also observed during the FCT-vocal condition when a 2-s time delay was introduced.

The FCT-vocal probe session (session 47; subphase V) that occurred at a 2-s time delay resulted in a decrease in independent and prompted responding. There were zero occurrences of independent FCRs emitted during the probe session and prompted responses occurred during 25% of opportunities. Given an increase in destructive behavior during the probe session the SR- phase was reintroduced (subphase VI). This corresponded with an increase in the time-delay to 5-s across both FCT conditions. Decreased levels of independent emission of the FCR were observed across the first four sessions (sessions 48, 49, 51, and 54) of FCT-card. Independent FCRs occurred 100% of opportunities during the fifth FCT-card session of this subphase (session 55) and remained relatively high and stable throughout the remainder of the phase. Independent and prompted FCRs emerged at low levels during the first two FCT-vocal sessions of this subphase (sessions 50 and 52), followed by a decrease to zero occurrences during the two subsequent sessions (sessions 53 and 56). During the final four sessions of FCT-vocal (sessions 57, 59, 61 and 63) moderate to high levels of independent FCR emissions (range 54%
to 100%) were observed. Additionally, combined independent and prompted responses occurred 100% of opportunities across the final three FCT-vocal sessions of subphase VI.

During subphase VII, the SR+ - SR- FCT conditions were reintroduced. Independent FCRs occurred 100% of opportunities across both conditions during all sessions. Destructive behavior immediately dropped to zero across all FCT-card sessions and the first two FCT-vocal sessions. Low rates of destructive behavior were observed during the final FCT-vocal session of the subphase (session 69).

FCT-card with negative reinforcement only (SR-) was more efficient at reducing destructive responses across successive sessions relative to FCT-vocal (SR-). During subphase I, moderate to high rates of destructive behavior occurred across both conditions, with destructive responding increasing across sessions during FCT-card. However, overall we observed lower rates of destructive behavior during the FCT-card condition compared to the FCT-vocal condition. Additionally, Henry contacted the functional reinforcer through emission of the alternative response (FCR) more efficiently during FCT-card given the therapist’s ability to physically guide the response. Independent emission of the FCR during the FCT-card condition also occurred more rapidly and remained consistently high when compared to the emergence of the independent FCR emitted during the FCT-vocal condition. However, neither condition given negative reinforcement only (SR-) proved to be the most efficient or effective treatment for Henry’s.

Despite destructive behavior decreasing to low rates during both FCT conditions in subphase VI (SR- only), addition of the positive reinforcer to the escape interval (SR+- SR-) was more efficient in reducing destructive responding and maintaining low rates of destructive behavior across successive sessions. Additionally, inclusion of the positive reinforcer
corresponded with consistently high levels of independent FCRs across both FCT-card and FCT-vocal conditions. Thus, it was determined that the most efficient and effective treatment package for Henry was an FCT intervention including access to a preferred activity during the escape interval (e.g., SR+ - SR-). Henry demonstrated the ability to consistently engage in the vocal FCR independently, as well as in zero to low rates of destructive behavior when negative and positive reinforcement were combined (see subphase VII). Given that increasing vocal behavior, in addition to decreasing destructive behavior, was a treatment goal for Henry the FCT-vocal condition, with inclusion of the positive reinforcer during escape intervals, was determined to be the most effective treatment package for Henry.

In the return to baseline (Phase III), immediate increases in destructive behavior were observed. Henry’s responding was slightly variable across the first three sessions, but stabilized towards the end of the phase. Following baseline, Henry participated in the final FCT treatment phase (Phase IV). Destructive behavior immediately dropped to zero and independent FCRs occurred 100% of opportunities. Henry met treatment criteria within three sessions.

Following the FCT analysis, Henry participated in the NCR comparison. Two novel therapists were selected to implement baseline sessions and subsequent NCR-card and NCR-vocal sessions (one therapist was assigned to each condition). Data for Henry’s destructive behavior across baseline and NCR comparison phases are shown in Figure 11. The top panel displays overall responding across phases and the bottom panel shows responding across therapists.

During the first baseline phase, rates of destructive behavior were relatively stable with a slight increasing trend towards the end of the phase. A slight differentiation in destructive behavior was observed across therapists (see Figure 11 – bottom panel). The mean rate of
destructive behavior was 2.9 per minute with Therapist 1 and 3.1 per minute with Therapist 2. Therefore, Therapist 2 (associated with slightly higher rates of destructive behavior) was assigned to the NCR-card condition and Therapist 1 implemented the NCR-vocal sessions.

Initially, high rates of destructive behavior were observed during the NCR-card condition (sessions 7 and 8). Moreover, an extinction burst was observed during session 7. A dramatic decrease in destructive behavior occurred during the remainder of the NCR-card sessions; however, treatment criterion was not met. Moderate rates of destructive behavior, similar to baseline rates, were observed during the first two NCR-vocal sessions (sessions 9 and 11). Destructive behavior increased during the third NCR-vocal session (session 12) and this was followed by a decrease in destructive behavior during the final two sessions (sessions 15 and 16). Treatment criterion was also not met during the NCR-vocal condition.

Given the sequential occurrence of two NCR-card sessions at the beginning of the aforementioned NCR comparison phase a replication occurred to control for order effects. Henry engaged in moderate and stable rates of destructive behavior during the second baseline phase. Mean rates of destructive responses were equal across the two therapists (e.g., 2.5 per minute). An immediate decrease in destructive responses occurred during the NCR-card condition relative to baseline. Destructive behavior remained low and relatively stable across the phase. However, treatment criterion was not met during the NCR-card condition. An extinction burst was observed during the first NCR-vocal condition (session 23). Destructive behavior decreased to baseline levels during the subsequent two sessions (sessions 26 and 28), followed by a near zero point (session 30). During the last NCR-vocal session, an increase in destructive behavior, slightly above that of baseline levels, was observed.

During the first NCR comparison, the phase began with an NCR-card session and during
the second NCR comparison the phase began with an NCR-vocal session. Therefore, to additionally control for order effects a replication of the second NRC comparison phase occurred. During the third baseline phase rates of destructive behavior were relatively stable, with slightly elevated rates observed during the first and last sessions of the phase. Mean rates of destructive responding were similar across therapists; 1.9 per minute occurred with Therapist 1 and 1.8 per minute with Therapist 2.

During the final NCR comparison phase low rates of destructive behavior were observed across all NCR-card sessions. Treatment criterion was not met during the NCR-card condition. An extinction burst was again observed during the NCR-vocal condition across the first two sessions (sessions 40 and 41). A decrease in destructive behavior occurred during the third NCR-vocal condition (session 44). During the next NCR-vocal session (session 46) a spike in destructive responses was observed. This was followed by a decrease in the rate of destructive behavior during the final NCR-vocal session (session 48).

**Discussion**

In the current study I evaluated the effects of EO manipulations on destructive behavior and FCR acquisition using FCT. Three participants (John, Frank, and Henry), with socially maintained destructive behavior, were exposed to two alternative FCT interventions, one in which a card touch (FCT-card) was used as the FCR and another in which a one- or two- word vocal mand was used as the FCR, with both FCRs taught in a parallel fashion using a PTD training procedure. Two of these participants (Frank and Henry) were also exposed to another analysis, one in which I compared the effects (on problem behavior) of two NCR schedules that were yoked to the FCT-card and FCT-vocal conditions. This analysis provided a direct test of my hypothesis that the FCT-card condition was more effective than the FCT-vocal condition.
because I was able to tightly control and limit exposure to the EO in the FCT-card condition but not in the FCT-vocal condition.

For all three participants, the FCT-card condition produced larger and more rapid reductions in problem behavior than the FCT-vocal condition. In addition, when NCR schedules were compared that were yoked to these two FCT conditions, the NCR-card conditions similarly produced larger and more rapid reductions in problem behavior for Frank and Henry. Moreover, two of the three participants (John and Henry) displayed extinction bursts (as defined by Lerman & Iwata, 1995), but only during the FCT-vocal condition and not during FCT-Card condition. Similarly, the two individuals who participated in the NCR analysis both showed extinction bursts, and again, only in the NCR-vocal condition and not in the NCR-card condition (with the exception of the first NCR comparison implemented with Henry). Taken together, these analyses indicated that controlling exposure to the EO for problem behavior can have a large influence on the effectiveness of FCT as a treatment for problem behavior.

It should be noted, however, that clinically acceptable reductions in problem behavior for one participant (Henry) were achieved only after the FCR produced both a break from nonpreferred tasks and access to a preferred tangible activity (a movie). Once this treatment component was added, Henry’s problem behavior decreased to near-zero levels in both the FCT-card and FCT-vocal conditions and we chose FCT-vocal as Henry’s final treatment because increasing his use of spoken words was a treatment goal in addition to decreasing his problem behavior.

Although Henry’s final treatment package included the FCT-vocal intervention with the addition of a positive reinforcer, his responding was consistent with my EO hypothesis during the initial FCT comparison, when both FCRs produced only a break from nonpreferred tasks.
More specifically, lower rates of target destructive behavior were observed during FCT-card compared to FCT-vocal. Initial differences in rates of destructive behavior were immediately observed during the first FCT intervention comparison (subphase I), with destructive behavior occurring below that of baseline levels within FCT-card and above that of baseline levels within FCT-vocal. Additionally, during the third FCT intervention comparison (subphase VI) rates of destructive behavior decreased more rapidly within FCT-card compared to FCT-vocal.

Henry’s independent FCR acquisition also occurred more rapidly within the FCR-card condition compared to FCT-vocal. Henry immediately emitted independent FCRs 100% of opportunities during FCT-card when the PTD was increased from 0- to 2-s. Henry’s independent emission of the FCR during FCT-vocal emerged with an increase from 0-to 2-s, but it did not immediately meet mastery criterion (at least 85% of opportunities). Additionally, Henry engaged in prompted responses 100% of opportunities during FCT-card given the therapist’s ability to physically guide the FCR; Henry engaged in prompted responses approximately 20% of opportunities during one session of FCT-vocal within subphase I. He did not begin to engage in prompted responses at clinically acceptable levels (at least 85% of opportunities) in the FCT-vocal condition until the positive reinforcer was added to the treatment package. Thus, it can be argued that FCT-card was in fact the more effective treatment for Henry given that across subphases (including negative reinforcement only and negative plus positive reinforcement phases) lower rates of destructive behavior and quicker acquisition of the target FCR occurred in this condition. However, given Henry’s success with FCT-vocal, provided the addition of the positive reinforcer, and the social validity associated with a vocal FCR, it was determined that the FCT-vocal plus positive reinforcer treatment package was most appropriate for Henry.
John and Frank also engaged in faster acquisition of the target FCR in FCT-card compared to FCT-vocal. Independent emission of the target FCR occurred rapidly for both participants, and actually occurred at maximal levels within FCT-card given the first opportunity (e.g., increasing the time delay to 2-s). John and Frank’s independent responding continued within FCT-card above criterion levels (at least 85% of opportunities) across the FCT intervention comparison phase.

John contacted the contingent relationship between the vocal FCR and access to the functional reinforcer during the first FCT-vocal condition, and contact occurred more frequently during the subsequent two sessions (e.g., 100% prompted responses). Despite this, John engaged in variable levels of prompted FCRs in the FCT-vocal condition across the FCT intervention comparison phase. In addition, John engaged in variable levels of the target FCR independently in the FCT-vocal condition when provided the opportunity to do so (i.e., increasing the time delay to the controlling prompt). John engaged in independent emission of the vocal FCR at or above the criterion level during just one FCT-vocal session.

During the FCT-intervention-comparison phase conducted with Frank, the time delay for delivery of the controlling prompt remained at 0 s throughout the phase, and thus all FCRs were prompted in all sessions for both conditions. However, during the final FCT treatment phase (e.g., FCT-card only), Frank independently emitted the target FCR during 100% of opportunities when the time-delay was increased to 2-s. Frank met the treatment criteria within five sessions at the 2-s time delay due to one session with independent responding that occurred below the criterion line (85%).

Frank did not emit an independent FCR during any FCT-vocal session. Although Frank engaged in prompted responses across the majority of sessions during the FCT intervention
comparison, he showed variability in his responding. Overall, the reduced exposure to the EO for destructive behavior during FCT-card resulted in greater and more rapid reductions in destructive behavior and faster acquisition of the target FCR for all three participants.

One limitation of the current study was that it was not possible to precisely equate response effort for the two FCT conditions. I attempted to mitigate the effects of this limitation by minimizing response effort in both FCT conditions. However, I did not formally assess response effort, and it is possible one of the FCRs was more effortful than the other FCR for one or more of the participants. It should be noted, however, that I removed response effort as a potential confounding variable in the NCR comparison, because during this analysis reinforcer deliveries occurred on a time-based, response-independent basis. Thus, the observed duration of exposure to the EO during FCT-card and FCT-vocal conditions was isolated to directly examine the effects on destructive behavior without the influence of response effort as a confounding variable during the NCR analysis.

The schedules of reinforcement present during the NCR analysis in the current study were exactly matched to those created by the individual participants based on their responding during the FCT intervention comparison conditions. Thus, each individual participant determined his own schedule of reinforcement and duration of exposure to the EO within the NCR conditions based on his level of independent and prompted FCRs within the FCT-card and FCT-vocal conditions. More specifically, the FCT intervention that facilitated efficient responding and produced more frequent access to reinforcement (e.g., FCT-card) resulted in a denser schedule of reinforcement during the NCR comparison.

Previous research has shown that NCR procedures are more effective when the initial schedule of reinforcement is dense (e.g., Hagopian et al. 1994). Results of the NCR analysis
conducted in the current investigation are consistent with this finding from prior research. Furthermore, the current results indicate that the schedule of reinforcement and corresponding duration of exposure to the EO are also relevant factors in the efficient reduction of target destructive behavior, as well as acquisition of alternative behavior, during other reinforcement-based procedures (e.g., DRA).

Frank and Henry both exhibited differentiated levels of responding, relative to baseline, across the yoked NCR-card and NCR-vocal conditions. Lower rates of destructive behavior were observed during NCR-card conditions compared to NCR-vocal conditions. Frank did not meet treatment criterion during either condition within the NCR comparison. Frank’s engagement in destructive behavior was variable across both conditions, but consistently lower within NCR-card. This finding is different from prior studies comparing FCT and NCR (e.g., Hanley et al., 1997), which have shown the two interventions to be equally effective. Frank’s levels of destructive behavior may have been somewhat higher in the NCR-card condition relative to the FCT-card condition in the current investigation because in the former condition Frank received only vocal attention whereas in the latter condition he received both vocal and physical attention (when he was physically guided to complete the card touch). This possibility could be evaluated in future research on FCT and NCR.

For Henry, an extinction burst was observed in the first NCR-card session during the initial NCR comparison phase, and elevated rates of destructive behavior during the second NCR-card session. It is not entirely clear why this extinction burst occurred during the NCR-card session but not in the FCT-card session to which the NCR-card session was yoked. One possibility is that the NCR analysis followed the FCT treatment that included access to both a break and preferred tangible item (i.e., a movie). This may have resulted in a contrast effect,
such that presentation of the break without the movie, after Henry had repeatedly received a break with the movie, evoked a burst of problem behavior. In the two subsequent phases in which the two NCR conditions were compared, extinction bursts were observed in the NCR-vocal condition but not in the NCR-card condition.

The results of the NCR comparison suggested that relative differences in response effort across the two topographies of the FCRs (e.g., card touch and single word vocal response) was not a relevant variable in the differences I observed in destructive behavior and FCR acquisition across FCT-card and FCT-vocal. However, a possible limitation was the inclusion of an extra stimulus (the card) within FCT-card and no extra stimulus within FCT-vocal. The presence of the card may have been a salient Sd and whether or not the presence of an additional stimulus signaling the availability of a break (contingent on the vocal FCR) within FCT-vocal will facilitate faster reductions in destructive behavior and acquisition of the FCR remains unknown. However, given that children with limited vocal repertoires do not readily imitate vocal responses this may not be likely.

Additional limitations of the current investigation include the lack of a formal assessment for the participants’ echoic and card response repertoires, as well as the accuracy of exposure to the EO during FCT-card (escape). Conducting assessments across several possible vocal topographies may be appropriate for selecting the best vocal FCR, as opposed to arbitrarily selecting a response and probing the child’s ability to emit the selected sound, word, or phrase. Assessments for the card response were also not conducted. It may be useful to complete pre-assessment probes to determine the relative response effort and compliance with exchanging a card versus touching a card. The initial difficulties I observed with Frank and Henry given a card exchange response may be avoided in future research given this pre-assessment
information.

It may be argued that the EO for destructive behavior was not truly present during FCT-card when problem behavior was reinforced by escape given that specific demands were never presented. Thus, it may be more appropriate to assume that the delivery of the Sd statement (“It’s time to do some work”) was a reflexive-conditioned EO (R-CEO) in that it served as a warning statement that work was approaching. This could be evaluated by pairing the Sd statement with a specific demand (e.g., “It’s time to do work. Touch your head.”) across FCT-card and FCT-vocal conditions.

The maintenance and generalization of the FCR across people and environments was not a goal of the current research. However, given that this was not evaluated, the effectiveness of the FCT-card intervention (John and Frank) in maintaining diminished rates of destructive behavior and clinically relevant levels of FCR emission across a variety of therapists and thinning schedules of reinforcement remains unknown. Thus, it also remains unclear as to whether or not selection of the FCT-vocal plus positive reinforcement treatment package was the most appropriate long-term intervention for Henry. It may be that the effectiveness of this intervention in maintaining low rates of destructive behavior and high levels of the vocal FCR breaks down across thinning schedules of reinforcement and/or given different positive reinforcers (the Spiderman video may not be available or an option across all contexts).

A more appropriate treatment package for participants, which future research should evaluate, may be to begin with the FCT-card intervention until low rates of destructive behavior and high levels of FCR emission stabilize across maintenance and generalization assessments (i.e., establish a history of reinforcement with an appropriate behavior and access to the functional reinforcer). After a reinforcement history is established with the FCR (card) the target
FCR can then be transferred to a vocal response (i.e., initially pairing the vocal response with the card response, then fade out the card response). More specifically, the FCT-card intervention ensures the maintenance of the contingency between the FCR and the functional reinforcer, even across increasing schedule requirements, given that the therapist has the ability to physically guide the response.

Differences in rates of destructive behavior and acquisition of the FCR were observed across the three participants suggesting that idiosyncratic variables may influence results. More specifically, an extinction burst was observed during FCT-vocal with John and Henry, but not with Frank. Additionally, difficulties in diminishing target and nontarget behavior during Henry’s FCT intervention comparison did not occur with the other two participants. Henry engaged in oppositional behavior, which may have influenced his willingness to comply with any request. Despite this, Henry was more readily exposed to the contingent relationship between emission of the FCR and access to the functional reinforcer within FCT-card. Thus, results of the current study suggest that an FCT-card intervention may be appropriate for individuals with vocal fluency or strong vocal repertoires who engage in noncompliance. Contact with the response-dependent contingency between the card touch (target FCR) and access to the reinforcer may facilitate decreases in noncompliance, which may then be followed by a shift in responding to a vocal FCR (as discussed above).

Although FCT-card was more effective in decreasing rates of destructive behavior and ensuring that Henry contacted the contingency between the FCR and access to the functional reinforcer compared to FCT-vocal, neither intervention produced clinically acceptable levels of problem behavior. The addition of a positive reinforcer to the negative reinforcement interval was necessary to diminish destructive behavior and facilitate acquisition of the FCR to clinically
acceptable levels. This may initially appear to contradict the current findings in regards to the relationship between the duration of exposure to the EO and destructive behavior. However, given findings from Golonka et al. (2000), this is not a surprising phenomenon, but more-so further evidence of the idiosyncratic differences that may influence responding. The aforementioned study indicated that access to preferred activities during breaks from demands diminished destructive behavior and increased appropriate behavior more-so than a break to nothing (Golonka et al.). Therefore, although the FCT-card condition was associated with decreased exposure to the EO, the functional reinforcer may not have been accurately captured during the negative reinforcement only phase in that a break to a preferred activity was most effective in diminishing destructive behavior relative to a break only. Thus, although the current findings demonstrated the importance of exposure to the EO in the reduction of destructive behavior and acquisition of the alternative response, Henry’s data indicate the relevance of multiple variables in identifying a clinically effective intervention for this participant.

The current research extends several areas of the applied literature on both extinction and FCT. More specifically, Hagopian et al. (2004) identify that EO manipulations (dense vs. lean schedules of reinforcement) within NCR interventions enhanced the effects of extinction and reduced the occurrence of bursting. The current study extends this literature by identifying that dense vs. lean schedules of reinforcement, which are associated with a weak vs. strong EO, respectively, within DRA interventions reduced the occurrence of destructive behavior and the probability of bursting behavior, as well as facilitated faster acquisition of the alternative response (e.g., FCR). Additionally, previous studies (e.g., Lerman & Iwata, 1996) indicated that although the addition of reinforcement-based interventions to extinction for the treatment of destructive behavior reduces the probability of the occurrence of extinction bursts, it does not
consistently diminish bursting behavior; however, the relevant variables related to this phenomenon were not discussed. The current results suggest that the duration of exposure to the EO for destructive behavior is an important variable related to the inconsistencies observed in the occurrence of bursting behavior within reinforcement-based procedures using extinction.

As previously noted, the current FCT literature has a primary focus on the maintenance and generalization of an FCR, leaving little known about the technological details of selecting or teaching the target FCR or acquisition of the target FCR. Winborn et al. (2002) examined response allocation given a novel and existing mand and Grow et al. (2008) used extinction to evoke appropriate mands to gain access to the functional reinforcer. These represent the few applied studies that have focused on selection or acquisition of the target FCR. The current study further extends the FCT literature by directly comparing responding among two different response topographies to determine which was more efficient in reducing destructive behavior and facilitating FCR acquisition. It may be that parents, caregivers, and teachers prefer vocal responses relative to card touch or exchange responses and thus this topography is arbitrarily selected based on preference. However, the current findings suggest that for a subgroup of children (with limited vocal repertoires), a vocalization may not be the most efficient or effective replacement response for target destructive behavior, at least initially. Future research should evaluate the efficiency of other response topographies (e.g., microswitch, sign language) in order to determine the most appropriate alternative response for individuals.

Additionally, I implemented a MTL teaching procedure (e.g., PTD) and demonstrated how this method can be effective in controlling the duration of exposure to the EO, given a response that can be physically guided, as well as in facilitating response acquisition. Previous research has identified a limitation of MTL procedures in that destructive behavior may not be
exposed to extinction, which may cause difficulties during maintenance and generalization of a response (see Tiger et al., 2008). However, the current results suggest that this is not always the case, given that destructive behavior that was present during FCT-vocal was exposed to extinction. Therefore, the problem with a lack of exposure to extinction using MTL teaching procedures may be topography based (i.e., motor responses). Additionally, despite being exposed to extinction, destructive behavior was not efficiently diminished and the target FCR was not effectively established in FCT-vocal.

Previous research has indicated that functional equivalence may not emerge between the mand and destructive behavior when long latencies occur prior to the emergence of an inverse relationship between manding and destructive behavior. Thus, using a teaching method with a dense schedule of prompts (such as MTL) may facilitate functional equivalence. Moreover, although destructive behavior effectively diminished across successive sessions within FCT-vocal, this condition was associated with greater latencies between a response allocation shift from destructive behavior to the FCR (which occurred inconsistently across participants), which indicates that functional equivalence may not have been established within this condition.

The current results also point to the importance of high procedural integrity when implementing reinforcement-based interventions. Although, therapist treatment integrity data was collected and observed throughout the current evaluation, manipulations in integrity (e.g., high vs. low) did not occur. However, given that the current findings indicated that prolonged exposure to the EO, which can occur when prompts and reinforcement are not delivered efficiently, results in slower reductions in destructive behavior and slower acquisition of a target response, the significance of high treatment integrity is relevant during implementation of DRA and other procedures aimed at reducing destructive behavior and/or increasing appropriate
behavior.

SUMMARY

The current study demonstrated the effect of EO manipulations on the effectiveness of two different FCT interventions (e.g., FCT-card and FCT-vocal). An FCT intervention that diminished the duration of exposure to the EO was more effective in reducing target destructive behavior and facilitating efficient acquisition of the alternative response. Future research should take into account the current results when considering variables that influence the effectiveness of reinforcement-based procedures used in conjunction with extinction.
References


effects of extinction on attention-maintained behavior through noncontingent delivery of attention or stimuli identified via a competing stimulus assessment. *Journal of Applied Behavior Analysis, 37*, 171-184.


Figure 1. John’s destructive responses per minute during the functional analysis.
Figure 2. John’s destructive responses (aggression, disruption) per minute during baseline and FCT treatment phases (top panel). John’s combined independent and prompted FCRs during FCT treatment phases (bottom panel).
Figure 3. John’s independent FCRs during baseline and FCT treatment phases (top panel). John’s prompted FCRs during FCT treatment phases (bottom panel).
Figure 4. Destructive responses (aggression and disruption) per minute for Frank during the standard functional analysis (top panel) and the attention/toy play pairwise functional analysis (bottom panel).
Figure 5. Frank’s destructive responses (aggression, disruption) per minute during baseline and FCT Treatment phases (top panel). Frank’s combined independent and prompted FCRs during FCT treatment phases (bottom panel).
Figure 6. Frank’s independent FCRs during FCT treatment phases (top panel). Frank’s prompted FCRs during FCT treatment phases (bottom panel).
Figure 7. Overall destructive behavior (top panel) during baseline and NCR comparison phases. Destructive behavior across therapist (bottom panel) during baseline and NCR comparison phases.
Figure 8. Functional analysis results for Henry (top panel). Demand and toy play reversal assessment results for Henry (bottom panel).
Figure 9. (Top Panel) Henry’s destructive responses per minute (aggression, disruption, screaming) during baseline and FCT treatment phases. (Bottom Panel) Henry’s combined independent and prompted FCRs during FCT treatment phases.
Figure 10. (Top Panel) Henry’s independent FCRs during FCT treatment phases. (Bottom Panel) Henry’s prompted FCRs during FCT treatment phases.
Figure 11. Henry’s overall destructive responses (top panel) during baseline and NCR comparison phases. Destructive responses across therapist (bottom panel) during baseline and NCR comparison phases.