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SCHEDULE THINNING FOLLOWING COMMUNICATION TRAINING: USING COMPETING STIMULI TO ENHANCE TOLERANCE TO DECREMENTS IN REINFORCER DENSITY

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Functional communication training (FCT) is a widely used treatment for individuals with developmental disabilities who exhibit severe behavior problems. One inherent challenge of employing FCT as a treatment in the community is that reinforcement for appropriate communication cannot always be immediate or even possible in some circumstances. Of the few studies that have incorporated some form of schedule thinning for communication, most have reported disruption of communication or increases in problem behavior when the schedule of reinforcement is thinned. In the current study, we compared FCT with extinction to FCT with extinction and access to competing stimuli. After conducting a functional analysis, a competing stimulus assessment was performed to identify stimuli that produce reinforcement that ostensibly competes with reinforcement that maintains problem behavior. It was hypothesized that FCT with competing stimuli would result in more stable reductions in problem behavior during schedule thinning, which would ultimately result in quicker achievement of the treatment goal (low levels of problem behavior under the terminal reinforcement schedule for communication) than FCT without competing stimuli. Results confirmed this hypothesis.

DESCRIPTORS: functional communication training, competing stimuli, extinction, reinforcement schedule thinning

Functional communication training (FCT) has been demonstrated to be an effective treatment for individuals with developmental disabilities who exhibit severe behavior problems (e.g., Bailey, McComas, Benavides, & Lovascz, 2002; Carr & Durand, 1985; Fisher et al., 1993; Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998; Shirley, Iwata, Kahng, Mazaleski, & Lerman, 1997; Wacker et al., 1990). FCT involves training an individual to emit an alternative communicative behavior to obtain the reinforcer determined to maintain problem behavior while problem behavior is concurrently placed on with extinction. One inherent challenge of employing FCT as a treatment in the community is that reinforcement for appropriate communication cannot always be immediate or even possible in some circumstances. Interestingly, the majority of published studies on FCT have not included reinforcement schedule thinning for communication.

Among the studies that have conducted schedule thinning for communication, several methods have been described, including introducing delays to reinforcement (e.g., Fisher et al., 1993), demand fading (e.g., Hagopian et al., 1998; Lalli, Casey, & Kates, 1995), and progressively longer signaled no-reinforcement periods using a multiple-schedule arrangement (e.g., Fisher, Kuhn, & Thompson, 1998; see Hanley, Iwata, & Thompson, 2001, for a comparison of schedule-thinning procedures for communication during FCT). Increases in problem behavior and disruption of communication during the course of schedule thinning

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have been reported in several studies (Fisher et al., 1993; Hagopian et al., 1998; Hanley et al., 2001). Researchers have described a few approaches for dealing with increases in problem behavior associated with schedule thinning during FCT. Returning to a richer schedule of reinforcement and then attempting to thin the reinforcement schedule again can sometimes be effective in reestablishing lower levels of problem behavior (Fisher et al., 1993; Hagopian et al., 1998). Another strategy for addressing persistent increases in problem behavior associated with reinforcement thinning during FCT is to incorporate additional treatment components. This has included the provision of an alternative activity during the delay to reinforcement (Fisher, Thompson, Hagopian, Bowman, & Krug, 2000), and the use of punishment for problem behavior (e.g., Fisher et al., 1993; Hagopian et al., 1998).

Fisher, Thompson, Hagopian, Bowman, and Krug (2000) described one case in which an alternative work activity was provided during the delay to reinforcement of communication (for access to tangible items). In a direct comparison of FCT with extinction versus FCT with extinction and an alternative work activity during delay periods, it was demonstrated that schedule thinning could proceed more rapidly in the condition with the alternative work activity. The authors suggested that the academic task might have functioned to distract the client and to provide an alternative source of reinforcement. Although introducing the alternative activity during the delay was successful in facilitating the speed in which the terminal delay goal was reached, the authors did not describe a methodology for systematically and empirically identifying what activity or stimulus to provide during the delay. The work procedure was selected based on observations that suggested that it was a preferred activity. Furthermore, the amount of time and monitoring necessary to prompt the participant through a work activity may limit the use of such procedures. Despite these limitations, the procedures described by Fisher and colleagues represent advancement given that they demonstrated that providing an alternative activity during no-reinforcement periods for communication could facilitate schedule thinning during FCT.

In another study, Fisher et al. (1998) reported on two cases for which two communication responses were trained in the context of an FCT intervention. During no-reinforcement periods for one reinforcer, mands for the alternative reinforcer were reinforced. Discriminative stimuli were used to signal which communication response would be reinforced during a given period. For one of the cases in which problem behavior was maintained by access to both attention and access to toys, the participant's mands for toys were reinforced during the period that attention was not available contingent on mands for attention. Likewise, the participant's mands for attention were reinforced during the period that mands for toys were not reinforced. For another case with attention-maintained behavior, the participant could gain access to toys (identified as highly preferred during a preference assessment) during the period that attention was not available. In addition to describing the use of a multiple schedule during FCT, this study is significant in that it demonstrated that alternative reinforcers could be used during periods in which communication to obtain the reinforcer that had been determined to maintain problem behavior would not be reinforced. Although these procedures were not implemented during the course of schedule thinning for communication in response to increasing levels of problem behavior, the authors demonstrated that problem behavior could be maintained at low levels during periods when the functional reinforcer was not available by providing alternative reinforcement.

Findings from a separate line of research on the identification and use of stimuli that

compete with reinforcement that maintains problem behavior may suggest additional strategies for addressing increases in problem behavior associated with reinforcement thinning during FCT. Procedures used to examine the degree to which access to various stimuli displace problem behavior, relative to a no-stimulus control condition, have recently been termed *competing stimulus assessments* (DeLeon, Rodriguez-Catter, Fisher, Delia, & Marhefka, 2000; Fisher, DeLeon, Rodriguez-Catter, & Keeney, 2004; Long, Hagopian, DeLeon, Marhefka, & Resau, in press). Several studies have demonstrated that noncontingent access to competing stimuli can effectively reduce problem behavior maintained by automatic reinforcement (Piazza, Fisher, Hanley, Hilker, & Derby, 1996; Ringdahl, Vollmer, Marcus, & Roane, 1997; Roane, Vollmer, Ringdahl, & Marcus, 1998; Shore, Iwata, DeLeon, Kahng, & Smith, 1997; Zhou, Goff, & Iwata, 2000). It is presumed that stimuli that are associated with decreases in problem behavior produce reinforcement that competes with reinforcement that maintains problem behavior. Although much of this research has focused on problem behavior maintained by automatic reinforcement, it has been demonstrated this approach can enhance noncontingent reinforcement (NCR) as a treatment for attention-maintained behavior (Fisher, DeLeon, Rodriguez-Catter, & Keeney, 2004; Fisher, O'Connor, Kurtz, DeLeon, & Gotjen, 2000). In these two studies, the competing stimulus assessment involved providing access to one stimulus during each trial while attention was concurrently available contingent on problem behavior. Stimuli associated with lower levels of problem behavior were presumed to produce reinforcement that competed with attention. Although these studies demonstrated that stimuli selected using a competing stimulus assessment can enhance NCR, no study has reported the use of a competing stimulus assessment to identify stimuli to enhance FCT interventions. The provision of stimuli with such properties may be particularly useful during schedule thinning for communication, when problem behavior is more likely to increase. That is, providing access to stimuli that produce reinforcement that ostensibly competes with the maintaining reinforcer during times when that reinforcer is not immediately available may function as an abolishing operation (AO) for problem behavior and thus decrease the probability that problem behavior will recur during schedule thinning (Michael, 1982). Therefore, the primary purpose of the current study was to determine whether schedule thinning during FCT could proceed more rapidly and with fewer increases in problem behavior by providing access to stimuli that produce reinforcement that ostensibly competes with reinforcement that maintains problem behavior.

GENERAL METHOD

Participants and Setting

Participants were 3 individuals who had been admitted to an inpatient unit for the assessment and treatment of severe behavior problems. Although similar procedures were used across participants (i.e., functional analysis, competing stimulus assessment, and treatment comparison of FCT vs. FCT with competing stimuli), variations to procedures were made on an individualized basis depending on the clinical needs of each case (e.g., functional analysis conditions, session length, etc.). Inclusion criteria for the current investigation were as follows: (a) A functional analysis showed that the client's problem behaviors were maintained by social reinforcement (attention or tangible), and (b) FCT with schedule thinning was selected as the intervention.

Stephen was a 13-year-old boy who had been diagnosed with pervasive developmental disorder, attention deficit hyperactivity disorder (ADHD), and mild mental retardation. He had been admitted for the treatment of *self-injurious behavior* (SIB), defined as skin picking and head banging; *aggression*, defined as hitting,

kicking, pinching, pulling hair, and throwing objects within 0.6 m of others; and *disruption*, defined as banging on surfaces, throwing objects, and property destruction. Stephen's communication response consisted of any verbal request for attention or interaction (e.g., "I need your attention," "I would like to talk," or "I have something to say"). Stephen was ambulatory, had good verbal communication skills, and could follow and complete complex demands. James was a 12-year-old boy who had been diagnosed with autism and mild mental retardation. He had been admitted for the treatment of *SIB*, defined as biting his hand or finger and hitting himself with his hand or object; *aggression*, defined as hitting, kicking, scratching, and biting; and *disruption*, defined as throwing objects, knocking over furniture, and banging on hard surfaces. James' communication response consisted of him placing a photo of a video game on a strip of hook-and-loop tape attached to the front of a communication book (a three-ring binder). James was ambulatory, could follow simple two- and three-step instructions, and used one- and two-word phrases along with gestures to communicate. Matt was a 7-year-old boy who had been diagnosed with autism, ADHD, and moderate mental retardation. He had been admitted for the treatment of *aggression*, defined as hitting, kicking, scratching, hair pulling, pinching, pushing, grabbing, and throwing objects at others. Matt's communication response consisted of him handing a picture card to the therapist and saying, "I want to play." Matt displayed severe ataxia but ambulated independently, communicated with a picture exchange communication system, and used some American sign language signs. Sessions were conducted in individual treatment rooms (3 m by 3 m) equipped with one-way mirrors. Functional analysis sessions and treatment comparison sessions were 10 min in length. Competing stimulus assessments varied in length across participants (see below).

Functional analysis sessions were conducted using a multielement design. Treatment comparison sessions were conducted using a combination of reversal and multielement designs. Matt's sessions were conducted in 1-hr session blocks during the treatment comparison; one condition was conducted per session block with sequence of conditions alternated across blocks.

Data Collection and Interobserver Agreement

Frequency data were collected on targeted problem behavior (described above) during Phase 1 (functional analysis), Phase 2 (competing stimulus assessment), and Phase 3 (treatment comparison) and are presented as a rate (responses per minute). Frequency data were also collected on communication responses during Phase 3 (treatment comparison) and also are presented as a rate. During Phase 2 (competing stimulus assessment), data also were collected on *stimulus engagement*, which was defined individually for each stimulus (as described by Hagopian, Rush, Lewin, & Long, 2001). Stimulus engagement usually included interaction with the stimulus, moving towards the stimulus, consuming the stimulus (for edible items and tangible stimuli), or engaging in the activity associated with that stimulus (e.g., reading a book). The duration of stimulus engagement was also recorded. All data were recorded using laptop computers. For Stephen, four 5-min trials were conducted, during which each stimulus was presented individually and stimulus engagement (with a 3-s delay onset and offset) was recorded. The observer recorded the number of seconds of engagement during that trial. Percentage of stimulus engagement was calculated by dividing the total number of seconds of engagement by 300 and then multiplying by 100%. For James, two 2-min trials were conducted in a manner similar to the procedures described for Stephen. Percentage of session time with stimulus engagement was calculated by dividing the total number of seconds of engagement by 120 and then multiplying by 100%. For Matt, three

5-min trials were conducted using the procedures described above for Stephen.

Two observers recorded target behaviors on laptop computers, and interobserver agreement was collected for 51%, 40%, and 30% of sessions during Phase 1 (functional analysis) for Stephen, James, and Matt, respectively. For frequency measures, exact agreement was calculated by dividing the number of exact agreements per 10-s interval by the number of exact agreements plus disagreements and multiplying by 100%. An exact agreement was defined as both observers recording the same frequency of a target response during a 10-s interval. Average exact agreement coefficients for combined target problem behaviors during Phase 1 were 96% for Stephen, 99% for James, and 92% for Matt.

Interobserver agreement was assessed during 68%, 58%, and 45% of sessions for Stephen, James, and Matt, respectively, during Phase 2 (competing stimulus assessment). Exact agreement coefficients for combined problem behaviors targeted during Phase 2 averaged 97% for Stephen, 94% for James, and 84% for Matt. For stimulus engagement, duration-per-interval agreement was calculated by dividing the smaller duration by the larger duration for each 10-s interval, obtaining the average across intervals, then multiplying by 100%. Duration-per-interval coefficients for stimulus engagement averaged 85% for Stephen, 98% for James, and 97% for Matt.

Interobserver agreement was collected for 43%, 39%, and 46% of sessions during Phase 3 (treatment comparison) for Stephen, James, and Matt, respectively. Average exact agreement coefficients for target problem behaviors were calculated as in Phase 1. For combined problem behaviors targeted during Phase 3, exact agreement coefficients averaged 95% for Stephen, 99% for James, and 89% for Matt. Average exact agreement coefficients for communication responses during Phase 1 were 99% for Stephen, 99% for James, and 94% for Matt.

Experimental Design

The functional analysis for each participant was conducted using a multielement design. The treatment analyses were conducted using combined multielement and reversal designs. For all participants an ABAB (BC) design was used (A = baseline, B = FCT with extinction, and C = FCT with extinction and competing stimuli). The BC phase was the multielement comparison of FCT with and without competing stimuli.

Phase 1: Functional Analysis

Procedure

A functional analysis was conducted for each participant based on procedures described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994). The functional analysis included the following conditions for all participants: social attention, tangible, demand, and toy play. The functional analysis for Stephen included an ignore condition and a mands condition, and the social attention condition was modified to include two therapists talking (i.e., a divided attention condition). The functional analyses for James and Matt included an alone condition. The functional analysis for Matt included a physical attention condition. For each participant, all behaviors described above were targeted during the functional analysis. During the attention condition, James and Matt were given adult attention in the form of a brief statement of concern contingent on the occurrence of a target behavior. During this condition, James had access to a toy keyboard and a Sesame Street® saxophone, and Matt had access to a ball and a frog toy. The divided attention condition for Stephen was developed based on caregivers' reports that he often engaged in problem behavior when the caregiver was talking with someone else. The divided attention condition was identical to the attention condition except that two therapists were present in the room and engaged in conversation with each other. One therapist provided a

brief statement of concern contingent on the occurrence of problem behavior. During this condition, Stephen had access to a Slinky® toy. During the physical attention condition, Matt was given 30 s of physical play that consisted of tickles, jumping, and spinning contingent on the occurrence of a target behavior. During this condition, Matt had access to a ball and a frog toy. The attention, divided attention, and physical attention conditions were designed to evaluate the role of attention in the maintenance of problem behavior. A tangible condition was conducted for James and Matt during which each participant was given access to tangible items contingent on the occurrence of problem behavior. The purpose of this condition was to evaluate the role of tangible items in the maintenance of problem behavior. Tangible stimuli were selected based on parent report indicating which stimuli, when removed, were likely to occasion problem behavior, or which stimuli parents reported offering in an attempt to calm or redirect the child. The tangible items were Nintendo® for James and whirly lights, music, Scooby® book, and an Elmo® "jammer" for Matt. The demand condition consisted of providing instructional demands to each child using a three-step guided-compliance prompting sequence. Compliance resulted in brief praise. Participants received 30 s of escape from demands contingent on the occurrence of a target behavior. This condition was designed to evaluate the role of escape from demands in the maintenance of problem behavior. During the ignore condition conducted with Stephen, the participant and a therapist remained in a padded session room for the entire session without the presence of items or social interaction; target behaviors were ignored. During the alone condition conducted with James, the participant was alone in the room with no toys present. The purpose of the ignore and alone conditions was to examine problem behavior in the absence of social consequences. During the mands condition (based on the procedures described by Bowman, Fisher, Thompson, & Piazza, 1997) with Stephen, the participant received 2 min of access to compliance with all of his mands prior to the session. After the session began, all mands were ignored. Following each occurrence of problem behavior, the therapist complied with his mands for 30 s. Items present during the mands condition included a puzzle, Legos®, a ball, and pen and paper. The purpose of the mands condition was to determine if problem behavior was maintained by adult compliance with mands. During the toy play condition, each participant had access to preferred toys and adult attention, and no demands were given. This condition was designed to serve as a control against which the other conditions could be compared. Items provided to the participants in the toy play condition consisted of a keyboard, bubbles, and water snake for Matt; Nintendo© for James; and a basketball and crayons with paper for Stephen.

Results

The top panel of Figure 1 depicts the results of Stephen's functional analysis. Problem behavior occurred at relatively higher rates in the divided attention condition (M = 6.4 responses per minute) relative to the control condition (M = 1) and the other test conditions. These results suggested that Stephen's problem behaviors were in part, sensitive to positive reinforcement in the form of social attention. In addition, problem behavior occurred at higher levels in the ignore condition (M = 3.2) than in the control condition. However, most of the problem behavior that occurred in the ignore condition was in the form of aggression (as opposed to disruption and SIB), which is consistent with the conclusion that Stephen's problem behaviors were maintained by attention. The middle panel of Figure 1 depicts the results of James' functional analysis. James displayed the highest rates of target behaviors in the tangible condition (M = 1.6 responses per minute) relative to the control

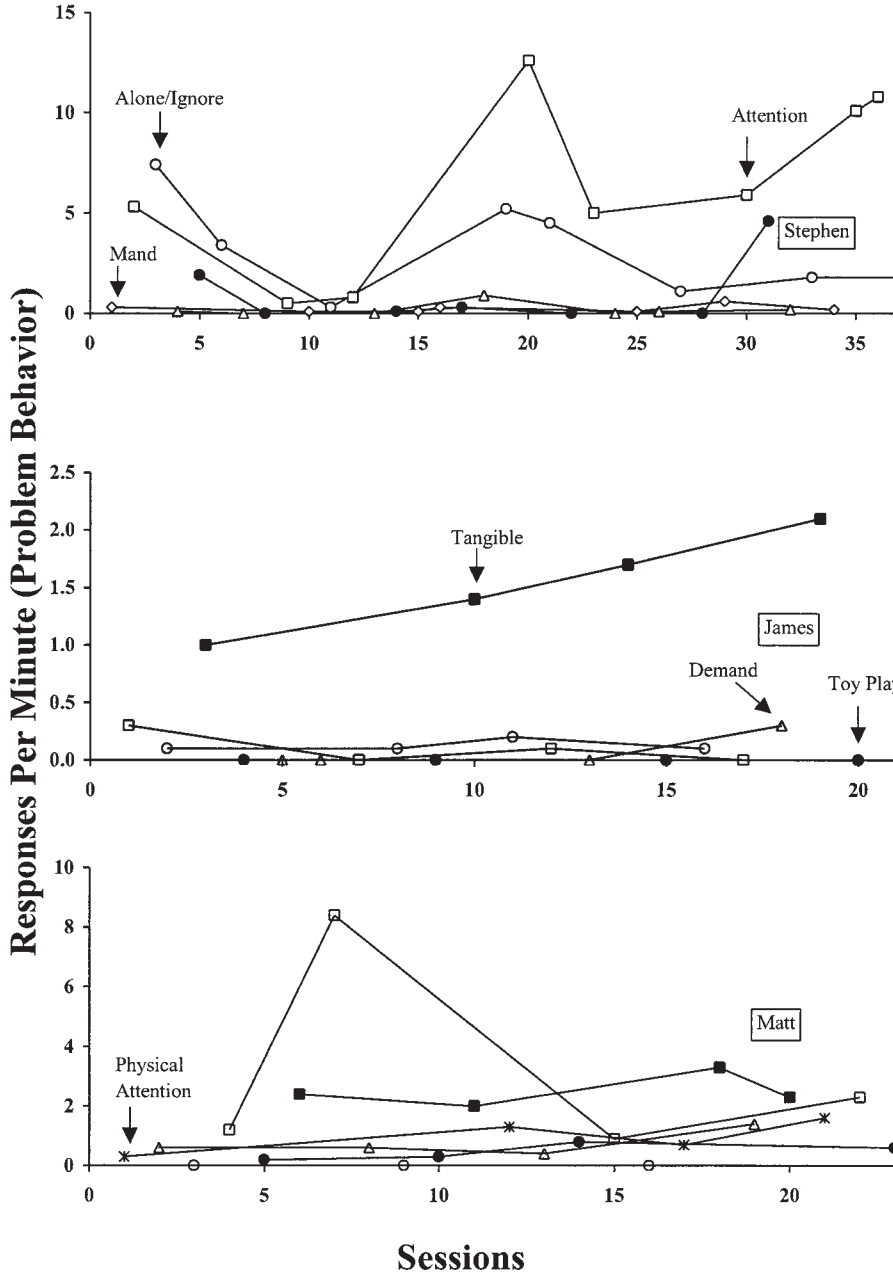

Figure 1. Rate of problem behavior (responses per minute) during the functional analysis for Stephen (top panel), James (middle panel), and Matt (bottom panel).

condition ($M = 0$) and the other test conditions. These results suggested that his problem behavior was maintained by access to preferred items. The bottom panel of Figure 1 depicts the results of Matt's functional analysis. Matt displayed the highest rates of problem behavior during the attention ($M = 2.9$) and tangible ($M = 2$) conditions and low rates of problem behavior in the toy play ($M = 0.1$), demand ($M = 0.2$), and alone ($M = 0$) conditions

(levels of problem behavior were also elevated in the physical attention condition; $M = 0.8$). These results suggested that access to verbal attention, physical attention, and tangible items maintained Matt's problem behaviors.

Phase 2: Competing Stimulus Assessment

Procedure

Reinforcer survey. The Reinforcer Assessment for Individuals with Severe Disabilities (Fisher, Piazza, Bowman, & Amari, 1996) was administered to the care provider of each participant. Based on the responses from the survey, 9 to 16 potentially preferred stimuli were identified for each participant.

Competing stimulus assessment. Each stimulus was presented singly to Stephen and Matt for 5 min and to James for 2 min while problem behavior resulted in access to the reinforcer determined to maintain problem behavior during the functional analysis. That is, during the assessment, Stephen's and Matt's problem behavior resulted in access to attention, whereas James' problem behavior resulted in access to a video game. During each trial, both the duration of stimulus engagement and the frequency of problem behavior were recorded. Stimuli were presented in a randomized order. This procedure was repeated four times for Stephen, two times for James, and three times for Matt. The number of administrations and trial length varied across participants based on the treating behavior analyst's determination of what was required to obtain a representative sample of behavior for each participant. Administrations were repeated until some level of stability in responding was obtained. Hierarchies of competition and preference were calculated based on the average rate of problem behavior and percentage of item interaction across administrations. The purpose of this assessment was to determine which stimuli might produce reinforcement that ostensibly competes with reinforcement that had been previously identified to maintain problem behavior.

Results

The results of the competing stimulus assessment are depicted in Figure 2. Across the four trials conducted with Stephen, the highest levels of problem behavior were in the control condition, in which no object was present ($M = 3.9$ responses per minute). The items that best competed with Stephen's problem behaviors were Game Boy® ($M = 0.15$ responses per minute), puzzles ($M = 0$), and Dr. Seuss books ($M = 0$). Across the two trials conducted with James, the highest levels of problem behavior were observed in the control and Bert and Ernie cycle toy conditions ($M = 1.5$ and 2.5 responses per minute, respectively). The items that best competed with James' problem behaviors were the whirly lights, Elmo book, remote control car, and the bubble machine. James did not engage in any problem behaviors when these items were present. Across the three trials conducted with Matt, the highest levels of problem behavior were observed in the control condition ($M = 3.6$ responses per minute). The items that best competed with Matt's problem behaviors were whirly lights ($M = 0$), music ($M = 0.5$), and a Game Boy® ($M = 0.1$).

Phase 3: Treatment Comparison

Procedure

Baseline. The baseline conditions for each participant were identical to the condition in which problem behavior was highest during the functional analysis (i.e., divided attention for Stephen, tangible items for James, and verbal and physical attention for Matt). That is, Stephen received attention in the form of a brief statement of concern, James received 30 s of access to a video game contingent on the occurrence of targeted problem behavior, and Matt received a brief statement of concern and 30 s of access to physical play (e.g., tickles, spinning).

FCT. After establishing a baseline for each participant, training sessions were conducted to

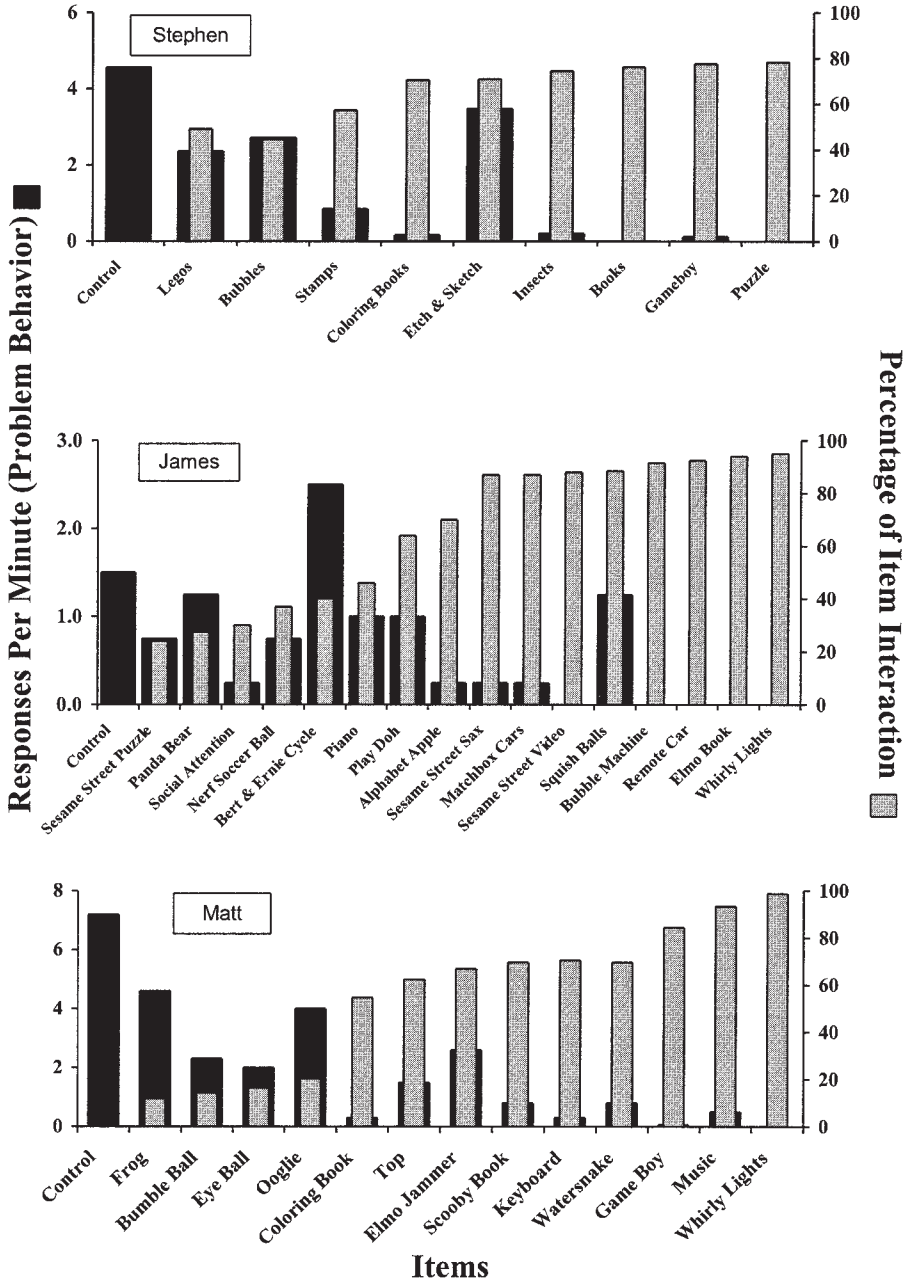

Figure 2. Rate of problem behavior (gray bars) and percentage of item interaction (black bars) during the competing stimulus assessment for Stephen (top panel), James (middle panel), and Matt (bottom panel).

teach Stephen, James, and Matt to appropriately request the reinforcer that maintained problem behavior. Stephen was instructed to request attention by stating, "I need your attention." Other appropriate verbal requests for attention (e.g., "I would like to talk" or "I have something to say") also were reinforced with 30 s of adult attention. Each session consisted of five 1-min trials. In each trial, Stephen had 15 s to communicate independently, after

which time a verbal prompt was provided. He independently emitted an appropriate communication response on 100% of trials for three consecutive sessions. For James, a picture communication book was selected as the mode of communication, based on his history and familiarity with this method of communication. To gain 30 s of access to the video game, James was required to open his communication book, remove the photo of the video game, and place it on the front of the book. James independently emitted this chain of responses to obtain the video game during 100% of trials during each of the first three sessions. Matt was taught to hand a picture symbol card to the therapist and say, "I want to play" to request verbal and physical attention. Matt received 30 s of attention for removing the picture card corresponding with the item or activity and placing it on the top of the sentence strip. In each training trial, Matt was allowed 10 s to communicate independently. If he did not communicate within 10 s, more intrusive prompts (verbal, model, physical) were given every 10 s thereafter. Matt independently emitted the appropriate communication response during 93% of the trials for three consecutive sessions within five sessions.

FCT with extinction. During the first phase of the treatment analysis, problem behaviors were on extinction while the appropriate communication response produced 30 s of access to reinforcement (attention for Stephen, access to video game for James, and verbal and physical attention for Matt).

FCT with extinction and competing stimuli. This condition was identical to FCT with extinction except that stimuli associated with the lowest rates of problem behavior during the competing stimulus assessment were provided noncontingently and continuously (Game Boy®, puzzles, and Dr. Seuss books for Stephen; whirly lights, Elmo book, remote control car, and bubble machine for James; and music and Game Boy® for Matt).

Schedule thinning. For all children the reinforcement schedule was thinned according to the predetermined schedule. For Stephen and James, schedule thinning involved increasing the delay between communication and reinforcement. The delay was signaled to both children by instructing them that they needed to wait after manding for the reinforcer (i.e., the therapist responded to mands for attention by saying, "Good asking, but you need to wait"). Competing stimuli were provided noncontingently during the delay during FCT with extinction and competing stimuli. The children were not prompted to play with the competing stimuli during the delay.

For Stephen, delays to reinforcement for communication were increased across nine steps with the following delay values: 5 s, 10 s, 15 s, 20 s, 30 s, 1 min, 2 min, 3 min, and 4 min (the terminal schedule). To determine whether the delay to reinforcement had to be increased gradually, steps were periodically skipped and a longer delay was probed. The criterion for advancing across steps was two consecutive sessions with 0.2 or fewer problem behaviors per minute. The criterion to return to earlier steps was two consecutive sessions with 0.2 or more problem behaviors per minute. For James, delays to reinforcement for communication were increased across eight steps with the following delay values: 15 s, 20 s, 30 s, 1 min, 2 min, 3 min, 4 min, and 5 min (the terminal schedule). To determine whether the delay to reinforcement had to be gradually increased, the terminal schedule was probed at the outset and again after successfully meeting criteria to advance to the next two steps. The criterion for advancing across steps was two consecutive sessions with 0.2 or fewer problem behaviors per minute. The criterion to return to earlier steps was two consecutive sessions with 0.2 or more problem behaviors per minute.

Schedule thinning was accomplished with Matt in the context of a fixed-ratio (FR) with extinction multiple-schedule arrangement based

on the procedures described by Hanley et al. (2001). The FR 1 component duration remained at 1 min and alternated with the extinction component, which was increased progressively in duration. Initially, the extinction component duration was 1 min and then was increased to 1.5 min, to 2 min, and then by an additional 1 min thereafter (up to 9 min). Thus, the terminal schedule consisted of 1 min of FR 1 and 9 min of extinction for communication. The criterion for advancing across these steps was two consecutive sessions with 0.4 or fewer problem behaviors per minute. The criterion to return to earlier steps was 0.4 or more problem behaviors per minute. These differences in schedule-thinning procedures (i.e., delay for James and Stephen and multiple schedule for James) were determined on an individual basis during the course of their clinical treatment.

Treatment goals, with respect to schedule of reinforcement for communication and rate of problem behavior, varied across participants because they were developed individually based on that child's level and severity of problem behavior. For Stephen, the treatment goal was to maintain rates of problem behavior at or below 0.2 per minute for two consecutive sessions under a 240-s delay to reinforcement. The treatment goal for James was to maintain rates of problem behavior at or below 0.2 for two consecutive sessions under a 300-s delay to reinforcement. Matt's treatment goal was to maintain rates of problem behavior at or below 0.4 for two consecutive sessions under 9-min extinction 1-min FR 1 component durations.

Results

Stephen. Results of Stephen's treatment comparison are depicted in the top panel of Figure 3. High and increasing rates of problem behavior were observed during the initial baseline phase, ranging from 7.9 to 17.1. With the introduction of FCT with extinction, problem behavior decreased relative to baseline, but remained variable. Following a reversal to baseline in which problem behavior increased, FCT with extinction was reimplemented, resulting in greater reductions in problem behavior than observed previously. Delays to reinforcement were gradually increased up to 60 s, but levels of problem behavior did not remain consistently low. This necessitated a return to briefer delays to reinforcement. Despite returning to a 15-s delay, problem behavior remained at unacceptable levels. Next, FCT and extinction with and without competing stimuli were compared with a multielement analysis. During this comparison, delays to reinforcement for communication were increased from 15 s using identical criteria across both conditions. During FCT with extinction and competing stimuli, the treatment goal was achieved after 16 sessions. The treatment goal was not achieved during FCT with extinction, in that problem behavior remained variable despite returning to briefer delays.

Stephen emitted an average of 0.61 communication responses per minute during FCT with extinction prior to schedule thinning (Figure 4, top panel). During schedule thinning, he engaged in average of 0.66 communication responses during FCT with extinction and 0.46 during FCT with extinction and competing stimuli. However, it should be noted that direct comparison of rates of communication across conditions should be made with caution given that delays to reinforcement were not equivalent across conditions. Specifically, delays to reinforcement did not exceed 20 s during FCT with extinction, whereas delays up to 4 min were achieved during FCT with extinction and competing stimuli.

James. The results of the treatment analysis for James are depicted in the middle panel of Figure 3. During baseline, James displayed variable rates of problem behavior, ranging from 0.5 to 1.7. FCT with extinction reduced problem behavior to zero levels for three consecutive sessions. After baseline rates recovered during a reversal, treatment effects were

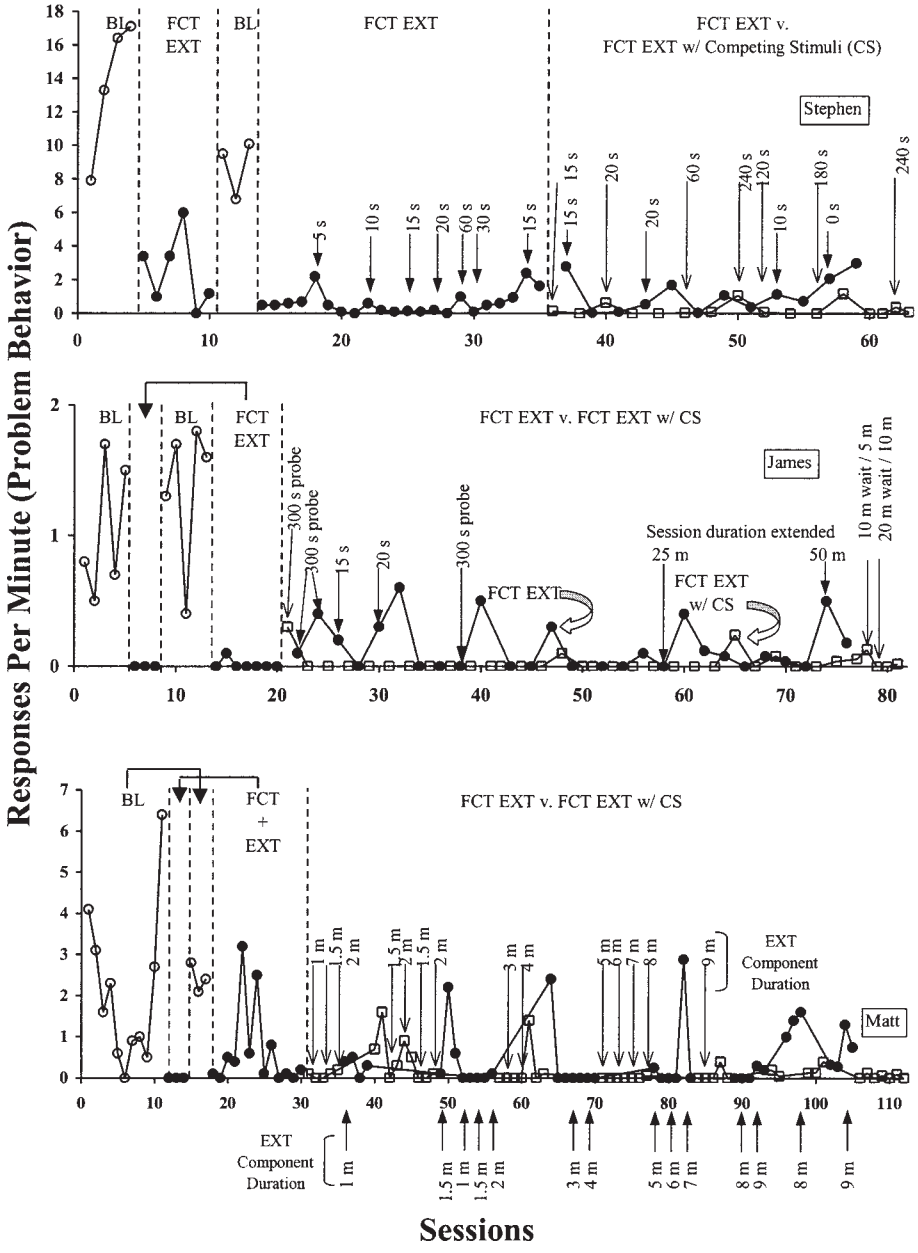

Figure 3. Rate of problem behavior during the treatment comparison for Stephen (top panel), James (middle panel), and Matt (bottom panel).

replicated. FCT and extinction with and without competing stimuli were compared using a multielement design while delays to reinforcement for communication were introduced as described above. The terminal delay (300 s) was probed to determine whether it was necessary to increase the delay to reinforcement gradually. With FCT with extinction and competing stimuli, the first session with a 300-s delay resulted in an increase in problem behavior; however, problem behavior returned to zero in the next session. During the majority of sessions that followed, problem behavior remained at zero. During FCT with extinction,

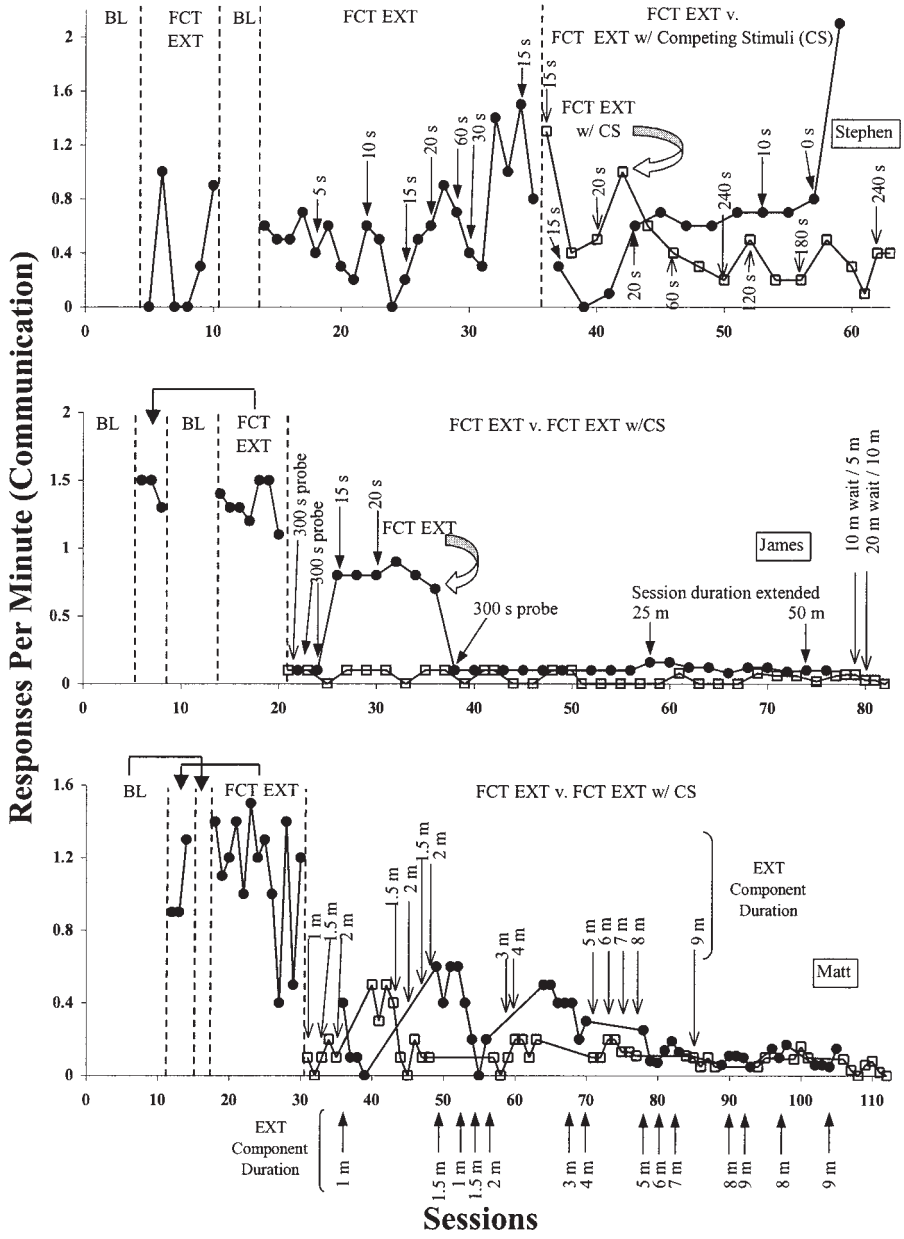

Figure 4. Rate of communication responses during the treatment comparison for Stephen (top panel), James (middle panel), and Matt (bottom panel).

the initial 300-s delay sessions resulted in higher levels of problem behavior for two consecutive sessions. Delays to reinforcement were then increased from 15 s to 20 s, after which the 300-s terminal delay was probed once again. Thus, the treatment goal was achieved after three sessions of FCT with extinction and competing stimuli and after 12 sessions of FCT with extinction. Session duration was then extended from 10 min to 50 min, with FCT with extinction and competing stimuli producing more stable reductions in problem behavior than FCT with extinction alone. Although the treatment goal was achieved in

both conditions, FCT with extinction and competing stimuli resulted in faster attainment of treatment goals and lower levels of problem behavior throughout the analysis.

Prior to schedule thinning, James emitted an average of 1.3 communication responses per minute (Figure 4, middle panel). He engaged in an average of 0.28 communication responses during FCT with extinction and 0.05 during FCT with extinction and competing stimuli (however, delays were not equivalent across conditions). For the sessions in which the terminal schedule (5-min delay) was in effect in both conditions, rates of communication averaged 0.1 per minute and 0.06 per minute during FCT with extinction (19 sessions) and FCT with extinction and competing stimuli (37 sessions), respectively.

Matt. The results of the treatment analysis for Matt are depicted in the bottom panel of Figure 3. During baseline, variable rates of problem behavior were observed across sessions, ranging from 0 to 6.4 per minute. FCT with extinction resulted in immediate and total elimination of problem behavior across three consecutive sessions. Levels of problem behavior increased during a reversal to baseline, after which treatment was reimplemented. Although initial treatment effects were not fully replicated initially, levels of problem behavior were greatly reduced relative to baseline, particularly during the last four sessions. FCT with extinction with and without competing stimuli were compared in a multielement design while schedule thinning (using the procedure described by Hanley et al., 2001) was implemented across both conditions. As described above, schedule thinning was accomplished by gradually increasing extinction component durations while decreasing FR 1 component durations for communication. Extinction component duration changes are depicted in the figure for each condition. The treatment goal was achieved during FCT with extinction and competing stimuli after 29 sessions. FCT with extinction produced similar effects as the schedule was thinned until the terminal schedule was implemented, at which time problem behavior increased over the next four sessions. Problem behavior decreased once the previous schedule had been reinstated; however, problem behavior increased again when the terminal schedule was reimplemented. Given that the treatment goal was achieved in FCT with extinction and competing stimuli, the analysis of FCT with extinction was terminated at that point. Thus, the treatment goal was not achieved with FCT with extinction.

Prior to schedule thinning, Matt emitted 1.1 communication responses per minute (Figure 4, bottom panel). He engaged in an average of 0.63 responses during FCT with extinction and 0.99 responses during FCT with extinction and competing stimuli (however, delays were not equivalent across conditions). For the sessions in which the terminal schedule was in effect in both conditions, rates of communication in both conditions averaged 0.8 per minute.

GENERAL DISCUSSION

Results of the current study suggest that the provision of stimuli identified via a competing stimulus assessment can enhance FCT, particularly during schedule thinning for communication. In general, schedule thinning proceeded more quickly and was associated with lower levels of problem behavior when competing stimuli were present relative to when they were not. Providing stimuli found to be associated with low levels of problem behavior during a competing stimulus assessment (presumably as a function of reinforcer competition) may attenuate the establishing operation for problem behavior during schedule thinning, and thus decrease the probability that it will recur. The current study extends research on the identification and use of competing stimuli as well as the literature on FCT.

Previous studies describing the use of competing stimulus assessments have, for the most part, addressed problem behavior maintained by automatic reinforcement. These assessments generally have involved the provision of test stimuli in the absence of any programmed reinforcer delivery for problem behavior (because problem behavior was determined to be maintained by automatic reinforcement). In the current study, the assessment was conducted to examine directly the extent to which the test stimuli provided reinforcement that competed with the reinforcer determined to maintain problem behavior. That is, the functional reinforcers for problem behavior (attention for Stephen and Matt and video games for James) were delivered contingent on problem behavior while the participant had the test stimulus and could obtain the reinforcement it produced concurrently. To date, only two other published studies have described the use of this type of assessment (Fisher et al., 2004; Fisher, O'Connor, Kurtz, DeLeon, & Gotjen, 2000). In those studies, Fisher and colleagues delivered attention contingent on problem behavior during the competing stimulus assessment after having determined that problem behavior was attention maintained. Those competing stimuli were then used in an NCR intervention.

Although several studies have demonstrated that access to competing stimuli delivered on an NCR schedule can effectively decrease problem behavior (e.g., Piazza et al., 1996; Shore et al., 1997), no study has used competing stimuli (identified using an empirical CSA) to enhance FCT. Of the two published studies describing FCT interventions involving the provision of alternative stimuli during no-reinforcement periods for communication (Fisher et al., 1998; Fisher, Thompson, Hagopian, Bowman, & Krug, 2000), neither involved selecting those alternative stimuli based on the results of a CSA. The fact that the problem behavior was reduced to low levels in those cases suggests that the stimuli delivered during no-reinforcement periods appeared to function as AOs (Michael, 1982) for problem behavior. Only one case (reported by Fisher, Thompson, Hagopian, Bowman, & Krug) involved a comparison of FCT with and without alternative stimuli during schedule thinning. Although the results of the current study do not permit us to ascertain whether FCT with CS is more effective than FCT with preferred stimuli, the methodology described in the current study may represent a procedural advancement in that it involves empirically selecting stimuli based on the results of a competing stimulus assessment. It is possible, however, that the provision of any preferred stimulus (selected via either a preference assessment or a competing stimulus assessment) can enhance FCT.

It is also possible that some highly preferred stimuli may provide reinforcement that is complementary to the maintaining reinforcer, and as such, might not enhance FCT. For example, a ball may be a highly preferred stimulus that establishes attention as a reinforcer. In this example, providing access to the ball during periods when attention is not available may evoke attention-seeking behavior (communication or problem behavior), and thus interfere with treatment. The design of the current study demonstrates only that FCT with competing stimuli is more effective than FCT as it is routinely applied (without alternative stimuli of any sort). Additional research is needed to address the question of whether it is more beneficial to select stimuli based on the results of a competing stimulus assessment or a preference assessment. Specifically, comparisons should be made between FCT with competing stimuli and noncompeting stimuli that are matched for level of preference.

The current study may have practical implications pertaining to the successful generalization and maintenance of interventions involving FCT. As noted at the outset, an important challenge when employing FCT is

arranging for the communication response to occur at rates that can be supported by level of reinforcement available in the natural environment. Failure to develop a schedule that is sustainable will likely disrupt communication and potentially lead to resurgence of problem behavior. The findings of the current study demonstrate that provision of competing stimuli can facilitate the process of schedule thinning during FCT. Although this represents a potential enhancement to FCT, additional research is needed to determine whether the effects obtained in this study would extend to the application of FCT in community settings.

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STUDY QUESTIONS

1. What strategies have been used to facilitate reinforcement-schedule thinning following functional communication training (FCT)?

2. Describe the competing stimulus assessment and indicate why it was important to continue to deliver reinforcement for problem behavior during the assessment.

3. Describe the results of the functional analysis shown in Figure 1 and summarize the authors' conclusions about those results.

4. The authors described two different schedule-thinning procedures. Based on the information provided, what type of schedule was used with each participant?

5. Summarize the results of the schedule-thinning phase of treatment with respect to levels of problem behavior and the rapidity with which treatment goals were achieved during FCT with extinction and FCT with extinction and competing stimuli.

6. Results showed that participants emitted lower rates of communication during FCT with extinction and competing stimuli relative to FCT with extinction. Why is this outcome desirable?

7. Under what conditions might the delivery of preferred leisure items at times when attention is unavailable be problematic?

8. Matt's functional analysis showed high levels of problem behavior in both the attention and the tangible conditions. How might this have influenced the outcome of FCT with extinction and competing stimuli relative to that of FCT with extinction?

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