

*UTILITY OF EXTINCTION-INDUCED RESPONSE VARIABILITY FOR
THE SELECTION OF MANDS*

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Functional communication training (FCT; Carr & Durand, 1985) is a commonly used differential reinforcement procedure for replacing problem behavior with socially acceptable alternative responses. Most studies in the FCT literature consist of demonstrations of the maintenance of responding when various treatment components (e.g., extinction, punishment) are present and absent (e.g., Fisher et al., 1993; Wacker et al., 1990). Relatively little research on FCT has (a) evaluated the conditions under which alternative responses are acquired or (b) described procedures with technological precision. Thus, additional research on a cogent technology for response acquisition appears to be warranted. In the current study, we evaluated the efficacy of exposing problem behavior to extinction for inducing response variability as a tool for selecting an alternative response during FCT. Once participants engaged in appropriate alternative responses, the reinforcer identified in the functional analysis as maintaining problem behavior was delivered contingent on the alternative behavior. Results showed that exposing problem behavior to extinction was a useful method for producing alternative behaviors during FCT.

DESCRIPTORS: extinction, functional analysis, functional communication training, manding

Differential reinforcement of alternative behavior (DRA) is one type of function-based treatment that may be implemented to reduce problem behavior (Vollmer & Iwata, 1992). Treatment with DRA involves providing reinforcement for an appropriate, alternative behavior while placing problem behavior on extinction. Functional communication training (FCT; Carr & Durand, 1985) is a specific DRA procedure in which the response–reinforcement contingency for problem behavior is terminated (i.e., extinction), and appropriate, alternative behaviors are shaped and maintained using functional reinforcers.

The efficacy of FCT has been demonstrated in a number of studies across various behavior problems (Belfiore, Browder, & Lin, 1993; Bird, Dores, Moniz, & Robinson, 1989; Jayne, Schloss, Alper, & Menscher, 1994), settings (e.g., Campbell & Lutzker, 1993; Hunt, Alwell, & Goetz, 1988; Smith & Coleman, 1986), and time (e.g., Durand & Carr, 1991). Thus, most studies have focused on the conditions under which a communication response is likely to be maintained rather than the necessary and sufficient conditions under which a response is acquired initially (e.g., Fisher et al., 1993; Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998; Wacker et al., 1990). Specifically, most studies do not provide acquisition data, and many studies exclude sufficient technological detail to draw conclusions about the efficacy of the procedures. Three studies, however, represent attempts to discover the conditions under which acquisition of an alternative response is likely to occur by evaluating the extent to which reinforcement schedules for problem behavior affect acquisition of alternative responses. Shirley, Iwata, Kahng, Maza-

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leski, and Lerman (1997) conducted a treatment comparison that evaluated acquisition of appropriate behavior when problem behavior continued to produce reinforcement on a fixed-ratio 1 schedule. Results indicated that when problem behavior continued to produce reinforcement, inappropriate behaviors persisted and interfered with the acquisition of alternative behaviors. However, once the participants acquired the alternative response, obtaining reinforcement with appropriate behavior effectively competed with ongoing reinforcement of problem behavior for 2 of 3 participants. The authors concluded that extinction of problem behavior may be necessary during the acquisition phase of FCT, but that appropriate responding may persist when reinforcement of problem behavior occurs after acquisition. Two other studies have examined the effects of providing intermittent reinforcement for problem behavior during the acquisition of appropriate behavior (Kelley, Lerman, & Van Camp, 2002; Worsdell, Iwata, Hanley, Thompson, & Kahng, 2000). The results of these studies were similar to those found by Shirley *et al.* in that for most participants, acquisition of appropriate behaviors occurred only when problem behavior was placed on extinction or was exposed to relatively thin reinforcement schedules.

Factors other than consequences for problem behavior also may influence acquisition during treatment with FCT, although little is known about the specific conditions under which acquisition occurs. When initiating an FCT treatment, it may be important to choose an alternative response that requires less response effort than the target inappropriate behavior (e.g., Horner & Day, 1991; Richman, Wacker, & Winborn, 2001) or has an established history of reinforcement. For example, Winborn, Wacker, Richman, Asmus, and Geier (2002) compared FCT treatments when the alternative response was either an existing response (i.e., based on caregiver reports or previous observations) or novel behavior (i.e., a behavior not

previously observed by caregivers). During the treatment evaluation, both novel and existing mands produced reinforcement within a concurrent-schedules design. The participants allocated their responding to the existing response more often than the novel behavior when both responses produced identical consequences. The participants may have allocated responding to the existing response because (a) the response had a history of reinforcement in the natural environment, or (b) the novel behavior required more effort (Horner & Day, 1991).

Using existing responses during FCT may increase the efficiency of implementing treatment because the necessity of training may be reduced if the alternative behavior already exists in an individual's repertoire. Although previous studies have used caregiver report or observation (e.g., Winborn *et al.*, 2002) to select responses, other procedures may facilitate identifying situations in which appropriate, alternative behaviors will emerge. One such procedure in which alternative behaviors may emerge occurs during periods of extinction for problem behavior (Lerman & Iwata, 1996). Extinction involves terminating the response–reinforcement contingency that maintains problem behavior and is characterized by a reductive effect on responding. However, extinction also is associated with some potential side effects, such as aggression, spontaneous recovery, extinction bursts, and response variability (Lerman & Iwata). For example, when a previously reinforced response is placed on extinction, other forms of the response or different responses that are in the same response class may emerge (i.e., extinction-induced response variability). These behaviors may be more dangerous or intense forms of the target behavior. However, responses that emerge during periods of extinction also may include previously reinforced appropriate behaviors such as vocally requesting or pointing to a preferred item. Previous research has shown that when appropriate behaviors are placed on extinction, other

desirable behaviors may emerge (Duker & van Lent, 1991; Harding, Wacker, Berg, Rick, & Lee, 2004; Lalli, Zanolli, & Wohn, 1994) and that reinforcing lower probability responses may produce variability in responding (Miller & Neuringer, 2000). However, limited research has evaluated whether appropriate behaviors may emerge during periods of extinction for problem behavior and whether these behaviors would be maintained if the reinforcer identified in the functional analysis was delivered contingent on the behavior. The purpose of the current investigation was to determine whether (a) appropriate responses would be emitted during extinction of problem behavior, and (b) the appropriate responses that emerge during extinction would be maintained by the same consequence that maintained problem behavior.

METHOD

Participants and Settings

Three individuals who had been admitted to a day-treatment facility for the assessment and treatment of problem behavior participated in the current study. Gus was an 8-year-old boy who had been diagnosed with autism and had been admitted to the day-treatment program for aggression and whining. He communicated vocally using sentences and followed one-step instructions. He participated in the present study following treatment of aggression. Whining was targeted for reduction because his caregiver complained that it interfered with normal activities in classroom and home settings. Curtis was a 10-year-old boy who had been diagnosed with autism and had been admitted to the day-treatment program for aggression, grabbing, and disruption. He communicated through signs and gestures and followed one-step instructions. Jason was a 15-year-old boy who had been diagnosed with autism and had been admitted to the day-treatment program for aggression. He communicated through gestures and one-word utterances.

All sessions were conducted in a room (4 m by 4 m) equipped with a one-way mirror. Two to five 10-min sessions were conducted daily. Materials relevant to each condition were present in the therapy room (see descriptions below).

Dependent Variables, Data Collection, and Interobserver Agreement

Data were collected on several potential appropriate behaviors for each participant (e.g., verbally requesting a break or an item; pointing to an item; and signing for a break, item, or activity) during the functional analysis and initial baseline phase. Potential appropriate behaviors were identified by therapists as behaviors that were observed to have been emitted by the participants during their admission (data available from the second author).

Gus' target problem behavior was *whining*, defined as nonsensical vocalizations above normal conversation levels. Curtis' target problem behaviors were (a) *aggression*, defined as hitting or kicking from a distance of 15 cm or greater; (b) *grabbing*, defined as grasping the therapist's clothes or body and pulling towards him; (c) *disruption*, defined as throwing or kicking objects and pushing work materials away from him. Jason's target problem behaviors were *aggression*, defined as hitting or kicking from a distance of 15 cm or greater; and *head butting*, defined as forceful contact between Jason's head and the therapist's body. Gus' target appropriate behavior consisted of "don't" requests, vocally asking the therapist to terminate activity interruption. Curtis' target appropriate behavior was shaking his head "no" in a side-to-side motion. Jason's target appropriate behavior reaching for an item.

Data were collected on laptop computers using a continuous recording procedure. A second observer independently collected data for Gus, Curtis, and Jason during 50%, 47%, and 34% of the functional analysis sessions, respectively, and during 53%, 32%, and 80% of treatment analysis sessions, respectively. Interobserver agreement

was calculated for each dependent variable by partitioning the sessions into 10-s bins, dividing the number of agreements by the number of agreements plus disagreements, averaging the quotients for each session, and multiplying by 100%. An agreement was defined as two observers scoring an occurrence or nonoccurrence of target behavior and a disagreement was defined as one observer scoring the occurrence of a behavior and the other observer not scoring the occurrence of behavior within a 10-s bin. Mean total interobserver agreement for problem behavior during the functional analysis was 95% (range, 87% to 100%) for Gus, 92% (range, 89% to 100%) for Curtis, and 97% (range, 93% to 100%) for Jason. Mean total agreement for problem behavior during baseline was 98% for Gus (range, 96% to 100%), 99% for Curtis (range, 97% to 100%), and 98% (range, 94% to 100%) for Jason. Mean agreement for appropriate behavior during baseline was 97% for Gus (range, 95% to 100%), 100% for Curtis, and 94% (range, 88% to 100%) for Jason. Mean total agreement for problem behavior during extinction plus reinforcement of emerging behavior (EXT plus reinforcement) was 95% for Gus (range, 89% to 100%), 89% for Curtis (range, 84% to 100%), and 99% (range, 97% to 100%) for Jason. Mean total agreement for appropriate behavior during EXT plus reinforcement was 98% for Gus (range, 95% to 100%), 100% for Curtis, and 91% for Jason (range, 84% to 100%).

Mean occurrence agreement for problem behavior during the functional analysis was 99% (range, 93% to 100%) for Gus, 98% (range, 88% to 100%) for Curtis, and 98% (range, 95% to 100%) for Jason. Mean occurrence agreement for problem behavior during baseline was 98% for Gus (range, 93% to 100%), 96% (range, 89% to 100%) for Curtis, and 96% (range, 89% to 100%) for Jason. Mean occurrence agreement for appropriate behavior during baseline was 95% for Gus (range, 93% to 100%), 100% for Curtis, and 93% (range, 89% to 100%) for Jason.

Mean occurrence agreement for problem behavior during EXT plus reinforcement was 93% (range, 88% to 100%) for Gus, 87% (range, 74% to 100%) for Curtis, and 98% (range, 95% to 100%) for Jason. Mean occurrence agreement for appropriate behavior during EXT plus reinforcement was 96% (range, 93% to 100%) for Gus, 100% for Curtis, and 89% (range, 78% to 100%) for Jason.

Mean nonoccurrence agreement for problem behavior during the functional analysis was 96% (range, 89% to 100%) for Gus, 95% (range, 85% to 100%) for Curtis, and 94% (range, 88% to 100%) for Jason. Mean nonoccurrence agreement for problem behavior during baseline was 93% for Gus (range, 85% to 100%), 97% (range, 92% to 100%) for Curtis, and 92% (range, 87% to 100%) for Jason. Mean nonoccurrence agreement for appropriate behavior during baseline was 97% for Gus (range, 95% to 100%), 94% for Curtis (range, 91% to 100%), and 96% (range, 92% to 100%) for Jason. Mean nonoccurrence agreement for problem behavior during EXT plus reinforcement was 87% (range, 81% to 100%) for Gus, 91% (range, 86% to 100%) for Curtis, and 89% (range, 76% to 100%) for Jason. Mean nonoccurrence agreement for appropriate behavior during EXT plus reinforcement was 94% (range, 90% to 100%) for Gus, 92% (range, 88% to 100%) for Curtis, and 93% (range, 87% to 100%) for Jason.

Procedure

Functional analysis. Each participant was exposed to a series of conditions based on those described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994), with some modifications. Interruption and toy-play conditions were evaluated for Gus. Attention, demand, tangible, ignore, and toy-play conditions were evaluated for Curtis. The same conditions were evaluated for Jason with the exception of the tangible condition. Also, an activity interruption condition was evaluated based on caregiver

report that interruption of preferred activities was likely to precede problem behavior. Sessions were 5 min in duration for Gus and 10 min in duration for Curtis and Jason. Functional analysis conditions were alternated in a multi-element design.

In the attention condition, the therapist diverted his or her attention and pretended to be engaged in an alternate activity (e.g., reading a magazine). The therapist delivered 20 s of attention in the form of mild reprimands (e.g., "Don't hit me, that hurts!") contingent on problem behavior. The therapist restricted access to preferred items in the tangible condition. The therapist delivered 20 s of access to the preferred item contingent on problem behavior. The therapist physically interrupted any activity in which the participant was engaged in the interrupt condition. The therapist delivered 20 s of access to the interrupted activity contingent on problem behavior. The attention, tangible, and interruption conditions were designed to test for problem behavior maintained by positive reinforcement. The therapist issued continuous demands using a three-step graduated guidance sequence (i.e., verbal, model, and physical prompts) in the demand condition. The therapist issued descriptive praise (e.g., "What a great job folding!") contingent on compliance. The therapist delivered 20 s of escape from the instructional sequence contingent on problem behavior. The purpose of the demand condition was to test for problem behavior maintained by negative reinforcement in the form of escape from demands. The therapist diverted his or her attention, no stimuli were present, and no demands were issued in the ignore condition. The purpose of this condition was to determine whether responding would persist in the absence of social consequences (i.e., test for responding maintained by automatic reinforcement). Finally, in the toy-play condition, the therapist provided attention and preferred items on a continuous basis and did not issue

demands. The purpose of the toy-play condition was to provide a condition in which motivation to engage in problem behavior for access to social reinforcement was minimized. Responding in all previous conditions was compared to responding in the toy-play condition to determine the function of problem behavior.

Treatment analysis. Baseline sessions consisted of the condition associated with the highest levels of target problem behaviors during the functional analysis. These sessions served as the baseline for EXT plus reinforcement. Data were collected on a variety of appropriate behaviors (e.g., signing, gesturing, vocal requesting). Therapists preselected these appropriate responses based on the client's history of responding during their admissions and parental report; data were collected on these responses during baseline as potential behaviors to be chosen for reinforcement in the EXT plus reinforcement phase. However, no programmed consequences were provided for appropriate behaviors during baseline.

During EXT plus reinforcement, problem behavior no longer resulted in the consequence that maintained behavior (i.e., extinction). In addition, the first appropriate response that each participant emitted was the behavior that was selected as the alternative response to be reinforced. If the participant engaged in an appropriate response that was not preselected during EXT plus reinforcement, therapists reviewed videotaped sessions to gather baseline data on the appropriate response. The first appropriate behavior emitted was a "don't" request for Gus. Over the course of the sessions, the therapist physically interrupted Gus in various activities (e.g., playing with a music board a particular way) and stated, "Gus, you cannot play with the toy like that." The therapist provided access to the activity for 20 s contingent on all "don't" requests that were relevant to the interrupted activity. The first appropriate behavior that Curtis emitted

was shaking his head “no.” The therapist delivered 20 s of escape from demands contingent on each response. Finally, appropriate behavior did not occur during the initial baseline phase for Jason. However, the first appropriate response Jason emitted during the EXT plus reinforcement condition that was relevant to the interrupted activity was reaching toward the materials (i.e., items in a plastic bin). The therapist provided 20 s of access to the activity contingent on each reach response towards the materials. No programmed consequences were in place if the participants engaged in any other alternative behavior. That is, after the first alternative behavior produced reinforcement, no other appropriate behaviors (or problem behavior) produced access to reinforcement. No specific training of appropriate behavior was conducted prior to or during EXT plus reinforcement. The effects of EXT plus reinforcement were evaluated in a reversal design.

RESULTS

The results of the functional analysis for Gus, Curtis, and Jason are presented in Figure 1. The results of the functional analysis for Gus suggested that his problem behavior (i.e., whining) was maintained by termination of activity interruption (Hagopian, Bruzek, Bowman, & Jennett, 2007). Gus engaged in high levels of problem behavior during the interruption condition ($M = 1.7$ responses per minute) compared to the toy-play condition ($M = 0.1$ responses per minute). Curtis engaged in high levels of problem behavior only during the escape from demands condition ($M = 4.4$ responses per minute), suggesting that his aggression, grabbing, and disruption were maintained by negative reinforcement in the form of escape from demands. The results of the functional analysis for Jason suggested that his aggression was maintained by termination of activity interruption (Hagopian *et al.*). Jason engaged in elevated levels of problem behavior

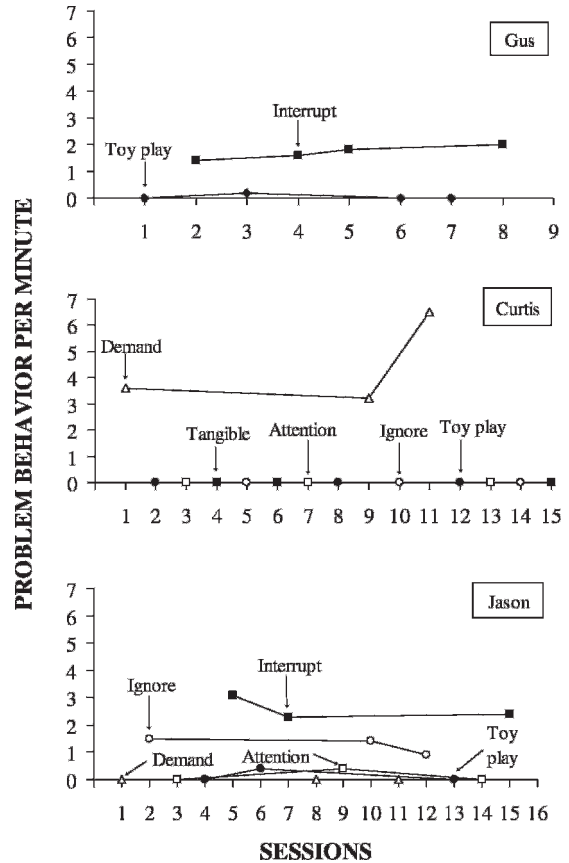


Figure 1. Problem behavior per minute across conditions during the functional analysis for Gus, Curtis, and Jason.

during the interruption condition ($M = 2.6$ responses per minute) compared to the toy-play condition ($M = 0.1$ responses per minute).

The top panel of Figure 2 depicts the results of baseline and EXT plus reinforcement for Gus. During baseline, high levels of whining occurred ($M = 1.7$ responses per minute). Low and variable levels of “don’t” requests occurred during baseline ($M = 0.2$ responses per minute). When problem behavior no longer produced uninterrupted activities, variable levels of problem behavior occurred ($M = 1.3$ responses per minute). However, rates of problem behavior decreased to near zero during the last portion of the phase. “Don’t” requests increased and were maintained at high levels during EXT plus reinforcement ($M = 1.3$ responses per minute).

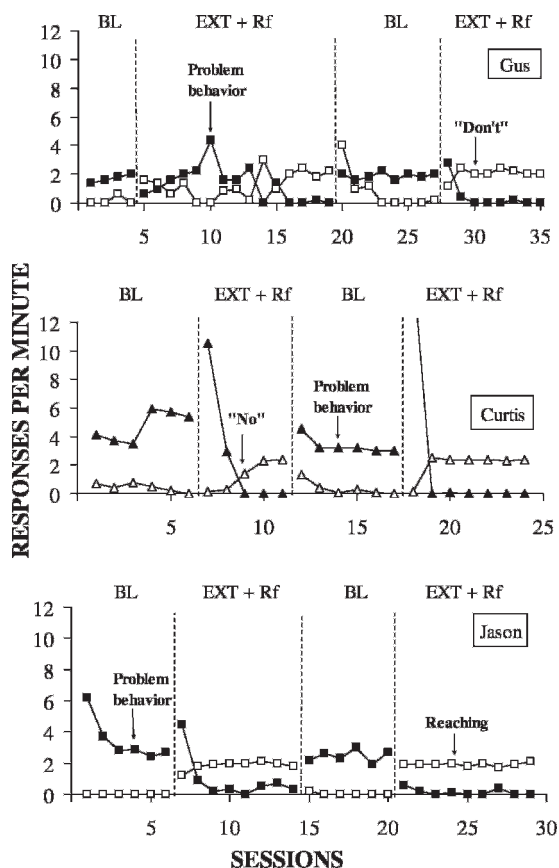


Figure 2. Problem behavior and “don’t” requests per minute by Gus; problem behavior and shaking head “no” per minute by Curtis; and problem behavior and reaching behavior per minute for Jason during baseline and EXT plus reinforcement.

In reversals to baseline and treatment, levels of problem behavior ($M_s = 1.9$ and 0.4 responses per minute, respectively) and manding ($M_s = 0.8$ and 2.0 responses per minute, respectively) were similar to those observed in the previous exposures to baseline and EXT plus reinforcement conditions.

The results of baseline and EXT plus reinforcement for Curtis are also shown in Figure 2. High levels of problem behavior occurred during baseline ($M = 4.7$ responses per minute). Curtis engaged in shaking his head “no” during baseline ($M = 0.4$ responses per minute) at low levels. An extinction burst of problem behavior occurred in both EXT plus

reinforcement phases ($M_s = 2.7$ and 2.3 responses per minute, respectively). However, levels of problem behavior were reduced to near zero over the course of the phases. Rates of shaking his head “no” were maintained at high levels during both EXT plus reinforcement phases ($M_s = 1.3$ and 2.1 responses per minute, respectively).

The results of baseline and EXT plus reinforcement for Jason are also shown in Figure 2. High levels of problem behavior occurred during baseline ($M = 3.5$ responses per minute). Jason did not engage in any specific appropriate responses during the initial baseline phase. An extinction burst of problem behavior occurred during the initial EXT plus reinforcement phase ($M = 1.0$ responses per minute), after which levels of problem behavior decreased to near zero over the course of the phases. An extinction burst was not observed during the second phase of EXT plus reinforcement ($M = 0.1$ responses per minute). Rates of reaching behavior were maintained at high levels during both EXT plus reinforcement phases ($M_s = 1.9$ and 1.8 responses per minute, respectively).

DISCUSSION

Results of the present study add to the growing literature on the conditions under which responses may be acquired during the acquisition phase of FCT (e.g., Kelley et al., 2002; Shirley et al., 1997; Worsdell et al., 2000). Most of the extant research on FCT has evaluated the conditions under which socially appropriate, communicative responses may be maintained subsequent to training the alternative behavior. However, relatively little is known about the conditions under which alternative behavior is acquired prior to maintenance evaluations. As in previous acquisition studies, extinction for problem behavior was used to produce low levels of problem behavior in the current study. However, the procedures in the current study were novel in that we did not specifically

preselect an arbitrary response as the alternative behavior, and we did not conduct training. Rather, exposure to extinction for problem behavior produced response variability, a well-described (but rarely studied) side effect of extinction. High levels of appropriate behavior were occasioned and maintained once the alternative response contacted reinforcement.

The results of this study are important for several reasons. First, the results suggest that each of the participants had response repertoires that included multiple behaviors in the same response class. The behaviors may have been classified as “appropriate” (e.g., reaching) or “inappropriate” (e.g., aggression) from the perspective of the caregiver. However, the behaviors may have occurred simply in a response hierarchy ranging from “efficient” relative to reinforcement parameters (e.g., small delay, high quality, high magnitude, rich schedule) to “inefficient” (e.g., long delay, low quality, low magnitude, thin schedule) from the perspective of the participants. Thus, although the participants likely had multiple behaviors in their repertoires that contacted reinforcement in the past, it is possible that the environment selected responses that were most likely to produce an efficient outcome (i.e., problem behavior). This interpretation is supported in part by studies conducted by Horner and Day (1991) and Lalli, Mace, Wohn, and Livezey (1995). Specifically, each of these studies showed that the likelihood of the occurrence of particular topographies within a response class was influenced by either response or reinforcement parameters. Future research should evaluate the possibility of response-class hierarchies when conducting acquisition research because training may be less difficult (i.e., lower levels of problem behavior, quicker acquisition) when previously reinforced behaviors are chosen as the alternative response.

Second, the results demonstrate that extinction may be used not only to directly affect problem behavior but also as a tool for

occasioning appropriate responses. In the past, the possibility of extinction bursts has been used as a reason for recommending against programming extinction into treatment packages (e.g., Lavigna & Donnellan, 1986). However, Lerman and Iwata (1995) evaluated 113 cases involving the use of extinction and found that extinction bursts (defined as an increase in the level of responding in any of the first three treatment sessions above all of the last five sessions from the previous phase) occurred in 24% of cases. In addition, extinction bursts were far less likely (12% of cases) when extinction was implemented in conjunction with alternative procedures such as differential reinforcement than when extinction was implemented alone (36% of cases). One limitation of the Lerman and Iwata study is that they could not evaluate the extent to which extinction produced increases in other response parameters (e.g., intensity and duration of responding). Most relevant to the current study is that the conditions under which extinction reliably produces response variability generally are unknown. Future research should evaluate whether the results of this study may be generalized to other participants and problem behaviors.

Third, using extinction as a means for selecting alternative responses may prevent the use of more intrusive procedures, such as graduated guidance or punishment. For example, in the studies conducted by Fisher *et al.* (1993), Hagopian *et al.* (1998), and Wacker *et al.* (1990), the alternative responses were selected arbitrarily; that is, there was no evidence that the selected responses had been reliably emitted by the participants prior to training. In each of those studies, intrusive procedures were necessary in a large percentage of cases to produce acceptable clinical outcomes for problem behavior. In the current study, extinction in combination with reinforcement for a response that was occasioned by the use of extinction produced acceptable clinical out-

comes for all 3 participants. Although other factors may have contributed to the disparate findings among these studies, existing response classes should be considered in research on FCT as part of an overall strategy for ensuring the use of least intrusive procedures.

There are several limitations of the study that warrant discussion. First, an extinction burst for problem behavior (as defined by Lerman & Iwata, 1995) occurred in four of the six phases in which treatment was implemented subsequent to baseline. In fact, problem behavior persisted for many sessions during Gus' first exposure to extinction (Figure 2). However, the persistence of problem behavior was tolerable compared to that seen in other acquisition studies (e.g., Kelley et al., 2002; Shirley et al., 1997; Worsdell et al., 2000). That is, despite the occurrence of extinction bursts, problem behavior decreased to low levels, and appropriate behavior persisted during treatment phases. A second limitation includes the restricted operants that could potentially contact reinforcement in treatment. That is, we observed behaviors during baseline that were selected a priori as potential responses for reinforcement in treatment. Future research could resolve this limitation by including formal descriptive analyses prior to baseline to identify potential behaviors for reinforcement during treatment. Third, it is unknown whether the current procedure would have been more efficient than using traditional acquisition methods (i.e., selecting an arbitrary response prior to treatment). Thus, future research could directly compare exposing a response to extinction to determine other behaviors in the same response class to a procedure in which responses are selected and specifically shaped.

Finally, the results of this study contribute to the growing literature on FCT in general and acquisition in particular by demonstrating a procedure for producing low levels of problem behavior and high levels of socially appropriate, alternative responding. The conditions under

which responses may be acquired during FCT should be evaluated thoroughly in future research.

REFERENCES

- Belfiore, P. J., Browder, D. M., & Lin, C. (1993). Using descriptive and experimental analyses in treatment of self-injurious behavior. *Education and Training in Mental Retardation, 28*, 57–65.
- Bird, F., Dores, P. A., Moniz, D., & Robinson, J. (1989). Reducing severe aggression and self-injurious behaviors with functional communication training. *American Journal of Mental Retardation, 94*, 37–48.
- Campbell, R. V., & Lutzker, J. R. (1993). Using functional equivalence training to reduce severe challenging behavior: A case study. *Journal of Developmental and Physical Disabilities, 5*, 203–216.
- Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis, 18*, 111–126.
- Duker, P. C., & van Lent, C. (1991). Inducing variability in communicative gestures used by severely retarded individuals. *Journal of Applied Behavior Analysis, 24*, 379–386.
- Durand, V. M., & Carr, E. G. (1991). Functional communication training to reduce challenging behavior: Maintenance and application in new settings. *Journal of Applied Behavior Analysis, 24*, 251–264.
- Fisher, W., Piazza, C., Cataldo, M., Harrell, R., Jefferson, G., & Conner, R. (1993). Functional communication training with and without extinction and punishment. *Journal of Applied Behavior Analysis, 26*, 23–36.
- Hagopian, L. P., Bruzek, J. L., Bowman, L. G., & Jennett, H. K. (2007). Assessment and treatment of problem behavior occasioned by interruption of free-operant behavior. *Journal of Applied Behavior Analysis, 40*, 89–103.
- Hagopian, L. P., Fisher, W. W., Sullivan, M. T., Acquisto, J., & LeBlanc, L. A. (1998). Effectiveness of functional communication training with and without extinction and punishment: A summary of 21 inpatient cases. *Journal of Applied Behavior Analysis, 31*, 211–235.
- Harding, J. W., Wacker, D. P., Berg, W. K., Rick, G., & Lee, J. F. (2004). Promoting response variability and stimulus generalization in martial arts training. *Journal of Applied Behavior Analysis, 37*, 185–195.
- Horner, R. H., & Day, H. M. (1991). The effects of response efficiency on functionally equivalent competing behaviors. *Journal of Applied Behavior Analysis, 24*, 719–732.
- Hunt, P., Alwell, M., & Goetz, L. (1998). Acquisition of conversational skills and the reduction of inappropriate social interaction behaviors. *Journal of the Association for Persons with Severe Handicaps, 13*, 20–27.

- Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27*, 197–209. (Reprinted from *Analysis and Intervention in Developmental Disabilities, 2*, 3–20, 1982)
- Jayne, D., Schloss, P. J., Alper, S., & Menscher, S. (1994). Reducing disruptive behaviors by training students to request assistance. *Behavior Modification, 18*, 320–338.
- Kelley, M. E., Lerman, D. C., & Van Camp, C. M. (2002). The effects of competing reinforcement schedules on the acquisition of functional communication. *Journal of Applied Behavior Analysis, 35*, 59–63.
- Lalli, J. S., Mace, C. F., Wohn, T., & Livezey, K. (1995). Identification and modification of a response-class hierarchy. *Journal of Applied Behavior Analysis, 28*, 551–559.
- Lalli, J. S., Zanolli, K., & Wohn, T. (1994). Using extinction to promote response variability in toy play. *Journal of Applied Behavior Analysis, 27*, 735–736.
- Lavigna, G. W., & Donnellan, A. M. (1986). *Alternatives to punishment: Solving behavior problems with non-aversive strategies*. New York: Irvington.
- Lerman, D. C., & Iwata, B. A. (1995). Prevalence of the extinction burst and its attenuation during treatment. *Journal of Applied Behavior Analysis, 28*, 93–94.
- Lerman, D. C., & Iwata, B. A. (1996). Developing a technology for the use of operant extinction in clinical settings: An examination of basic and applied research. *Journal of Applied Behavior Analysis, 29*, 345–382.
- Miller, N., & Neuringer, A. (2000). Reinforcing variability in adolescents with autism. *Journal of Applied Behavior Analysis, 33*, 151–165.
- Richman, D. M., Wacker, D. P., & Winborn, L. (2001). Response efficiency during functional communication training: Effects of effort on response allocation. *Journal of Applied Behavior Analysis, 34*, 73–76.
- Shirley, M. J., Iwata, B. A., Kahng, S., Mazaleski, J. L., & Lerman, D. C. (1997). Does functional communication training compete with ongoing contingencies of reinforcement? An analysis during response acquisition and maintenance. *Journal of Applied Behavior Analysis, 30*, 93–104.
- Smith, M. D., & Coleman, D. (1986). Managing the behavior of adults with autism in the job setting. *Journal of Autism and Developmental Disorders, 16*, 145–154.
- Vollmer, T. R., & Iwata, B. A. (1992). Differential reinforcement as treatment for behavior disorders: Procedural and functional variations. *Research in Developmental Disabilities, 13*, 393–417.
- Wacker, D. P., Steege, M. W., Northrup, J., Sasso, G., Berg, W., Reimers, T., et al. (1990). A component analysis of functional communication training across three topographies of severe behavior problems. *Journal of Applied Behavior Analysis, 23*, 417–429.
- Winborn, L., Wacker, D. P., Richman, D. M., Asmus, J., & Geier, D. (2002). Assessment of mand selection for functional communication packages. *Journal of Applied Behavior Analysis, 35*, 295–298.
- Worsdell, A. S., Iwata, B. A., Hanley, G. P., Thompson, R. H., & Kahng, S. (2000). Effects of continuous and intermittent reinforcement for problem behavior during functional communication training. *Journal of Applied Behavior Analysis, 33*, 167–179.

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