Journal of
Applied Behavior Analysis

Journal of Applied Behavior Analysis 2022, **55,** 121–137 NUMBER 1 (WINTER)

Understanding the effects of prompting immediately after problem behavior occurs during functional communication training

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When reported, the methods for prompting functional communication responses (FCRs) following problem behavior during functional communication training (FCT) vary. Some researchers have prompted the FCR immediately following problem behavior but doing so may inadvertently strengthen problem behavior as the first link in an undesirable response chain. This study investigated the effects of prompting FCRs following problem behavior during FCT with 4 children who exhibited severe problem behavior. Problem behavior remained low and FCR rates were near optimal when prompts were delivered immediately following problem behavior for 2 participants. Delaying prompts following problem behavior was instrumental for FCR acquisition for 1 participant but led to escalation of problem behavior for a 2nd participant. The conditions under which immediate prompts following problem behavior may improve or worsen FCT are discussed.

Key words: chaining, functional analysis, functional communication training, prompting

The goal of functional communication training (FCT; Carr & Durand, 1985) is to reduce problem behavior while establishing an appropriate functional communication response (FCR). Published studies on FCT are often conducted in contrived teaching situations in which (a) clinicians periodically disrupt access to reinforcers for problem behavior, (b) return those reinforcers following instances of the FCR, and (c) no longer return those reinforcers following problem behavior (i.e., problem behavior is placed on extinction). This general approach has been demonstrated efficacious in more than 90 published studies (Tiger et al., 2008). The earliest stages of FCT require clinicians to prompt and reinforce novel FCRs, but technological descriptions of prompting strategies are often omitted from published studies (Ghaemmaghami et al., 2018). Those studies that have offered more robust procedural detail have included notable variations. One such variation involves the timing of prompts following (a) problem behavior and (b) disruption of reinforcer access.

For example, if an individual engages in a problem behavior during FCT, the clinician could reactively prompt the FCR and then reinforce the prompted response. This strategy was reported by Shukla and Albin (1996) and Najdowski et al. (2008), who immediately responded to problem behavior by reactively prompting the FCR. The rationale behind this strategy is to ensure the FCR occurs and contacts reinforcers when those reinforcers are established (evinced by the occurrence of problem behavior). Logically, this strategy should result in acquisition of the FCR, but this programmed contingency may also inadvertently

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This manuscript was prepared in partial fulfillment of the doctoral program requirements of the Psychology Department at Western New England University. The authors thank Rachel Thompson, William Ahearn, and Jonathan Pinkston for their comments on earlier versions of this manuscript and Mahshid Ghaemmaghami for assistance with data collection and other aspects of the project.

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doi: 10.1002/jaba.889

strengthen problem behavior as the first part of a response chain (e.g., problem behavior → prompt → FCR → reinforcement), rendering FCT ineffective. Only a few studies report undesirable response chaining (Hagopian et al., 1998; Shirley et al., 1997; Wacker et al., 1990) as a result of immediate, reactive prompting, but the possibility of forming undesirable chains during FCT has led researchers to develop alternative prompting strategies.

One such alternative involves reacting to problem behavior by first implementing a brief time-out (i.e., a period in which FCRs would not be reinforced) following each instance of problem behavior and then prompting the FCR at the end of the time-out period. This approach of arranging delayed reactive prompts ensures reinforcement of the FCR is proximally distant from any instance of problem behavior, decreasing the likelihood of inadvertent reinforcement. Although this contingency may minimize inadvertent chaining of problem behavior with the FCR, this programmed contingency may create other challenges. For instance, if problem behavior occurs frequently during the time-out interval, and thereby extends the interval, the individual may rarely contact FCR prompts (Brown et al., 2000; Kuhn et al., 2006; Worsdell et al., 2000), slowing acquisition. Further, if the individual engages in frequent FCRs during the time-out interval, the FCR may extinguish (see Shirley et al., 1997 for a similar argument). These outcomes would render FCT equivalent to extinction only, which is associated with a higher probability of extinction bursting (Lerman et al., 1999). Despite concerns raised about both reactive prompting strategies, no published study has directly compared the approaches during FCT.

Concerns regarding reactive prompting may be mitigated through proactive, or *preemptive*, prompting (i.e., prompting a response prior to the occurrence of problem behavior). Specifically, in lieu of waiting for problem behavior to occur, clinicians could instead prompt the FCR immediately upon the disruption of reinforcement. For instance, the clinician may instruct the individual to "Put away their toys" and then prompt the FCR "Play, please" before problem behavior occurs. These prompts are typically issued shortly after the disruption of reinforcement and are then progressively delayed to promote independence. This approach was reported by Shirley et al. (1997) and may minimize both the risk of response chaining associated with immediate reactive prompting and the risk of extinction bursts associated with delayed reactive prompting.

The primary goal of this study was to identify the effects of FCT with immediate reactive prompting. A second goal was to evaluate prompting modifications designed to address undesirable response chains. Three prompting variations were evaluated. Experimenters first conducted FCT with immediate reactive prompting and determined whether problem behavior decreased or persisted in the form of an undesirable response sequence. If problem behavior persisted, experimenters delayed reactive prompts or made preemptive prompts more immediate.

Method

Participants and Setting

Four children referred by local developmental pediatricians to a university-based outpatient clinic for the assessment and treatment[1] of severe problem behavior participated in this study. These were the first four children admitted to the clinic following Institutional Review Board approval of this project for whom (a) functional analyses showed problem behavior sensitivity to social reinforcers and (b) skill-

[1]Functional analysis data for all participants in the current study were also reported by Warner et al. (2020). Functional analysis data for Luke were also reported by Ghaemmaghami et al. (2018)

based treatment including FCT was therefore scheduled.

Mike was a 4-year-old typically developing boy who engaged in aggression, disruptive behavior, disruptive vocalizations, arguing, and flopping; he spoke in full sentences. Jordan was a 3-year-old typically developing boy who engaged in aggression (e.g., hitting, kicking, scratching, and biting), throwing, noncompliance, and disruptive vocalizations (e.g., whining, crying, protesting); he spoke in full sentences and engaged in imaginative story telling. Annie was a 4-year-old girl with a diagnosis of hydrocephalus, conduct disorder, and destructive behavior disorder. She was referred for aggression, swearing, throwing, and various forms of disruption (e.g., swiping, pouring liquids onto the floor). Annie communicated in short phrases, but often with poor articulation. Luke was a 5-year-old boy with a diagnosis of autism and attention-deficit/hyperactivity disorder. He was referred for aggression, yelling, throwing, and other forms of disruption (e.g., stomping); he spoke in full sentences. We did not conduct or request reports of developmental assessments for participants in this study. However, participants were observed and reported to emit multiple word mands and echo vocal models.

Parents provided consent and children provided assent to participate on each visit to the clinic. Each session lasted 5 min and was conducted in treatment rooms equipped with a one-way mirror, video cameras, chairs, tables, and materials necessary for the contingency (e.g., demand materials, toys).

Measurement

Observers collected data using a laptop computer equipped with data collection software. The occurrence of problem behavior was scored as either a more concerning topography or lesser concerning topography. More concerning topographies included aggression, throwing materials, and self-injurious head slapping (Annie only). Lesser concerning topographies included inappropriate vocalizations (e.g., cursing, yelling) and disruptive behavior (e.g., stomping, grunting, protesting, crawling away from the analyst). Observers also recorded the duration of emotional responding (e.g., crying) but did not score this as problem behavior.

Observers scored the occurrence of FCRs as either simple (i.e., the vocal response "My way please" for Mike, Jordan, and Luke; the vocal response "My way" for Annie) or intermediate (i.e., "May I have my way please" for Jordan and "My way please" for Annie). FCRs were further differentiated as prompted when they occurred within 5 s of an analyst's verbal prompt; all other FCRs were considered independent.

A second, independent observer scored problem behavior (both more and less concerning topographies) and FCRs during at least 20% of sessions in each phase. We compared observer records within 10-s intervals and calculated interobserver agreement by dividing the smaller number of responses by the larger number of responses in the interval. Mean agreement during the functional analysis was 99% (range, 87% to 100%) for problem behavior and 100% for FCRs for all participants. Mean interobserver agreement for problem behavior and FCRs during the treatment analysis was 98% (range, 87% to 100%) and 97% (range, 71% to 100%), respectively.

Procedures

Functional Assessment Process

Analysts conducted open-ended interviews with participants' primary caregivers to identify the topographies of problematic and co-occurring behaviors and the events reported to establish and maintain those behaviors. An interview-informed synthesized contingency analysis (as defined by Jessel et al., 2016) was then conducted to analyze the relation between the reported events and the occurrence of

problem behavior. This functional analysis involved comparing the effects of a single synthesized-contingency test condition to those of a matched control condition in a multielement design.

Caregivers reported that Mike's problem behavior typically occurred when he was told to stop playing and clean up his toys, particularly when these demands were continuous or "nagging." Caregivers said they responded by providing rationales, removing him from the situation, and allowing him to complete tasks in a child-directed manner (i.e., "his way"). During the test condition, analysts instructed Mike to stop playing and start cleaning up. If Mike did not cooperate, the analyst continued to re-present the instruction in a stern manner. The analyst also attempted to limit child-directed interactions by redirecting and blocking certain responses during instruction (e.g., by telling him to clean up a different toy first and blocking attempts to pick up a toy other than the one he was directed to clean up) and withholding reinforcement for his requests. Contingent on problem behavior, the analyst terminated demands, allowed Mike to resume playing with his toys without interference, returned to providing only "pleasant" attention (e.g., speaking to him using a gentle rather than firm tone), and responded to all reasonable requests (i.e., requests for readily available items, activities, and interactions that could be safely permitted). During control sessions, the analyst withheld demands, allowed Mike to play with his toys, and responded to all reasonable bids for attention and other materials.

Jordan's caregivers reported that he typically engaged in problem behavior when instructed to transition from more preferred to less preferred activities, such as when asked to stop playing on his iPad™ to clean up toys, get dressed, and/or get in the car. They also indicated that Jordan was "bossy" and would have a "meltdown" if he did not have the opportunity to direct situations such as the way his mother played with him or the specific items she used during common household routines. Caregivers reported that they often catered to his wishes to avoid problem behavior. When problem behavior did occur, they reported that they usually removed Jordan from activities, talked with him and provided rationales, and offered soothing attention (e.g., hugs). During test sessions of Jordan's functional analysis, the analyst told Jordan that play time was over and he needed to clean up (i.e., place his iPad™ and other toys in a storage bin) and then do something else (e.g., play with something else, put on his coat). The analyst ignored Jordan's attempts to interact with the analyst, attempted to limit child-directed interactions by redirecting certain responses during instruction (e.g., attempts to select the order of demands he completed), and withholding reinforcement for requests to perform the task differently. The analyst blocked deviation from instruction and prompted cooperation as needed. Contingent on problem behavior, the analyst ceased issuing demands, returned the bin of toys, provided attention, allowed Jordan to play and interact with the analyst freely, and honored all reasonable requests following an instance of problem behavior. Demands were withheld, Jordan was allowed to interact with toys and the analyst freely, and reasonable requests were honored during the control condition.

Luke's caregivers reported that he often emitted problem behavior when adults corrected him, denied access to items, told him to clean up or transition to less preferred tasks (e.g., sitting at the table, completing work), or interacted with his toys differently than how he specified that he wanted to play. His caregivers stated that they managed his behavior by allowing him time to calm down (thus delaying instructions and allowing him to resume his previous activity), placing him in time out (thus allowing escape from previous instructions), sitting with him and talking about the situation, and/or interacting with him the way that he preferred. During the

test condition, the analyst terminated Luke's play by instructing him to do something different (e.g., clean up, transition to the table for work, or play differently with his toys), removing or restricting access to toys, and withholding attention (i.e., preferred conversation). The analyst attempted to limit child-directed interaction during the establishing operation interval by ignoring requests that were not relevant to the instruction, using three-step prompting as needed, and redirecting certain responses during instruction (e.g., telling him to rewrite his name more neatly). Contingent on problem behavior, the analyst terminated the instruction, returned toys, and allowed Luke to play and interact with the analyst freely. Demands were withheld, and Luke was allowed to play and interact with the analyst freely during the control condition.

Analysts reinforced both more- and lesser-concerning topographies of problem behavior in each functional analysis but observed only lesser-concerning topographies of problem behavior for each participant; more-concerning topographies were never emitted. To assess if these lesser- and more-concerning topographies were members of the same response class, analysts conducted an additional functional analysis, but restricted the reinforcement contingency in the test condition to only follow more-concerning topographies (data reported by Warner et al., 2020). Analysts then repeated the initial functional analysis by reinforcing both more- and lesser-concerning topographies. This final condition served as the baseline[2] for functional communication training. Reinforcement intervals during the functional analyses varied between 30 to 45 s.

Functional Communication Training

FCT was conducted using the same synthesized reinforcers delivered in each participant's test condition of the functional analysis. Reinforcement was presented for at least 30 s prior to starting each 5-min session, and reinforcement intervals varied between 30 to 45 s during each session. Analysts vocally prompted FCRs for all participants across conditions. If this prompt did not evoke the FCR, analysts immediately presented the prompt a second time. If the prompt was still ineffective, the analyst repeated the prompt once every 15 to 20 s until the participant emitted the FCR (except when problem behavior occurred during the delayed reactive prompting condition; see below).

Analysts initiated FCT with *delayed preemptive + immediate reactive* prompts. The analyst disrupted reinforcer access, waited 3 s for the participant to emit the FCR independently, and then prompted the FCR after 3 s with no response (3-s preemptive prompt delay) or immediately following any topography of problem behavior (immediate reactive prompt). Each FCR, whether independent, prompted, or contiguous with problem behavior resulted in a reinforcement period.

If problem behavior persisted, analysts then implemented *delayed preemptive + delayed reactive* prompts. This was similar to the previous phase, except that analysts no longer prompted the FCR immediately following problem behavior. Instead, the analysts continued to present instructions and withhold reinforcement until problem behavior ceased for 10 s. After this 10-s time-out period, the analyst prompted and delivered reinforcement following the FCR. If problem behavior still persisted, the time-out interval was decreased to 5 s to ensure the FCR did not extinguish.

If problem behavior was not eliminated by delaying reactive prompts, analysts implemented *immediate preemptive + immediate reactive* prompts. This condition was similar to those described previously except that the disruption of reinforcement was followed immediately by a prompt for the FCR rather than after a 3-s delay. A progressive prompt delay was introduced following the first session with no more

[2]These data were also reported previously by Warner et al. (2020).

than one instance of problem behavior. The progressive prompt delays varied within-session such that if problem behavior occurred during a trial at the scheduled prompt delay (e.g., 1 s), the analyst prompted the FCR with a shorter latency (e.g., 0 s) on the subsequent trial. Once the participant responded without problem behavior, the analyst reinstated the originally scheduled prompt delay. These delays were programmed to increase in 1-s increments following each session with no more than one instance of problem behavior.

Results

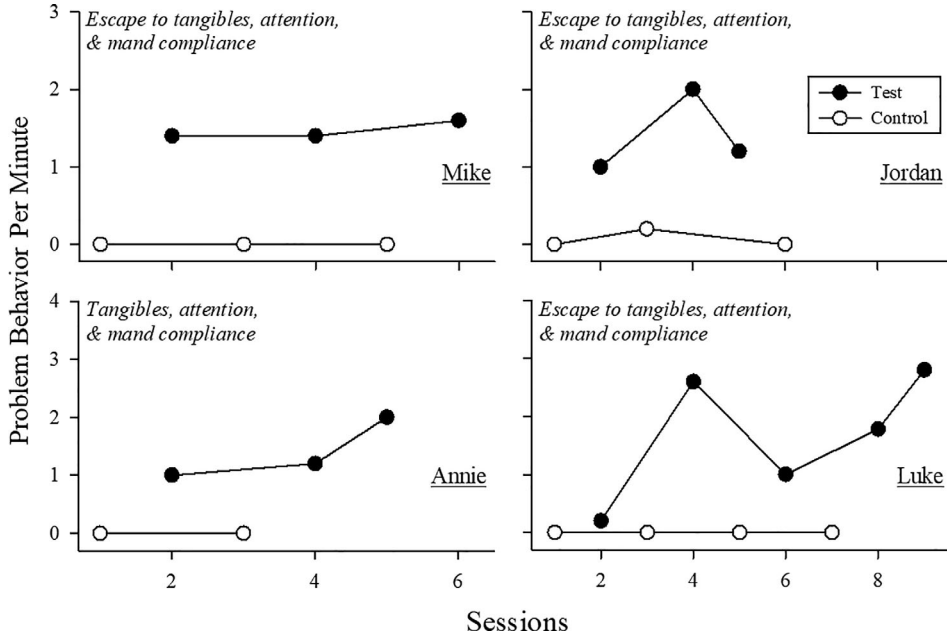
Problem behavior occurred exclusively (Mike, Annie, and Luke) or nearly exclusively (Jordan) during the test condition of the functional analysis (see Figure 1), illustrating behavioral sensitivity to a synthesized contingency of escape to tangibles, attention, and mand compliance for Mike, Jordan, and Luke, and access to tangibles, attention, and mand compliance for Annie.

Results of Mike's FCT evaluation are depicted in Figure 2. He engaged in problem behavior and emitted no independent FCRs during baseline. Problem behavior reduced to zero levels and both prompted and independent FCRs occurred by the first session of FCT with delayed preemptive + immediate reactive prompting. Independent simple FCRs persisted but problem behavior increased when baseline was reintroduced. Problem behavior returned to zero when FCT with delayed preemptive + immediate reactive prompting was reinstated. These data indicate that immediate reactive prompting did not strengthen problem behavior via response chaining for Mike.

Jordan (Figure 3) engaged in problem behavior (top panel) at higher rates during the first two sessions of FCT with delayed preemptive + immediate reactive prompting than in baseline. Given additional exposure, problem behavior reduced to near zero levels and independent simple FCRs increased (middle panel). A return to baseline resulted in increased problem behavior and decreased FCRs. FCT with delayed preemptive + immediate reactive prompting was then replicated; problem behavior returned to zero levels and simple FCRs occurred independently. Analysts then began prompting and restricting the reinforcement contingency for intermediate level FCRs and was acquired without an associated increase in problem behavior. Similar to Mike, the delivery of immediate reactive prompts did not result in inadvertent maintenance of problem behavior.

Annie's treatment evaluation results are depicted in Figure 4. Analysts initially targeted the intermediate FCR "my way, please," but Annie did not imitate the prompt accurately during the first two sessions. The analyst began targeting the simpler FCR "my way" using delayed preemptive + immediate reactive prompts. Annie's problem behavior persisted, and she emitted the FCR only when prompted. Analysts then implemented delayed reactive prompts. Annie began emitting simple FCRs independently and problem behavior decreased to low levels. A return to baseline contingencies resulted in increased problem behavior and decreased FCRs. FCT was then reintroduced with immediate reactive prompts. Unlike the initial introduction of these contingencies, independent FCRs increased, and problem behavior decreased to zero levels. Analysts then began prompting and restricting the reinforcement contingency for the more complex, intermediate FCR, "my way, please" (bottom panel). Similar to the initial teaching of the simpler FCR, problem behavior increased and the intermediate FCR occurred only when prompted. When reactive prompts were delayed for 3 s following problem behavior, intermediate FCRs occurred independently, and problem behavior decreased to low levels. Upon another return to baseline, problem behavior increased although independent intermediate FCRs persisted. A final implementation of

Figure 1
Functional Analysis Results for Each Participant



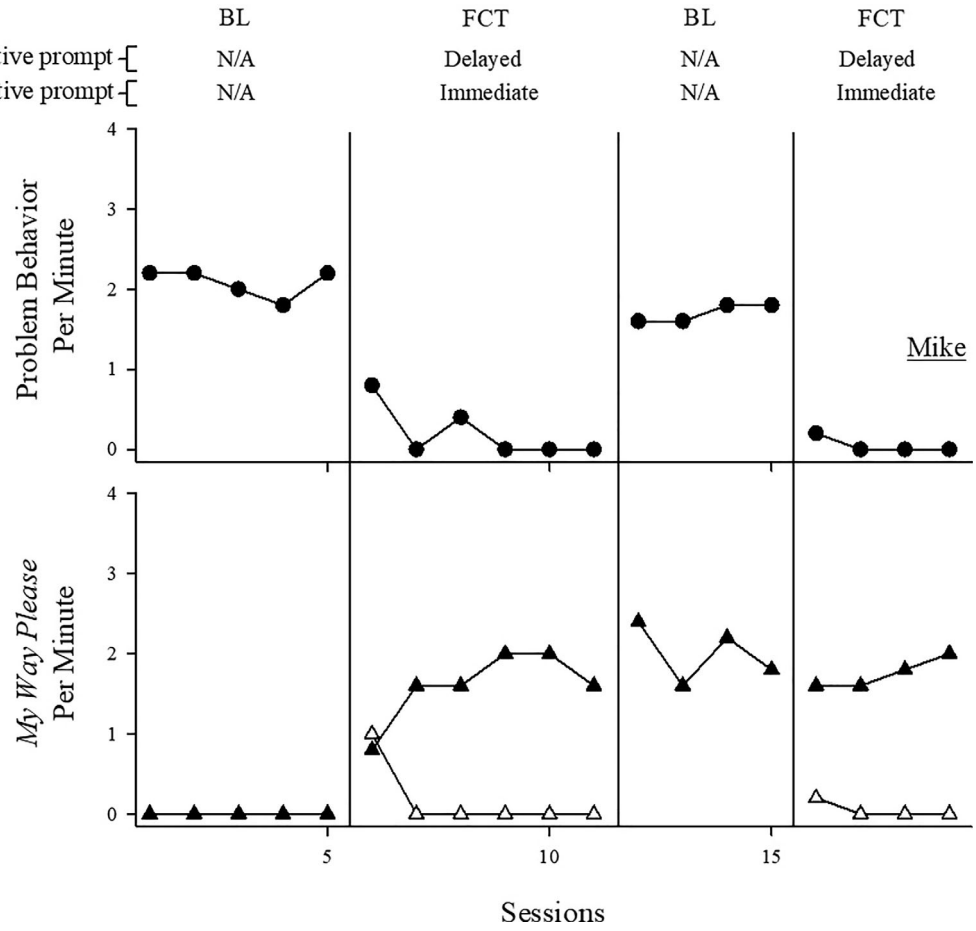
immediate reactive prompting resulted in decreased problem behavior. Annie's problem behavior persisted, and she did not acquire FCRs until reactive prompts were delayed. Delaying reactive prompts was no longer necessary once FCRs were acquired—FCT with immediate reactive prompting decreased problem behavior and re-established previously acquired FCRs.

Luke's FCT evaluation results are displayed in Figure 5. The introduction of delayed preemptive prompts and immediate reactive prompts had no impact on Luke's problem behavior and his FCRs did not consistently occur independently. The analyst therefore implemented a 10-s delay to reactive prompts, but this contingency resulted in an increase in problem behavior. This pattern is consistent with the extinction burst that may occur if reinforcement opportunities are entirely omitted due to frequent problem behavior. To increase the likelihood that Luke's FCRs would contact reinforcement, analysts decreased the delay period following problem behavior from 10 to 5 s. Problem behavior remained at elevated, variable levels and did not result in sustained independent FCRs. Analysts therefore implemented immediate proactive prompting with progressive delay fading to preempt the occurrence of problem behavior. During this phase, problem behavior rapidly reduced to near-zero levels and independent FCRs were established.

Within-Session Analyses

The session means presented in Figures 2, 3, 4, and 5 characterize the overall changes in problem behavior rates across conditions but do not fully characterize the pattern of contact between problem behavior and reinforcement that resulted from the arranged prompting contingencies. Those patterns may provide important information on why the arranged

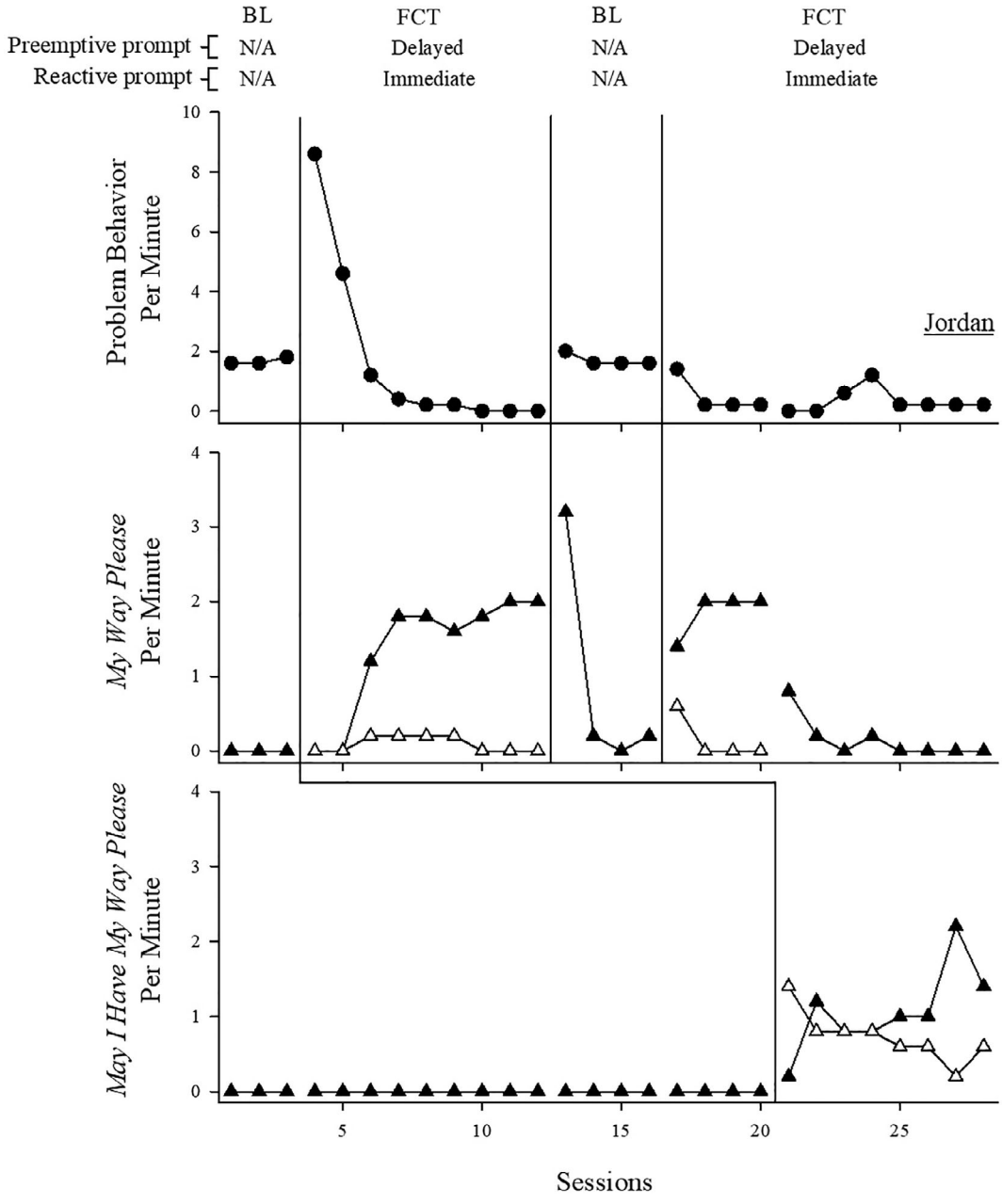
Figure 2
Results of the FCT Evaluation for Mike



contingency did or did not reduce problem behavior for a particular participant. Figure 6 depicts within-session sequences of problem behavior, prompting, FCRs, and reinforcement delivery that highlight potentially important patterns.

Mike (top panel; session 6) engaged in problem behavior at the onset of the first three trials (i.e., the first three times that reinforcement was disrupted; depicted by breaks in the solid line). Problem behavior was immediately followed in each of these instances by a reactive prompt, after which Mike emitted the prompted FCR and reinforcement periods resumed. Thus, reinforcement was delivered following a "chained" response (i.e., problem behavior → prompt → prompted FCR). This chained sequence occurred on the fourth trial as well, but Mike engaged in an independent FCR following problem behavior. Thus, the conditions to produce a response chain were evident early in Mike's treatment evaluation. However, Mike did not engage in problem behavior for the remainder of that session. Programmed preemptive prompts were delivered following the next two reinforcement disruptions, occasioning an appropriate FCR. He then engaged in independent FCRs for the

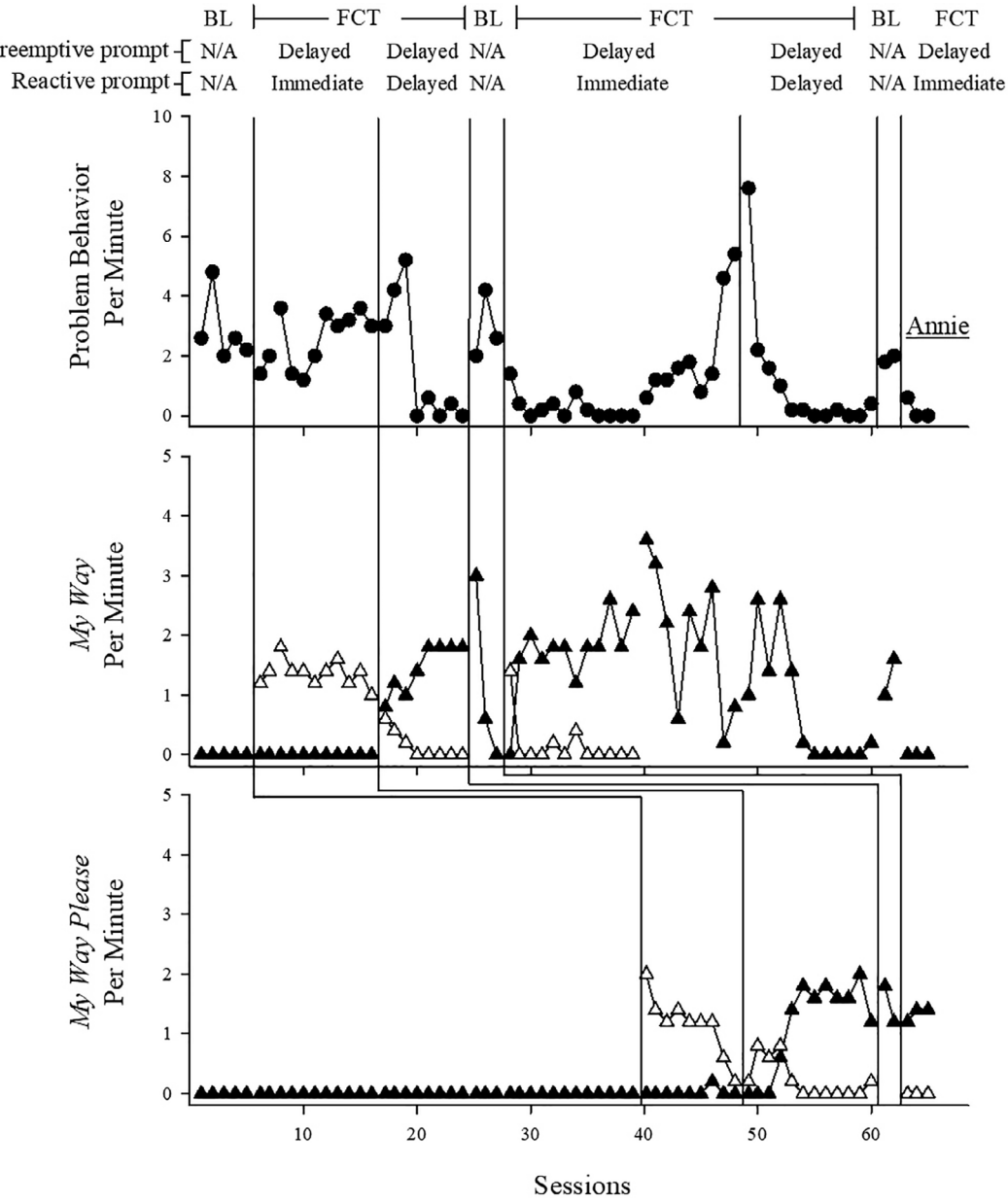
Figure 3
Results of the FCT Evaluation for Jordan



remaining three trials of the session. Notable from these data were that 100% (4/4) of instances of Mike's problem behavior were closely followed by reinforcement delivery.

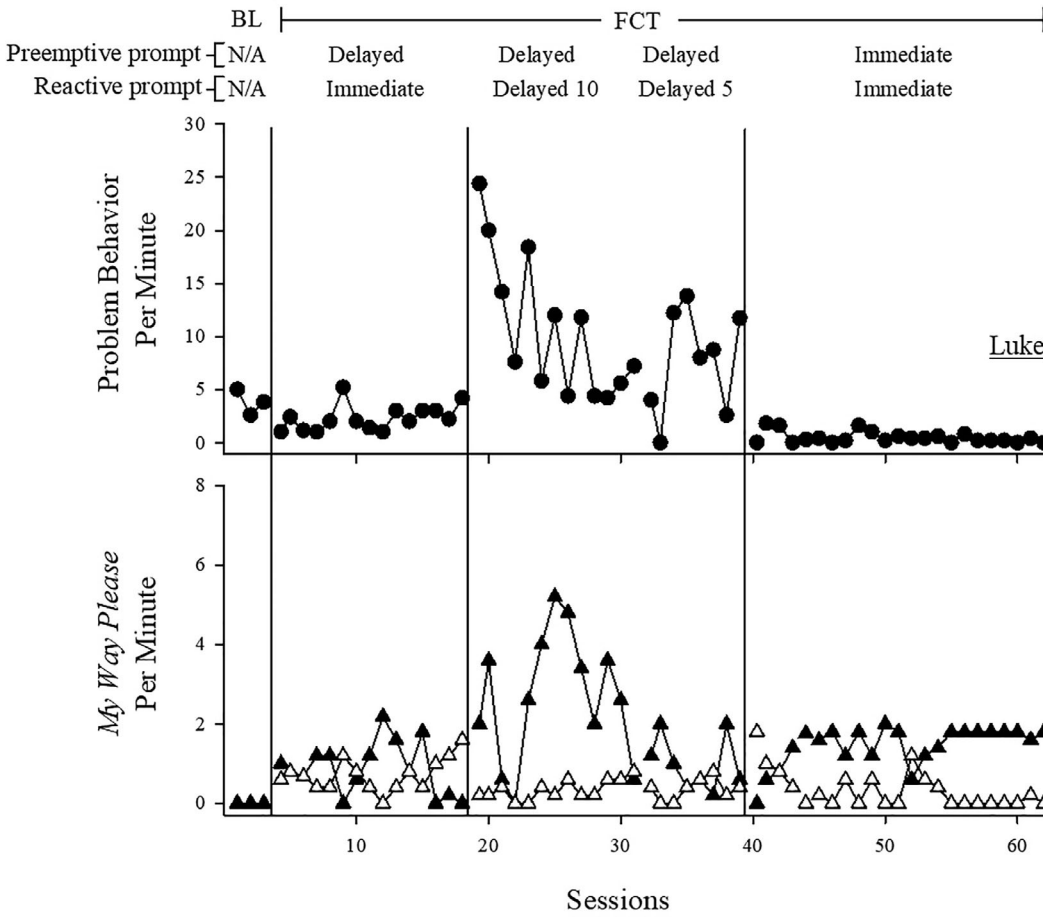
Jordan (middle two panels) engaged in multiple instances of problem behavior at the start of the first trial of session 6. Problem behavior was immediately followed by a reactive prompt,

Figure 4
Results of the FCT Evaluation for Annie



but problem behavior continued and the prompted FCR did not occur until the third presentation of the prompt. As a result, multiple instances of problem behavior did not contact reinforcement (within a 10-s window). Jordan engaged in problem behavior within 3 s of the disruption of reinforcement on the second trial (i.e., before the scheduled preemptive prompt). This problem behavior was followed by an immediate reactive prompt, the

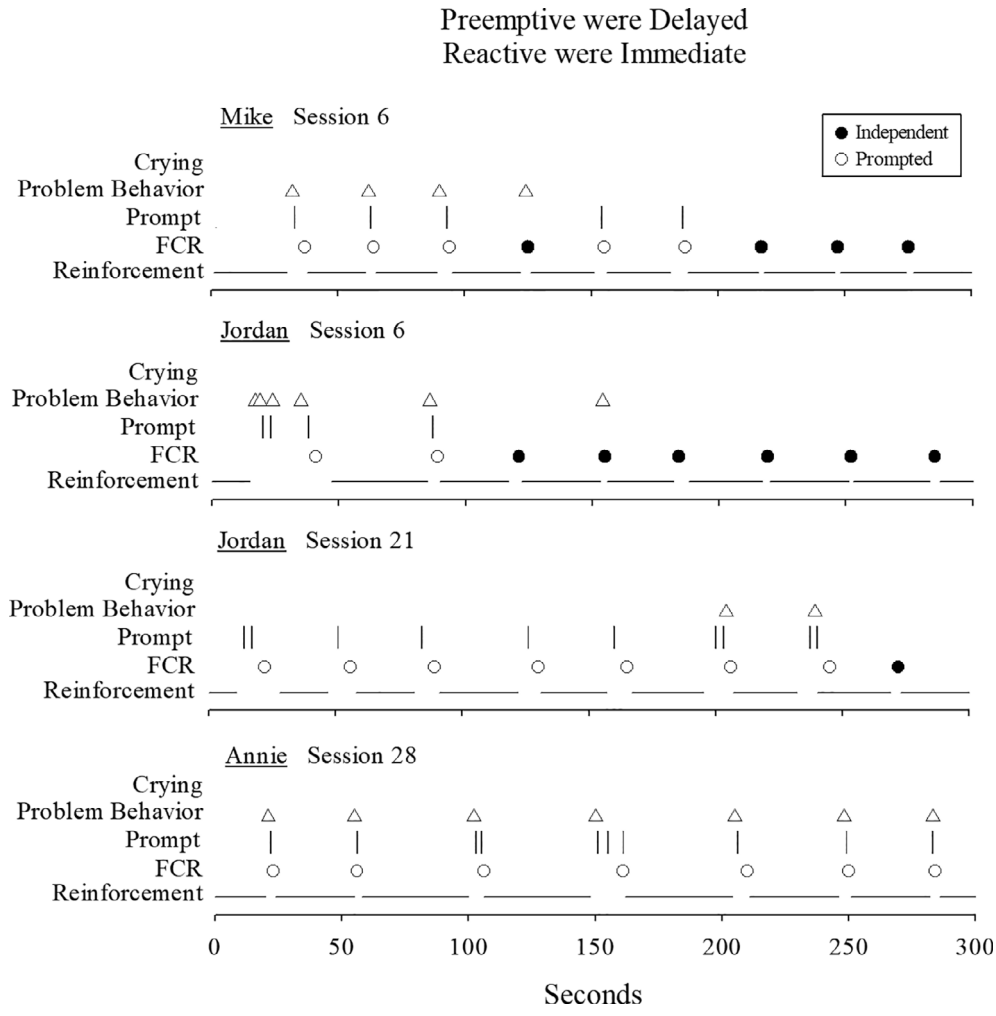
Figure 5
Results of the FCT Evaluation for Luke



prompted FCR, and reinforcement. Reinforcement was delivered within 10 s of problem behavior during the fourth trial, in which Jordan emitted problem behavior and an independent FCR in succession. Despite the occasional close associations between problem behavior and reinforcement, Jordan's problem behavior eventually decreased and FCRs occurred independently. Jordan did not experience any preemptive prompting during session 6. However, he did experience several preemptive prompts and reinforcement for problem behavior thereafter. For example, Jordan experienced preemptive prompts in 7/8 trials when FCT was later initiated to teach the intermediate FCR "May I have my way please?" (second panel; session 21). Jordan emitted prompted FCRs following preemptive prompts in the first five trials and engaged in problem behavior followed by a prompted response and reinforcement in the next two trials. Jordan's problem behavior then decreased, and he began emitting independent FCRs despite close associations between each instance of his problem behavior and reinforcement.

Annie (Figure 6; bottom panel) engaged in problem behavior at the start of every trial, resulting in reinforcement delivery following the

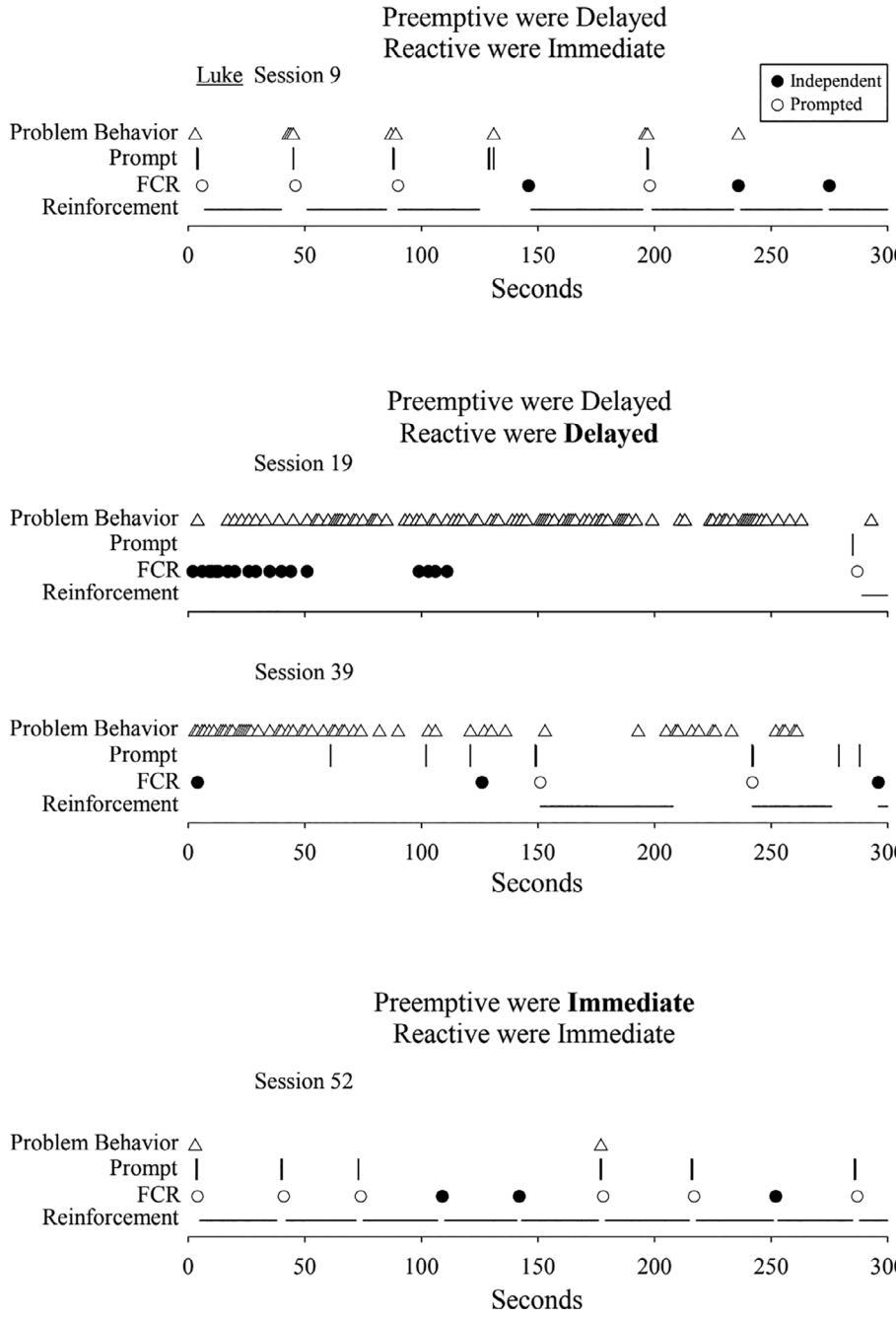
Figure 6
Second-by-Second Data in Efficacious Applications of FCT with Immediate Reactive Prompting



problem behavior → prompt → FCR response sequence in 100% of trials (7/7). Annie's immediate problem behavior following reinforcement disruption regularly precluded the delivery of any preemptive prompts, unlike the displays for Mike (fifth and sixth trials) and Jordan (first seven trials of session 21). The latency to the onset of problem behavior (and thus opportunity to preemptively prompt an FCR) may be one important characteristic that predicts for whom response chains will and will not persist. Despite her limited exposure to preemptive prompting, Annie's problem behavior eventually decreased, and she began emitting independent FCRs (see Figure 3). However, these outcomes were observed only after her problem behavior had been extinguished through delayed reactive prompting. It is possible that increasing the immediacy of preemptive prompts could have produced similar outcomes. These treatment options were explored via within-session analyses for Luke.

Figure 7 depicts within-session data across the three prompting conditions for Luke. The

Figure 7
Second-by-Second Data for Luke Across Each Prompting Condition



first panel depicts Session 9, in which FCT was implemented with immediate reactive prompting. In this condition, all FCRs were reinforced (i.e., both those that were and were not preceded by problem behavior). Luke engaged in problem behavior the first six out of seven

times reinforcement was disrupted, and he experienced only reactive prompts. Reactive prompts evoked the FCR in all but the fourth trial, during which Luke failed to respond within 5 s of the first two prompts, but then emitted an independent FCR during the delay to the third prompt. Thus, the chained-response sequence frequently occurred and contacted reinforcement. The second panel depicts Session 19, in which FCT was implemented with delayed reactive prompting. During this phase, only FCRs not preceded by problem behavior were reinforced by delaying reactive prompts. As a result, reinforcement was rarely delivered, and problem behavior continued during the reinforcer interval. This pattern was repeated and was more apparent in Session 39 (see third panel), in which Luke experienced three reinforcement periods and engaged in problem behavior during two of these three periods. The fourth panel of Figure 7 depicts Session 52, in which FCT was implemented with immediate preemptive and reactive prompting. When both preemptive and reactive prompts were immediate, Luke regularly experienced the preemptive prompt, and his problem behavior reduced considerably and no longer occurred during reinforcement periods.

Delayed reactive prompting was associated with an increase in the rate of more concerning topographies of problem behavior (data not depicted). The rate of more concerning topographies was 0.3 for Luke and 0.6 for Annie during the last three sessions of baseline. During the first three sessions of FCT with immediate reactive prompting, the rate was 0.5 for Luke and 0.3 for Annie. However, when reactive prompts were delayed, concerning topographies of behavior increased to a rate of 3.9 for Luke and 1.9 for Annie.

Collectively, immediate reactive prompting, and the subsequent reinforcement of chained FCRs, did not regularly impede treatment. With immediate reactive prompting, problem behavior episodes tended to be relatively short in duration and tended to subside after reinforcement was delivered. By contrast, when reactive prompts were delayed, problem behavior tended to occur at higher rates (e.g., Luke's Sessions 19 and 39) and persist through reinforcement periods.

Participants for whom FCT with immediate reactive prompting was initially unsuccessful regularly emitted problem behavior shortly after reinforcement was disrupted and rarely experienced preemptive prompting. For one participant (Annie), FCT with immediate reactive prompting was successful only after problem behavior had been extinguished. For another participant (Luke), delaying reactive prompts did not extinguish problem behavior. The FCT with immediate reactive prompting was successful after preemptive prompts were made more immediate such that they were delivered before problem behavior typically occurred. Delaying reactive prompts minimized access to reinforcement, was associated with frequent and uncontrolled problem behavior, and extinguished problem behavior for only one participant.

Discussion

The current study examined the effects of FCT with reactive prompts. Prompting the FCR immediately following problem behavior risks problem behavior being inadvertently strengthened as the first part of a response chain (e.g., problem behavior → prompt → FCR → reinforcement). FCT with immediate reactive prompting was associated with reduced problem behavior and increased independent FCRs in 8 of 11 phases (including within-subject replications) in the current study. Immediately prompting the FCR following problem behavior therefore does not appear to regularly establish undesirable response chains, typically results in independent FCRs, and is recommended during FCT.

Experimenters initially prompted the FCR at a 3-s delay after terminating the reinforcement interval and immediately following problem behavior (i.e., during FCT with delayed preemptive prompts and immediate reactive prompts). Within-session analyses of this condition showed that problem behavior was closely followed by reinforcement for all four participants—that is, reinforcement was contiguous with problem behavior. However, problem behavior persisted during this first application of FCT for only two participants (Annie and Luke). Those participants often exhibited problem behavior immediately following the disruption of reinforcement, and thus their problem behavior was usually followed by the reactive prompt, the prompted FCR, and reinforcement. They rarely received preemptive prompts, and most reinforcer deliveries were preceded by problem behavior. These participants experienced a strong contingency in which reinforcement was frequently contiguous with problem behavior. For these participants, experimenters evaluated delayed reactive prompting and immediate preemptive prompting as a means of disrupting this contingency.

Delaying reactive prompts eliminated the contingency for problem behavior by ensuring that reinforcement never closely followed problem behavior (i.e., was never contiguous with problem behavior). However, delayed reactive prompting was initially associated with an increase in the rate and severity of problem behavior, minimal exposure to reinforcement, and problem behavior that persisted into the reinforcement interval. Although problem behavior was eventually eliminated via delayed reactive prompting for one participant (Annie), problem behavior remained at elevated levels across 21 sessions for the other participant (Luke), leading experimenters to terminate this condition and evaluate immediate preemptive prompting instead.

Immediate preemptive prompting was designed to disrupt the contingency between problem behavior and reinforcement without eliminating the contiguity between problem behavior and reinforcement. During FCT with immediate preemptive prompting, experimenters first prompted the FCR immediately after disrupting reinforcement and later gradually delayed the preemptive prompt, while immediately prompting the FCR following problem behavior. Problem behavior was eventually eliminated without an associated burst of severe problem behavior. Furthermore, problem behavior did not persist into the reinforcement interval as it did during FCT with delayed reactive prompting. To this extent, problem behavior was more constrained to nonreinforcement periods when reactive prompts were immediate, and was unconstrained during both reinforcement and nonreinforcement periods when reactive prompts were delayed (see Luke's within-session analysis for a comparison of these effects). Immediate preemptive and reactive prompting is therefore recommended for remediating undesirable response sequences without a burst of severe and uncontrolled problem behavior during FCT. It is also recommended to initiate FCT by immediately prompting FCRs following the disruption of reinforcement and immediately following problem behavior in contexts in which safety is paramount, and to delay reactive prompts in these contexts only if this immediate prompting arrangement is ineffective.

Immediate preemptive prompting was evaluated with only one participant, after undesirable response sequences had already developed. However, successful applications of immediate preemptive prompting and immediate reactive prompting have been described elsewhere (e.g., Ghaemmaghami et al., 2018; Najdowski et al., 2008). Furthermore, the results of this study are commensurate with Michael's (2000) recommendations for addressing undesirable response chains. Michael suggested that undesirable response chains are unlikely when one reinforces the desired response in isolation with

equal or greater density than they reinforce the desired response in sequence with the undesired response (e.g., when one reinforces FCRs that are independent of problem behavior at least as often as they reinforce FCRs that follow problem behavior). That is, undesirable response chains are unlikely to develop and persist when the reinforcement favors the independent emission of the target skill over the chained sequence. Effective preemptive prompting may be the key to tipping the reinforcement contingency away from problem behavior without programmed extinction.

There are some potential disadvantages to immediate preemptive prompting. Tiger et al. (2008) noted that successful preemptive prompting may minimize the occurrence of problem behavior and thus minimize exposure of problem behavior to extinction. Exposing problem behavior to extinction early in treatment may impact the likelihood of the resurgence of problem behavior later in treatment, such as when the schedule of reinforcement is thinned or delayed. However, this sort of resurgence has been observed even when extinction is experienced during FCT (see Hanley et al., 2001), and despite repeated exposure to extinction (e.g., Wacker et al., 2011), and resurgence has never been shown to be more probable because extinction was not experienced during FCT.

We are unaware of other studies examining the timing of prompts during FCT. The results and recommendations described above should therefore be constrained to the procedures of the current study until further evaluations are conducted. Experimenters in the current study initiated FCT based on recommendations from previous research, which included targeting a novel, low-effort target response (Derby et al., 1998; Horner & Day, 1991), delivering synthesized reinforcement for FCRs (Jessel et al., 2018; Slaton et al., 2017), and gradually introducing the full establishing operation while progressively increasing the developmental complexity of the targeted FCR (Ghaemmaghami et al., 2018). It is unclear whether the results of the current study would be replicated under different conditions. Continued comparisons of the effects of preemptive and reactive prompting strategies are therefore warranted to further understand the benefits and limits to immediate prompting approaches during FCT.

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Received May 28, 2020
Final acceptance October 22, 2021
Action Editor, Jeffrey Tiger