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INTELLECTUAL DISABILITIES (M FELDMAN AND R CONDILLAC, SECTION EDITORS)

Variations of Functional Communication Training and Their Effects on Resurgence

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Abstract

Purpose of Review The purpose of this study was to evaluate what effect teaching multiple functional communicative responses (FCRs) as outlined in serial functional communication training (FCT) had on resurgence of problem behavior and FCRs during extinction challenges. Researchers then evaluated what effect implementing a lag schedule of reinforcement following serial FCT had on resurgence of problem behavior and FCRs during extinction challenges compared with serial FCT.

Recent Findings Recent findings evaluated the effect of a serial FCT procedure on resurgence of problem behavior, and the persistence of FCRs in an applied setting to determine if serial FCT would decrease the total number of responses of problem behavior during the resurgence (extinction) test while simultaneously increasing the total number FCRs as compared with the traditional (single) FCT condition for two children. They observed more manding (use of FCRs) and a smaller percentage of total responding occupied by problem behavior during serial FCT relative to traditional FCT. However, they also observed that problem behavior occupied the largest percentage of total relapse, demonstrating a primacy effect.

Summary The results of the present study indicate that teaching multiple FCRs in a serial FCT context is not sufficient to ensure the persistence of FCRs and significant delays or elimination of the resurgence of problem behavior during extinction challenges. Implementing a lag-2 schedule of reinforcement produced some desired effects, such as a higher total frequency of FCRs; however, resurgence of problem behavior was observed at higher rates and short latencies.

Keywords Functional communication training · Resurgence · Extinction · Lag schedule · Problem behavior · Treatment fidelity

Introduction

Since Carr and Durand [1] introduced functional communication training (FCT) as a procedure that is implemented to decrease problem behavior and increase appropriate behavior for individuals with autism spectrum disorder (ASD) and other developmental disabilities, it has become one of the most common-function–based treatments [2]. FCT is a differential reinforcement procedure in which an individual is taught an alternative, more appropriate communicative response that results in the delivery of the same class of reinforcer identified as maintaining problem behavior. Problem behavior is typically placed on extinction [3]. Over time, there have been a number of manipulations to the treatment process. Tiger et al. [3] provided a review of the past 20 plus years of research of these variations from research to provide an empirical basis for best practices and making decisions during the implementation of FCT as a treatment for severe problem behavior.

Although FCT has been demonstrated to be a well-established and effective treatment for reducing problem

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behavior [3, 4, 5], it is possible that procedures will not be implemented with high fidelity by caregivers in the naturalistic environment. In these situations, the alternative responses (i.e., functional communicative responses or FCRs) are likely to contact extinction (no reinforcement of the FCR) resulting in resurgence or reemergence of problem behavior [e.g., 6, 7]. Resurgence occurs when previously extinguished responses recover after an alternative response has contacted extinction [8]. In applied contexts, the resurgence of problem behavior during temporary lapses in procedural fidelity represents a reality for which there are currently few solutions [9••].

Lambert et al. [9••] evaluated the effect of a serial FCT procedure (teaching multiple mands individually and only after mastery has been demonstrated with the previous FCR) on resurgence of problem behavior and the persistence of FCRs in an applied setting (participant's house and a local university clinic) to determine if serial FCT would decrease the total number of responses of problem behavior during the resurgence (extinction) test while simultaneously increasing the total number FCRs as compared with the traditional (single) FCT condition for two children. They observed more manding (use of FCRs) and a smaller percentage of total responding occupied by problem behavior during serial FCT relative to traditional FCT. However, they also observed that problem behavior occupied the largest percentage of total relapse, demonstrating a primacy effect. These results suggest that serial FCT may require modification before it can be expected to consistently produce therapeutic outcomes beyond what is already possible through a traditional FCT paradigm. Lambert et al. suggested that repeated and/or more rapid exposure to shifting contingencies might increase the probability of the occurrence of recency effect and the reversion of response resurgence.

One potential method to arrange for contact with shifting contingencies could be to implement a lag schedule of reinforcement. Lag schedules of reinforcement arrange contingencies that directly influence operant response variability [10]. During a lag schedule, a response is reinforced if it differs from an indicated number of previous responses. The variability requirement is specified by the parameter of the lag schedule. A lag schedule of reinforcement following multiple mand training could potentially teach individuals to vary the use of multiple FCRs during extinction challenges.

The purpose of this study was to, first, evaluate what effect teaching multiple FCRs as outlined in serial FCT by Lambert et al. [9••] have on resurgence of problem behavior and FCRs during extinction challenges. Second, researchers evaluated what effect implementing a lag schedule of reinforcement following serial FCT had on resurgence of problem behavior and FCRs during extinction challenges compared with serial FCT.

Method

Participants and Setting

Three individuals diagnosed with ASD were recruited for participation in this study. All participants engaged in some form of problem behavior. Participants were able to emit a minimum of one-word vocal mands or mand approximations. All sessions took place in a private therapy room at an outpatient clinic.

Craig was a 9-year-old male referred to an outpatient clinic for assessment and treatment of aggressions maintained by escape from demands and access to attention. Ron was a 12-year-old male referred to an outpatient clinic for assessment and treatment of aggressions maintained by escape from demands and access to tangibles. Tom was a 4-year-old male referred to an outpatient early intensive behavioral intervention clinic based on reported concerns relating to deficits in communication and problem behaviors. Tom's primary problem behaviors consisted of SIB and disruptions maintained by access to tangibles.

Dependent Variables and Response Measurement

Problem Behavior

We collected frequency data, which was converted to rate (i.e., responses per minute [RPM]) and latency (seconds) to problem behavior.

The target behavior for Craig was aggression that included hitting, head-butting, scratching, pinching, biting, pushing, hair-pulling, propelling objects toward, spitting in the direction of, or poking the eye of another individual. The target behavior for Ron was aggression that included hitting, kicking, scratching, pinching, shoving, hair pulling, and throwing objects in the direction of another person. The target behavior for Tom was disruptions that included yelling, screaming, and crying, and self-injurious behavior (SIB) that included hand-to-head, self-biting, and head banging against objects.

FCR

Four topographically different FCRs were taught to each participant. Participants were taught to exchange a communication card, press a button on a speech-generated device (SGD), emit an American sign language (ASL) response, and emit a vocal response. We collected frequency data and converted it to a rate measure in the form RPM. Each participant FCR responses is outlined in Table 1.

Table 1 FCR description across participants

Participant	Exchange communication card exchange	Button press on a SGD	ASL	Vocal
Craig	Laminated card with the words, "Break + Talk" printed on the center of the card.	Button press on a SGD resulted in a male voice saying, "Break time. Let's talk."	Sign "all done"	"Break time. Let's talk."
Ron	Laminated card with the words, "Break + Play" printed on the center of the card.	Button press on a SGD resulted in a male voice saying, "Break time. Let's Play."	Sign "play"	"Play, please"
Tom	Laminated card with the word, "Play" printed on the center of the card.	Button press on a SGD resulted in a male voice saying, "Play with toys, please."	Sign "play"	"Play, please"

Interobserver Agreement and Procedural Fidelity

A second observer independently collected data for a total of 41%, 37%, and 34% of sessions for Craig, Ron, and Tom, respectively. We calculated interobserver agreement (IOA) scores using the exact agreement method by dividing the session components into 10-s intervals for each active variable, calculating a proportion of agreement, dividing the sum of these proportions by the total number of intervals, and converting the result to a percentage. An agreement was defined as both observers scoring the same behavior in a 10-s interval. IOA scores are summarized in Table 2. Procedural fidelity was collected for 46%, 33% and 34% of Craig, Ron, and Tom's sessions, respectively. Craig, Ron, and Tom's fidelity scores were an average of 98% procedural (*R* 85 to 100%), 97% (*R* 87 to 100%), and 94% (*R* 80 to 100%), respectively.

Experimental Design

Functional analyses were conducted for all participants in order to identify the variable(s) maintaining problem behavior using a multi-element design [11] or pair-wise experimental [12] design (data available upon request). During the FCT evaluation, we used a reversal design between four conditions: (a) baseline, (b) serial FCT [8], (c) resurgence, and (d) FCT with lag schedule of reinforcement. The sequence for reversals was ABCBCADCDC. If either serial FCT or FCT with a lag schedule of reinforcement were ineffective, the conditions were not replicated. All sessions were 10-min. Because some FCRs were free operant responses (i.e., vocal mands and signs), all FCR materials were available during all sessions. A control response (i.e., a black card) was also available during all sessions in order to verify that the recovery of previously extinguished responses was response resurgence rather than the product of some other behavioral operation such as extinction-induced variability [9••, 13]. After completion of this study, post-extinction FCT and schedule thinning was conducted with all participants but are not reported in this study.

Procedures

Baseline

During baseline, the reinforcer-maintaining problem behavior was delivered contingent on the target problem behavior. All FCR materials were present but did not result in reinforcement.

Serial FCT

Participants were taught to exchange a communication card, press a button on a SGD, emit an ASL response, and emit a vocal response [9••]. Procedures are summarized in Table 3. A picture prompt for the ASL response, and a script for the vocal response were provided. Order of training for the four FCRs was randomized across participants, and FCRs were reinforced on an FR1 schedule. The order of training for FCRs for each participant is summarized in Table 4. During the first session for each FCR condition, the experimenter provided the participant with a contingency review and immediately

Table 2 Mean percentage of interobserver agreement and range across variables for participants

Participant	Problem behavior		FCR 2	FCR 3	FCR 4
Craig	98%	97%	98%	99%	99%
	R 88–100%	*R* 82–100%	*R* 88–100%	*R* 90–100%	*R* 90–100%
Ron	99%	98%	98%	97%	98%
	R 95–100%	*R* 85–100%	*R* 85–100%	*R* 70–100%	*R* 75–100%
Tom	98%	99%	99%	98%	99%
	R 70–100%	*R* 77–100%	*R* 99–100%	*R* 87–100%	*R* 95–100%

R = range

Table 3 Procedures for training multiple FCRs during the serial FCT condition

Topography	Procedure
Exchange communicative card	PBx ➔ extinction FCR 1 ➔ S^r+
Button press on SGD	PBx ➔ extinction FCR 1➔ extinction FCR 2 ➔ S^r+
ASL	PBx ➔ extinction FCR 1 ➔ extinction FCR 2 ➔ extinction FCR 3 ➔ S^r+
Vocal	PBx ➔ extinction FCR 1 ➔ extinction FCR 2 ➔ extinction FCR 3 ➔ extinction FCR 4 ➔ S^r+

Topography order was randomized across participants. *PBx*, problem behavior; S^r+, reinforcement

prompted the FCR using a full physical prompt (hand-over-hand) after each presentation of an establishing operation (EO). For example, if a behavior was maintained by access to tangibles and the target FCR was the card exchange, the therapist would remove the tangibles and immediately guide the participants' hand to pick up the card and hand it to the therapist. For the vocal FCR, the participant was prompted to touch the script while the therapist provided a vocal prompt. A prompt therapist provided a vocal prompt on a FT 15-s schedule for all subsequent sessions. If the participant engaged in an incorrect FCR, the prompt therapist provided a vocal prompt to engage in the correct FCR. An FCR was considered mastered when the participant independently engaged in the FCR response for 90% of opportunities and problem behavior was at or below 0.2 RPM across three consecutive sessions. Independent FCRs were defined as any occurrence of the participant engaging in the FCR without the use of physical guidance and before a prompt has been delivered or when 5 s or more had elapsed since a vocal prompt had been delivered. A prompted FCR was defined as any occurrence of the participant engaging in the FCR with a full physical prompt or within 5 s of a verbal prompt. The percentage of independent FCRs was calculated by taking the RPM of independent FCRs divided by the sum of independent and prompted FCRs.

FCT with Lag Schedule of Reinforcement

A lag-2 schedule of reinforcement was implemented for FCRs that had been previously taught during the serial FCT condition. This schedule required the participant to emit an FCR that is different than the previous two FCRs. Teaching, prompting, and mastering criteria were identical to that of the serial FCT phase.

Resurgence

All responses (target problem behavior and FCRs) were placed on extinction until stability of data was established. Due to the counter-therapeutic nature of the condition, researchers did not conduct more than ten sessions in any one resurgence phase. Therapeutic contingencies were reinstated following resurgence.

Results

Figure 1 shows the results of the FCT evaluation for Craig. In the first baseline, elevated levels of problem behavior on an increasing trend were observed with a mean 7.2 RPM. Additionally, Craig did not engage in any FCRs, suggesting that these responses were not previously in his repertoire. During serial FCT, Craig engaged in all of the FCRs at elevated levels while problem behavior was immediately reduced and maintained at zero or near zero levels. The mean RPM of FCRs for the card exchange, SGD, ASL, and vocal phases were 4.2, 7.7, 6.5, and 9.7, respectively. The mean RPM of problem behavior for the card exchange, SGD, ASL, and vocal phases were 0.06, 0, 0, and 0, respectively. During the resurgence phase following serial FCT, we observed resurgence of problem behavior with a mean 0.16 RPM but did not see persistence of FCRs. Craig engaged in two FCRs, both ASL responses, in the first resurgence phase. These results were not desired; therefore, the serial FCT phase was not replicated. In the return to baseline, problem behavior was on an increasing trend with a mean 14.06 RPM. Craig engaged in low rates of FCRs with a mean 0.02 RPM. When FCT with a lag-2 schedule of reinforcement was implemented, problem behavior decreased to zero rates. Responding for all

Table 4 Order of FCR training across participants

FCR	Craig	Ron	Tom
FCR 1	Exchange communication card	Exchange communication card	ASL
FCR 2	Button press on SGD	ASL	Exchange communication card
FCR 3	ASL	Button press on SGD	Vocal
FCR 4	Vocal	Vocal	Button press on SGD

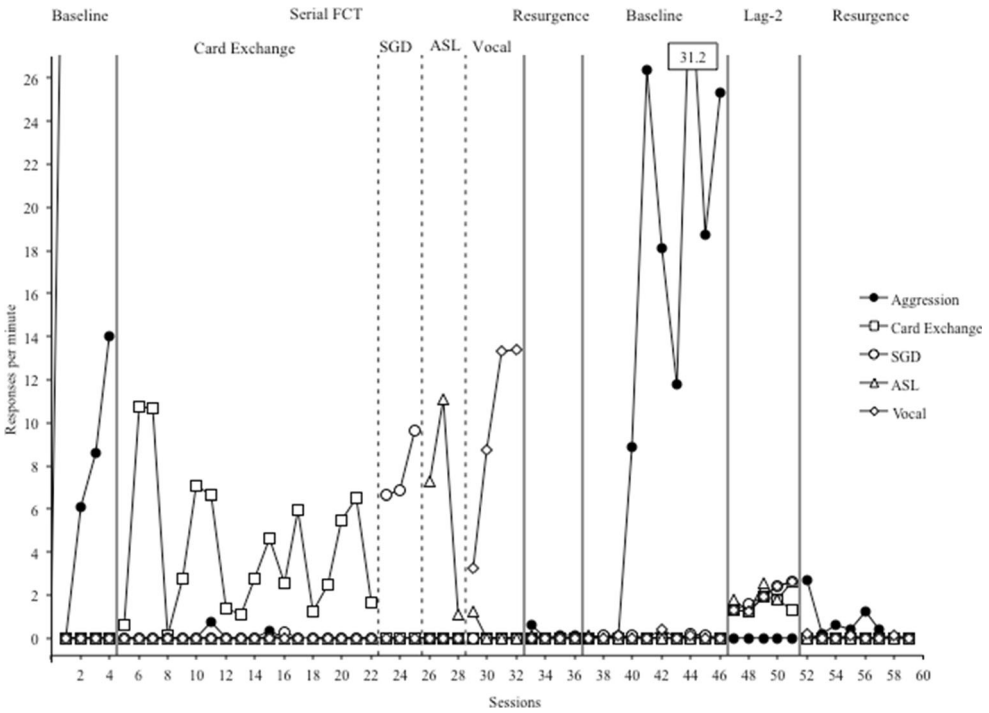

Fig. 1 Responses per minute of problem behavior and FCRs for Craig

of the FCRs was elevated. The mean RPM for card exchange, SGD, ASL, and vocal FCRs were 1.5, 2, 2, and 1.9, respectively. During the following resurgence phase, researchers observed resurgence of problem behavior at higher rates than the previous resurgence phase with a mean 0.7 RPM. We observed low rates of FCRs with a total frequency of 4 vocal responses. Craig also did not vary the use of FCRs in this phase. These results were not desired; therefore, this phase was not replicated.

We compared the latency to problem behavior during the resurgence test following serial FCT and FCT with lag-2 schedule of reinforcement for Craig. The mean latency to problem behavior following serial FCT was 271 s. The mean latency to problem behavior following the lag-2 schedule of reinforcement was 294 s. However, more sessions were conducted in the resurgence phase following the lag-2 schedule of reinforcement due to variability in problem behavior. Therefore, we compared the first four sessions of resurgence following serial FCT and FCT with a lag-2 schedule of reinforcement and found that the mean latency to problem behavior was 271 s and 96 s, respectively. These data show that, initially, there was a much shorter latency to problem behavior in the resurgence phase following FCT with a lag-2 schedule of reinforcement.

We also examined the mean percentage of response allocation during the resurgence phase following serial FCT and FCT with lag-2 schedules of reinforcement for Craig. In the resurgence phase following serial FCT, problem behavior occupied a mean of 80% of response allocation, and FCRs occupied a mean of 20%. In the resurgence phase following FCT with a lag-2 schedule of reinforcement, problem behavior occupied a mean of 93% of response allocation and FCRs a mean of 7%.

Because the resurgence phase following serial FCT had only four sessions, we also evaluated the frequency of FCRs in the first four sessions of the resurgence phase following FCR with a lag-2 schedule of reinforcement. Craig engaged in two FCRs in the resurgence phase following serial FCT, four FCRs in the resurgence phase following FCT with a lag-2 schedule of, and three FCRs when the first four sessions of the resurgence phase following FCT with a lag-2 schedule of reinforcement was evaluated. While we did see more FCRs in the resurgence phase following FCT with a lag-2 schedule of reinforcement, they were not clinically significant.

Figure 2 shows the results across all FCT phases for Ron. During baseline, elevated levels of problem behavior on an increasing trend were observed with a mean 0.9 RPM. Ron did not emit any FCRs. During serial FCT, Ron engaged in all of the FCRs at elevated levels while problem behavior was immediately reduced and maintained at zero or near zero levels. The mean RPM for the card exchange, ASL, SGD, and vocal FCRs were 3.2, 3.6, 12.2, and 3.6, respectively. The mean RPM for problem behavior across conditions was 0.2, 0.2, 0, and 0, respectively. During the resurgence phase following serial FCT, researchers did not observe resurgence of problem behavior. However, persistence of FCRs did not occur. Ron engaged in a total frequency of four FCRs in the first resurgence session, all of which were vocal responses. Ron did not engage in any FCRs in the subsequent sessions. These results were not desired; therefore, the serial FCT phase was not replicated. In the return to baseline, problem behavior

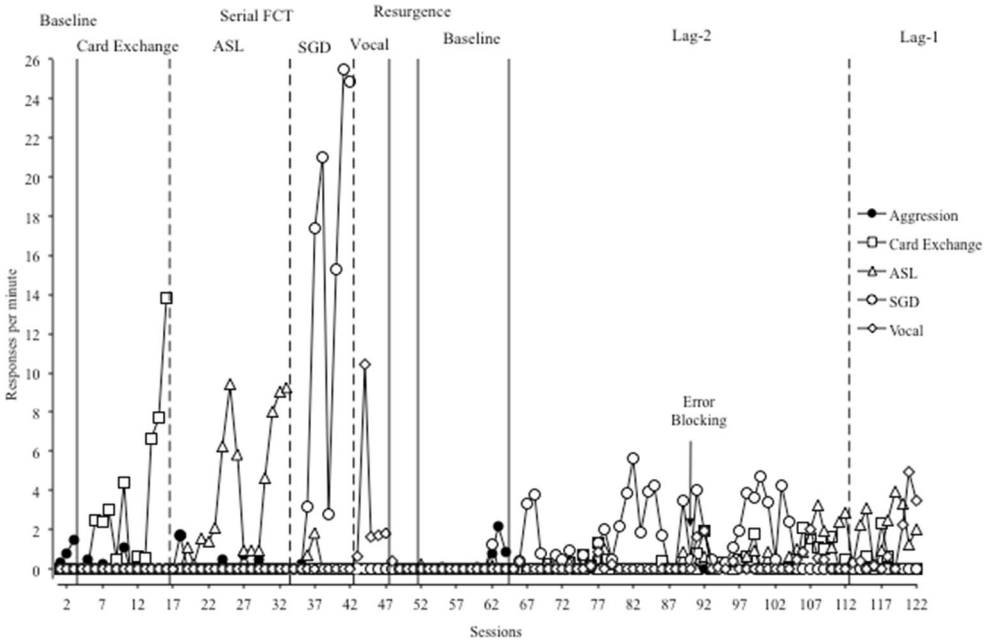

Fig. 2 Responses per minute of problem behavior and FCRs for Ron

before was initially low before observing elevated levels of problem behavior. Problem behavior occurred at a mean 0.3 RPM. Ron engaged in low rates of FCRs with a mean 0.03 RPM. When FCT with a lag-2 schedule of reinforcement was implemented, we observed problem behavior decrease to zero rates. Ron was consistently selecting the SGD and did not vary FCRs. Due to a lack of varying FCRs, we conducted two consecutive training sessions in which an immediate prompt was provided to engage in an FCR that met the lag-2 schedule of reinforcement requirement. We also modified the error correction procedure to error blocking and redirection. Ron still did not independently vary the use of FCRs with these modifications. The SGD was removed at session 105 in an attempt to shift responding to the other FCRs. Initially, some independent variability in responding was observed when the SGD was removed. Responding then shifted to consistent use of the ASL response. After making the aforementioned modifications and no signs of progression, Ron was removed as a participant from this study. Ron's problem behavior was addressed clinically but is not reported here.

Figure 3 shows the results across FCT phases for Tom. In the first baseline phase, Tom engaged in elevated rates of problem behavior with a mean RPM. Tom engaged in the vocal FCR at low rates in baseline. Tom did not engage in any other FCRs. During serial FCT, Tom engaged in all of the FCRs at elevated levels while problem behavior was reduced and maintained at zero or near zero levels. The mean RPM for ASL, card exchange, vocal, and SGD RCRs were 4.9, 4.6, 10.6, and 6.3, respectively. The mean RPM for problem behavior was 0.09, 0, 0, and 0, respectively. During the resurgence phase following serial FCT, researchers observed resurgence of problem behavior with a mean 2.7 RPM but did not see persistence of FCRs at stable elevated levels, and FCRs were quickly extinguished. These results were not desired; therefore, the serial FCT phase was not replicated. In the return to baseline, problem behavior increased with a mean of 11 RPM. Tom engaged in low rates of FCRs with a mean of 0.06 RPM. When FCT with a lag-2 schedule of reinforcement was implemented, problem behavior decreased to zero rates. Responding for all of the FCRs increased. The mean RPM for the ASL, card exchange, vocal, and SGD FCRs were 0.3, 0.8, 1.8, and 1.2, respectively. Initially, Tom was demonstrating a preference for the vocal response and requiring prompts to vary FCRs. Additional training sessions with immediate prompts were conducted before returning back to the FT-15 s prompt. Tom again showed preference for the vocal response. Additional training sessions with 0 s (immediate) prompts were conducted. Following the training sessions, error correction procedures were modified to include a 15 s no prompt following an error. This allowed Tom the opportunity to independently select another FCR when an error was emitted. Tom was able to master this phase following the implementation of the delayed error correction procedure. During the following resurgence phase, problem behavior increased with a mean 1.55 RPM. Higher rates and more varied use of FCRs was observed during resurgence following FCT with a lag-2 schedule of reinforcement. However, problem behavior occurred at consistently higher rates than FCRs. These results were not desired; therefore, this phase was not replicated.

We compared the latency to problem behavior during the resurgence test following serial FCT and FCT with lag-2 schedule of reinforcement for Tom. The mean latency to problem behavior following serial FCT was 119 s. The mean latency to problem behavior following the lag-2 schedule of

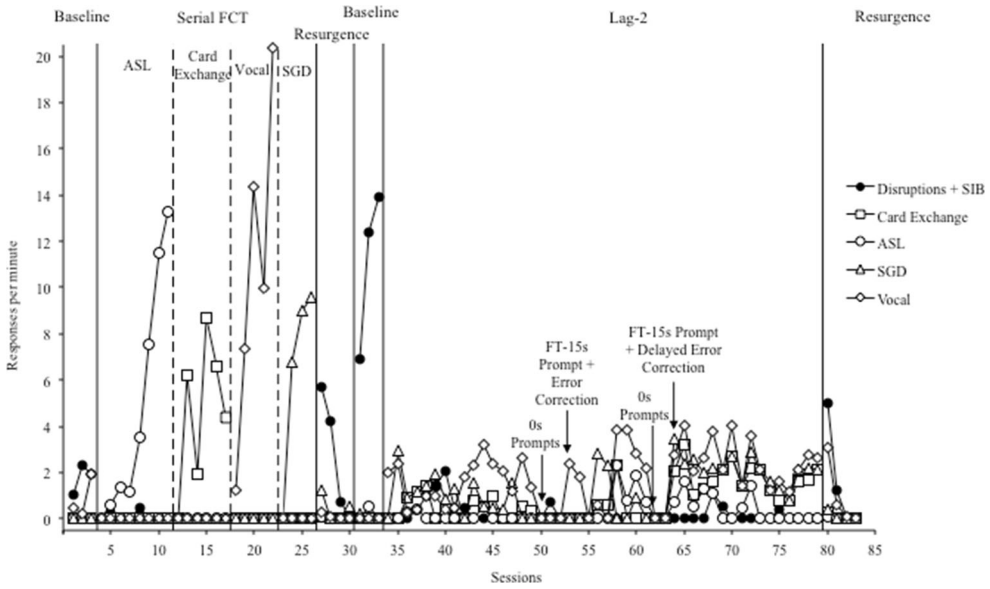

Fig. 3 Responses per minute of problem behavior and FCRs for Tom

reinforcement was 334 s. While the mean latency to problem behavior following the lag-2 schedule of reinforcement was longer, we observed comparable latencies to problem behavior in the first two sessions of each resurgence phase for Tom. The first and second resurgence sessions following serial FCT was 48 s and 10 s respectively. The first and second resurgence sessions following FCT with a lag-2 schedule of reinforcement was 26 s and 10 s respectively.

We also examined the mean percentage of response allocation during the resurgence phase following serial FCT and FCT with lag-2 schedules of reinforcement for Tom. In the resurgence phase following serial FCT, problem behavior occupied a mean of 82% of response allocation and FCRs occupied a mean of 18%. In the resurgence phase following FCT with a lag-2 schedule of reinforcement, problem behavior occupied a mean of 57% of response allocation and FCRs a mean of 43%. A significantly higher percentage of responding was allocated to the FCRs following the lag-2 schedule when compared with following serial FCT; however, problem behavior still occupied the highest percentage of responding.

Finally, Tom engaged in 23 FCRs in the resurgence phase following serial FCT and 46 FCRs in the resurgence phase following FCT with a lag-2 schedule of reinforcement. While we observed a higher frequency of FCRs following the lag-2 schedule, it is important to note that problem behavior had short latencies and still occupied the highest percentage of response allocation.

Conclusions

The results of the present study indicate that teaching multiple FCRs in a serial FCT context is not sufficient to ensure the persistence of FCRs and significant delays or elimination of the resurgence of problem behavior during extinction challenges. These findings were consistent with the findings of Lambert et al. [9••] and suggest that further modifications are needed before it can be expected to produce outcomes that are more beneficial than what can be achieved through traditional FCT. This study extended the work of Lambert et al. [9••] by training multiple FCRs following serial FCT in the context of a lag-2 schedule of reinforcement in order to teach the participants to vary the use of FCRs and arrange for more rapid shifting contingencies. Implementing a lag-2 schedule of reinforcement produced some desired effects, such as a higher total frequency of FCRs; however, resurgence of problem behavior was observed at higher rates and short latencies. One desired effect that was observed for two of the participants in resurgence following the lag schedule was a higher frequency of FCRs. While Craig only had a moderate increase in the number of FCRs used, Tom's data show a large increase in the number of FCRs that were emitted in the resurgence phase.

While some desired effects were achieved, there were several limitations to note. First, one participant, Ron, never mastered FCT with a lag-2 schedule of reinforcement. Ron showed a high preference for the SGD FCR. Procedures were modified in an attempt to teach Ron to vary the use of FCRs, including additional training sessions, implementing an error blocking procedure, and temporarily removing the SGD. Despite these modifications, Ron never mastered the lag schedule. Second, participants spent a relatively short amount of time exposed to the contingencies of the FCRs while problem behavior has likely been reinforced across numerous people and settings for several years before receiving behavioral services. It is possible that the differing reinforcement history may have impacted the results. Future research may want to prolong reinforcement of FCRs before conducting a resurgence test, which could increase the probability of seeing a

greater persistence of FCRs and lower rates with longer latencies to problem behavior. It is also possible that varied rates of reinforcement within the different FCR topographies could have influenced responding. Future research could also potentially yoke the rate of reinforcement for each FCR. Third, some of the results may have been impacted by a sequencing effect. Problem behavior and FCRs contacted extinction in both phases, and it is possible that extinction in one phase influenced the rate and/or pattern of the subsequent component. Future research should examine implementing a more realistic resurgence test. For the purposes of this study, all responses (problem behavior and FCRs) were placed on extinction during resurgence. However, it is unlikely that these behaviors will face prolonged extinction in a naturalistic setting. It is much more likely that the behaviors occurring will be intermittently reinforced. It is possible that FCRs would have persisted and problem behavior could have remained low if there was intermittent reinforcement for FCRs.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent Humans were used in this study and we obtained the appropriate IRB approval as well as consent.

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