Functional Communication Training using Concurrent and Chained Schedules of Reinforcement in Public Elementary School Classrooms

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INTRODUCTION

Children with intellectual and developmental disabilities (IDD) frequently engage in problem behavior, which can negatively impact their educational experiences in a variety of ways (Dworschak et al., 2016; Matson et al., 2005; Simó-Pinatella et al., 2019). For example, problem behavior has been shown to limit children's exposure to academic instruction (Carr et al., 1991), their access to peer interactions (Carter, 2018; Lyons et al., 2016), and may lead to placement in more restrictive educational settings (Yianni-Coudurier et al., 2008). For many children with disabilities and communication deficits, problem behavior represents a form of communication to meet one or more social needs. Reviews analyzing functions of problem behavior have estimated problem behavior serves some social function in 84% of cases (Beavers et al., 2013; Hanley et al., 2003). Common social functions include accessing teacher or peer attention, accessing preferred activities, avoiding non-preferred activities, or some combination thereof.

Negatively-reinforced or 'escape-maintained' problem behavior is the most prevalent type of socially-mediated problem behavior, particularly within educational settings (Anderson et al., 2015; Beavers et al., 2013; Hanley et al., 2003; Iwata et al., 1994). These behaviors are evoked by the presentation of a non-preferred task or activity and are reinforced by the removal or delay of that activity (Cooper et al., 2007). In classroom settings, students with IDD may initially engage in problem behavior to avoid an academic task that is too difficult or appears overwhelming. These patterns of problem behavior can then impact their teachers' behavior, such that teachers become less likely to present instructional demands to these students,

especially those that might be perceived as too difficult (Carr et al., 1991). This creates a cycle in which students receive less and less instruction over time, which only intensifies the aversiveness of difficult or otherwise non-preferred tasks, and their motivation to escape them.

There are a number of function-based interventions designed to reduce escape-maintained problem behavior and increase prosocial or academic behaviors (Geiger et al., 2010). One of the most commonly used and effective interventions is differential reinforcement of alternative behavior (DRA) with extinction (Geiger et al., 2010). During DRA with extinction, interventionists teach and reinforce appropriate behaviors, while withholding reinforcement for problem behavior (Petscher et al., 2009). Functional communication training (FCT) is an application of DRA that promotes acquisition of a functional communicative response (FCR) as an alternative to problem behavior. FCT has decades of evidence supporting its use in treating problem behavior for individuals with IDD (Heath et al., 2015; Kurtz et al., 2011), but it has also been shown to have limited efficacy when implemented without extinction (Hagopian et al., 1998; Rooker et al., 2013).

While extinction has been shown to be effective when implemented with fidelity, it can be difficult to use in classroom settings. When applied to escape-maintained behavior, extinction requires withholding reinforcement following problem behavior such that the individual is prevented from escaping the aversive situation as long as problem behavior is occurring (Cooper et al., 2007). In classroom settings, this means school personnel need to continue prompting compliance with demands even if a student is engaged in dangerous behavior, such as aggressing toward peers. This may compromise the safety of the student and those around them. Escape extinction also requires school staff to use manual guidance following noncompliance to prevent escaping a demand, which may lead to a physical struggle. The use of extinction in interventions

for escape-maintained problem behavior is also problematic because extinction can have negative side effects, including bursting and extinction-induced aggression (Lerman et al., 1999). These side effects make it difficult to implement extinction with fidelity, which is critical for extinction to be effective, as lapses in implementation can result in counter-therapeutic changes in behavior (St. Peter Pipkin et al., 2010).

A separate issue around function-based intervention for escape-maintained problem behavior is the relatively limited body of literature informing effects of intervention procedures beyond the initial phases of intervention (Heath, et al., 2015; Neely et al., 2018). FCT addresses initial treatment goals by teaching a functional alternative to problem behavior (e.g., requesting a break) to ensure children have the communication skills to meet their needs without engaging in problem behavior (Carr & Durand, 1985). But after children build fluency with FCRs, it becomes critical to teach the student to tolerate periods in which the FCR cannot be reinforced, as breaks will not be continuously available in any classroom. That is, the primary goal of intervention shifts from teaching the student *how* to appropriately request breaks to teaching them *when* it is appropriate to ask for them, and how to respond when breaks are not available. In doing so, the intervention increases opportunities for the student to engage with instruction, earn breaks by completing assigned tasks, and appropriately request those breaks as soon as they become available.

While previous studies have focused on delay and denial tolerance training following FCR acquisition (Skill-Based Treatment; Ghaemmaghami et al., 2016; Jessel et al., 2018; Santiago et al., 2016), they have not included procedures to teach children when breaks are available. Rather, delay and denial tolerance training uses un-signaled schedules of reinforcement for FCRs, where sometimes the therapist immediately reinforces FCRs (2/5 trials)

and sometimes the therapist programs a delay between the FCR and the break (2/5 trials). A potential disadvantage of this approach is that delays between the FCR and reinforcer delivery weaken the contingency between the two events, which can result in extinction of the FCR and recovery of problem behavior (Hanley et al., 2001; Hagopian et al., 2011). Previous studies on delay and denial tolerance training also have relied on extinction as a critical component of intervention, and have largely been implemented in clinical settings. In sum, there are few published examples of function-based interventions for escape-maintained problem behavior that address goals related to maintaining appropriate rates of the FCR, maintaining low rates of problem behavior, teaching when breaks are available, and increasing opportunities to engage with instruction, all while using procedures that are feasible for schools.

Differential Reinforcement of Alternative Behavior Using Concurrent Schedules of Reinforcement

When using DRA, concurrent schedules offer a potential alternative to extinction for problem behavior. Concurrent schedules of reinforcement are defined as two or more schedules operating simultaneously and independently in which at least two different responses are associated with their own schedules of reinforcement (Catania, 2013). Thus, contingencies can be arranged such that problem behavior results in reinforcement, but alternative behaviors result in more advantageous reinforcement (Athens & Vollmer, 2010; Trump et al., 2019). For example, a teacher might provide a 10-s break contingent on aggression, while providing a 45-s break with access to preferred activities contingent on appropriate requests for a break. In other words, the implementer continues to reinforce problem behavior with low-quality reinforcement, but increases the quality, magnitude, or immediacy of reinforcement for alternative behaviors to

encourage children to choose these alternatives over problem behavior (Athens & Vollmer, 2010; Briggs et al., 2019; Kunnavatana et al., 2018).

There is a small body of literature evaluating concurrent schedules as an alternative to extinction during DRA for children with IDD and escape-maintained problem behavior (c.f., Trump et al., 2019). While the results of these studies suggest concurrent schedules have promise, most of them were conducted in clinical settings (e.g., Davis et al., 2018; Lalli et al., 1999; Piazza et al., 1997). Results of evaluations in clinic settings may not generalize to classroom settings where not all environmental variables can be controlled for and resources for intervention implementation may be more limited. In addition, only a few studies have explored the effects of concurrent schedules during schedule thinning when therapists require children to complete increasing amounts of academic work before accessing high-quality breaks (e.g., Briggs et al., 2019; Hoch et al., 2002). Teaching children to tolerate periods of academic work is a necessary component of addressing escape-maintained problem behavior in classrooms.

Chained Schedules of Reinforcement with Demand Fading

Chained schedules of reinforcement with demand fading is a recommended method for thinning schedules of reinforcement for escape-maintained problem behavior following FCT because it promotes work engagement or compliance, while still providing access to breaks for appropriate behaviors (Hagopian et al., 2011). Chained schedules are a type of compound schedule in which completion of all signaled component schedules produces access to reinforcement (Catania, 2013). For example, in a classroom setting, the teacher might instruct a student to complete three work stations, each of which is signaled by a colored card (e.g., the red, blue, and yellow stations). After completing these three stations, the student may ask the teacher

to take a break. This procedure not only requires the student to complete some amount of work before breaks become available, but it also preserves the contingency between the FCR and reinforcer. Demand fading is a response-chaining procedure in which the number of demands is systematically increased before a request for a break will be honored (Hagopian, Boelter, & Jarmolowicz, 2011). Demand fading provides a method for gradually and systematically increasing work requirements to prevent ratio strain during schedule thinning.

While previous evidence supports using chained schedules following FCT for escape-maintained problem behavior, most studies have taken place in clinical settings and included extinction as a treatment component (e.g., Falcomata et al., 2013; Lalli et al., 1995; Peck Peterson et al., 2005). Only a few studies have evaluated the utility of chained schedules in classrooms using concurrent schedules as an alternative to extinction (e.g., Briggs et al., 2019; Davis et al., 2018; Hoch et al., 2002). Moreover, only one of these studies implemented the chained schedule following FCT, and only descriptively evaluated the effects of the chained schedule for one participant with attention deficit hyperactivity disorder (Davis et al., 2018). The other two studies' results showed chained and concurrent schedules reduced problem behavior and increased alternative behaviors (i.e., compliance, task completion) when both alternative and problem behaviors were reinforced on FR 1 schedules (Briggs et al., 2019; Hoch et al., 2002). Neither of these studies attempted to replicate intervention effects when schedule requirements exceeded FR 1. Thus, research is needed to evaluate the effects of chained schedules when schedule requirements more closely approximate those that can be reasonably implemented in classrooms.

Study Purpose

There is a need for interventions addressing escape-maintained problem behavior that are practical for educators to implement and that address goals related to functional communication, tolerance for demands, and work completion. While FCT is considered a well-established intervention for treating problem behavior for children with IDD (Kurtz et al., 2011), there are relatively few evaluations of its efficacy when applied to escape-maintained problem behavior and implemented without extinction in classroom settings. A small body of literature suggests concurrent schedules may be a viable alternative to escape extinction, but more evidence is needed to assess the effects of FCT with concurrent schedules in classrooms. Following FCT, chained schedules with demand fading offer a method for increasing tolerance for demands and work completion, while maintaining appropriate levels of functional communication and low levels of problem behavior. No studies have evaluated the effects of these combined procedures for children with IDD in classrooms with thinner schedules of reinforcement for alternative behaviors compared to schedules used during initial acquisition phases.

The purpose of this study was to evaluate a multi-component intervention designed to address educators' needs for interventions treating escape-maintained problem behavior for children with IDD that (1) decreased problem behavior, (2) promoted functional communication skills, (3) promoted academic work completion, and (4) taught children when to request high-quality breaks. Specifically, I planned to evaluate the effects of a packaged intervention (FCT + concurrent schedules + chained schedules + demand fading) to treat escape-maintained problem behavior for children with IDD in classrooms. I planned to introduce intervention components in stages. First, for all participants, I evaluated the effects of FCT + concurrent schedules on problem behavior, FCRs, and requests for other reinforcers (research question 1). When I

identified functional relations, I planned to then evaluate the effects of chained schedules + demand fading on work completion, FCRs, requests for other reinforcers, and problem behavior (research questions 2-3).

Research Questions

1. Does FCT + concurrent schedules increase the rate of FCRs and decrease the rate of problem behavior relative to baseline for children with IDD in classroom settings?
2. Following FCT + concurrent schedules, do chained schedules with demand fading produce differentiated rates of work completion, FCRs, and requests for other reinforcers for children with IDD in classroom settings?
3. Following FCT + concurrent schedules, do low levels of problem behavior maintain throughout implementation of chained schedules with demand fading for children with IDD in classroom settings?

CHAPTER 2

METHOD

Participants

I recruited participants by contacting district behavior support teams and school principals to identify students (1) with intellectual or developmental disabilities (2) in grades K–5 (3) who already had a functional behavior assessment and behavior plan or had been identified as needing a functional behavior assessment and (4) who exhibited problem behavior that occurred at least daily. Following participant nominations by behavior support team members or school principals, I contacted the student's teachers. Each participating student was required to have at least one educator (i.e., teacher or paraprofessional) who was willing to participate. Only educators who provided direct instruction to the student for at least 20 min per day were eligible to participate. If an educator agreed to participate, a teacher or principal contacted the student's parents to seek informed consent for study participation. After obtaining informed consent, the research team conducted an FA to evaluate the final eligibility criterion, which was for problem behavior to be maintained, at least in part, by negative reinforcement (i.e., escape from demands). I would have excluded participants if FA results suggested problem behavior was in part automatically maintained or if no problem behavior occurred during the FA, but this did not occur. The first two participants nominated who met inclusion criteria participated in the study. Each participant served as his or her own control in a single-case design, which allowed opportunities for demonstrations of experimental control within participants and replications of effect across participants.

Price was a five-year-old, African-American boy with diagnoses of developmental delay and autism. He was nominated for participation based on severe and persistent problem behavior including aggression (directed toward adults and peers), property destruction, and disruption. Price communicated using a combination of word approximations, gestures, signs, and picture cards. Price's teacher reported he rarely used signs or picture cards independently. Price had individualized education plan (IEP) goals related to expressive labeling; using vocal words and word approximations independently; receptively and expressively identifying letters and numbers; one-to-one correspondence; and requesting a break and help using words, gestures, or pictures. Price spent half of his school day in a self-contained special education classroom and the other half of his school day in general education settings. Midway through the study during intervention data collection, Price's IEP team decided to change his placement to a special education day school due to the severity of his behavioral concerns. However, this transition did not occur during the study.

Mira was a five-year-old, African-American girl with a diagnosis of developmental delay. She was nominated for participation based on severe and persistent problem behavior including aggression (directed toward adults), property destruction, and disruption. Mira communicated using fluent vocal sentences. However, Mira's teachers reported she did not use words to communicate when she was upset. Mira had IEP goals related to categorizing and describing objects, expressively identifying letter sounds, receptively and expressively identifying numbers, one-to-one correspondence, identifying emotional states, and following classroom rules. While Mira was scheduled to spend most of her day in general education settings, at the time this study was completed, she was spending almost the entire day in the school office due to problem behavior.

Setting

I recruited participants from public elementary schools in a large metropolitan school district in the southeastern United States. Study procedures occurred as pull-outs during teacher-specified convenient times. For Price, we conducted the FA in his special education classroom with peers present. We conducted baseline, FCT, and chained schedule sessions either in the special education classroom or in an empty classroom the school team used for instruction and crisis intervention when Price was unsafe around peers. The school team determined the setting in which we worked with Price based on the presence and intensity of problem behavior. Price's special education classroom had 3–5 peers and 3–5 staff members. We worked with Price in a separated area of this classroom that had two bookshelves, a built-in desk, and two chairs. Price's empty classroom contained one table, three chairs, and an empty media cabinet.

For Mira, we conducted the FA in her special education classroom without peers. We conducted baseline and FCT sessions in an empty classroom the school team used for crisis intervention when Mira was unsafe in the general education classroom. Mira's special education classroom had no peers present during data collection and 1–2 staff members. It had approximately eight student desks, a U-shaped table, a teacher desk, a large bean bag, a filing cabinet on wheels, and several empty cubbies. The other empty classroom had two child-sized tables, 4–5 child-sized chairs, a piano, and cabinets and shelves that stored instructional materials. After meeting a pre-set work criterion, I planned to generalize the intervention to programmed classroom activities in the special education classroom for both participants.

Materials

I used Countee to collect data (Countee program; Gavran & Hernandez, 2018) and monitor interobserver agreement; GraphPad Prism to graph and analyze data; and paper/pencil data collection sheets and clipboards to collect procedural fidelity data (see Appendix B), summarize research activities, and document any unusual or otherwise noteworthy events (e.g., fire alarm, disciplinary action by school staff). I used reading or math related academic work aligned to individualized education plan (IEP) goals or classroom learning objectives during selected FA conditions (e.g., escape sessions) and during intervention. I selected the type of academic work based on teacher report of work that was likely to evoke problem behavior, but was also on a level the student could complete independently. Examples of academic work included match-to-sample tasks, receptive identification tasks, expressive identification tasks (e.g., numbers and letters), and writing letters. I used a picture card (see Appendix A) to prompt requests during intervention. These request modalities were also present during baseline conditions. During intervention, I used a 4x6 laminated two-sided card (e.g., red with a circle on one side, green on the other) to signal contingencies in place during chained schedules. I also used preferred items identified via student request during selected assessment conditions (e.g., tangible FA sessions) and during intervention.

Response Definitions and Measurement

Problem Behavior

I scored *problem behavior* each time a participant engaged in their targeted topographies of problem behavior or a teacher-reported precursor to problem behavior. For both participants, we defined *problem behavior* to include forceful contact between the participant's body and

another person, object, or self from a distance of 6 in or more; throwing objects; breaking objects or otherwise altering an object's functionality; or verbally threatening to harm self or others. Precursors to problem behavior included active noncompliance (refusing to complete an academic objective) and yelling (Mira only). Examples of Price's problem behavior included hitting, kicking biting, hair pulling, pinching, disrobing, and climbing on furniture. Examples of Mira's problem behavior included hitting, kicking, scratching, tipping over furniture, and slamming doors.

Functional Communicative Response (FCR)

We scored a *functional communicative response (FCR)* each time a participant independently requested escape from demands using a picture card or vocal response. The exact form of the FCR was decided in collaboration with the teacher. We coded an FCR for Price when he said "break" or when he touched the relevant picture card. During the final FCT and chained schedule phases, Price was required to hand the therapist the picture card, rather than only touching it. We coded an FCR for Mira when she said, "break, please" or when she handed the therapist the relevant picture card. Requests for other reinforcers were not scored as FCRs.

Prompted FCR

We scored *prompted FCR* each time a participant emitted an FCR within 15 s of a therapist prompt to request escape from demands.

Other Reinforcer Requests

We scored *attention requests* and *tangible requests* each time a participant independently requested the specified reinforcer. The modality of other reinforcer requests matched the FCR modality, and like FCRs, therapists reinforced both vocal and picture card requests. Price's other reinforcer request was for tangible items. We taught him to ask for "toys, please" or "iPad,

please" (these two requests rotated based on what Price chose to play with during the informal preference assessment at the beginning of each appointment). Mira was taught two other reinforcer requests: one for tangible items ("play, please") and one for attention ("hug, please"). Requests for a break were not scored as an other reinforcer request (were scored as an FCR).

Prompted Other Reinforcer Requests

We scored *prompted attention requests* and *prompted tangible requests* each time a participant requested the specified reinforcer within 15 s of a therapist prompt to request the reinforcer.

Work Completion

We scored *work completion* each time a participant accurately completed a therapist-given task using a permanent product of the participant's work or following correct completion of the task if the task did not produce a permanent product (see Appendix C for an example data collection form). When a therapist provided error corrections, work completion was not scored until the participant made the correction. The therapist tallied error corrections, if provided, in the indicated area of the data collection form. Examples of work completion included match-to-sample tasks, receptive and expressive identification tasks, and writing letters. Completing only part of a therapist-given task was not scored as work completion.

Data Collection System

For all student target behaviors except work completion, we collected timed event data using Countee Software on iPods (see Appendix D for an example template). For work completion, we used event recording via paper/pencil data collection (see Appendix C for an example form). We also used event recording via paper/pencil data collection to collect procedural fidelity data (see Appendix B for procedural fidelity forms). We used checklist

recording for variables that should have only occurred one time per session and opportunity-based recording for variables that could occur multiple times per session and depended on student behavior.

Data Collector Training

Graduate student research assistants in special education collected session data and procedural fidelity data across study phases and participants. I trained data collectors by first reviewing the coding manual and data collection software in a 20–30 min meeting. Then, I collected live data alongside each trainee in a classroom setting until we reached a training criterion of 85% agreement on all variables across three consecutive sessions. If average agreement for any variable fell below 80%, data collectors reviewed the coding manual and discussed observed examples and non-examples of the variable(s). During the next data collection day, data collectors used the first session as a re-training session, during which observers called out variables as they coded them to identify and discuss agreements between observers. I collected additional IOA beyond 33% of sessions across participants and experimental phases when average agreement for any variable fell below 80%.

Interobserver Agreement (IOA)

A second observer collected data independently and simultaneously to evaluate IOA. We collected IOA for at least 33% of sessions across participants and experimental phases. I evaluated IOA for all variables using a point-by-point method. During the functional analysis, I scored an agreement when both observers scored problem behavior within a 5-s window of agreement. During baseline and intervention conditions and for all variables except work

completion, I used Countee software to calculate agreement. This software calculates 10-s interval-by-interval agreement and then averages agreement across intervals and multiplies by 100 to produce a percentage of agreement for each variable. For work completion, I scored an agreement between two observers when both observers score the assigned task as either complete or incomplete (e.g., both observers score problem 1 as completed). I then divided the number of agreements by the sum of agreements plus disagreements and multiplied this quotient by 100%. For Price, mean IOA was 100%, 99% (range, 97%–100%), 98% (range, 96%–100%), and 94% (range, 88%–98%) for FA, baseline, FCT, and chained schedule sessions, respectively. For Mira, mean IOA was 100%, 99% (range, 95%–100%), and 96% (range, 92%–99%) for FA, baseline, and FCT sessions, respectively. See Table 1 for a summary of IOA by participant, behavior, and condition.

Table 1

Interobserver Agreement

	Average Percentage Agreement (Range)	
Dependent Variable	Price	Mira
Functional Analysis		
Problem behavior	100	90 (0–100)
Baseline		
Problem behavior	97 (75–100)	95 (87–100)
Escape FCRs	100	100
Tangible requests	100	100
Attention requests	100	100
Work completion	100	100
Functional Communication Training		
Problem behavior	98 (92–100)	97 (87–100)
Escape FCRs	97 (75–100)	97 (87–100)
Tangible requests	96 (75–100)	93 (73–100)
Attention requests	–	99 (87–100)
Work completion	100	92 (67–100)
Chained Schedule		
Problem behavior	98 (95–100)	–
Escape FCRs	98 (93–100)	–
Tangible requests	98 (93–100)	–
Attention requests	–	–
Work completion	93 (80–100)	–

Experimental Design

Across experimental phases, I conducted sessions 2–3 times per week. I conducted FAs using a multielement design. FA sessions were no longer than 5 min and ended contingent on the first instance of problem behavior, except control sessions which always lasted 5 min. FA conditions were individualized based on teacher interviews and informal classroom observations. I visually analyzed latencies to targeted problem behavior within and across conditions. I concluded the FA after identifying consistent response differentiation between at least one test condition and the control condition. FAs included a minimum of three series.

I evaluated the effects of FCT + concurrent schedules using an A-B-A-B withdrawal design. Sessions in this evaluation were 5 min each. Condition A was a synthesized baseline condition that included all establishing operations (EOs) and reinforcers shown to maintain problem behavior during the FA, or all EOs and reinforcers in synthesized test conditions that were shown to maintain problem behavior. Condition B was FCT + concurrent schedules. The primary dependent variable used to inform condition changes in this withdrawal design was rate of problem behavior. Baseline conditions included a minimum of three sessions and FCT conditions included a minimum of five sessions. We changed conditions from baseline to FCT following stable and elevated rates of problem behavior or a countertherapeutic trend in problem behavior. We changed conditions from FCT to baseline (or chained schedules) when rates of independent escape FCRs exceeded rates of problem behavior with a zero-celerating or decreasing trend in problem behavior for three consecutive sessions.

I evaluated the effects of the chained schedule intervention using an alternating treatments design. The design consisted of two conditions: S^D and S^Δ, signaled using correlated stimuli (i.e., a green card and red card with a circle). Each session included five trials. A trial was made up of one S^Δ component followed by one S^D component. Thus, chained schedule session durations varied by session. I graphed appropriate behaviors (i.e., FCRs, other requests, work completion) by schedule component to evaluate discriminated responding. Discriminated responding indicated these behaviors were under stimulus control. Specifically, I evaluated whether rates of work completion were higher during S^Δ components relative to S^D components, and whether rates of FCRs and other requests were higher during S^D components relative to S^Δ components. These patterns would show evidence of experimental control.

Procedures

Teacher Interview

I interviewed the participant's teacher or behavior analyst to gather information about the participant's problem behavior and academic skills and performance. This 30-min interview took place prior to conducting assessment sessions. I used an open-ended interview protocol (adapted from Hanley, 2009; see Appendix E).

Preference Assessment

The therapist conducted a brief, informal preference assessment before each day's assessment, baseline, and intervention sessions to select tangible items to use for the day. The therapist selected 2–4 items the teacher reported as highly preferred, or those the child was observed to frequently request or play with during free time. To conduct the preference assessment, the therapist asked the child what they wanted to play with today. The first 1–3 items the child requested or touched were used for high-quality reinforcement and as reinforcers for tangible requests.

Functional Analysis (FA)

I conducted a multielement latency-based FA of each participant's targeted problem behavior (Thomason-Sassi et al., 2011) to identify EOs and sources of reinforcement for problem behavior. FAs began with standard conditions (i.e., attention, tangible, escape, and play) with individualized antecedents and consequences based on teacher interviews and an initial classroom observation. The play condition served as the control condition. Control sessions lasted 5 minutes. Test sessions ended after providing 30 s of the prescribed consequence following the first instance of the target behavior or after 5 min if no target behavior occurred. After a session ended, I did not initiate the next session until 1 min elapsed with no occurrences

of target behavior. Across conditions, FCRs and other reinforcer requests were placed on extinction.

During the *play* (control) condition, the therapist provided continuous access to preferred activities and provided attention at least once every 30 s. The therapist did not present any demands. During *attention* conditions, the therapist diverted attention at session onset by providing help to other students, talking to another adult in the classroom, or completing their own work and provided 30-s attention contingent on problem behavior.

During *escape* conditions, the therapist delivered academic demands with as little attention as was possible. If the student was working on the task, the therapist provided no attention. If the student was not working, the therapist used two-step prompting (verbal, model) with a 5-s inter-prompt interval and repeated this prompting sequence until the student either complied or engaged in problem behavior. Contingent on problem behavior, the therapist provided a 30-s break by removing demand materials and diverting her attention.

During *tangible* conditions, the therapist restricted access to preferred activities at session onset and provided 30-s access to these activities contingent on problem behavior. The student did not have access to other items or instructional materials.

Price's FA was adapted after the first tangible session due to high rates and a long duration of problem behavior following the first test session when tangible items were restricted to begin an escape session. To minimize the likelihood of multitreatment interference, we adapted Price's FA to include one synthesized test condition, rather than three isolated test conditions. In this synthesized escape-to-tangible-and-attention test condition, the therapist initiated a session by simultaneously presenting academic work and restricting access to tangible

items and ‘playful’ attention. Contingent on problem behavior, the therapist removed the work, and provided access to preferred tangible items and attention.

I conducted a minimum of three series (a series is a sequence of all test sessions and one control session) of FA conditions and ended FAs when latencies to problem behavior were consistently lower during at least one test condition relative to the control condition (i.e., three consecutive test sessions with lower latencies to problem behavior than play sessions, three of four test sessions with lower latencies to problem behavior than play sessions, or a decreasing trend in latency to problem behavior across three consecutive test sessions). If the participant’s problem behavior was at least in part maintained by escape, the participant was eligible for study participation and proceeded to the baseline condition. Neither participant was excluded due to problem behavior’s function.

Baseline

Following the FA, I designed a baseline condition that included all EOs and reinforcers shown to evoke or maintain problem behavior during the FA to establish base rates of problem behavior for the context in which intervention was implemented. For Price, the baseline condition EOs and reinforcers were the same as his synthesized FA test condition. For Mira, the baseline condition combined EOs and reinforcers shown to maintain problem behavior (i.e., escape to tangible and attention). For both participants, the therapist reinforced problem behavior with 30-45-s access to all reinforcers shown to maintain problem behavior. Following the reinforcement interval, the therapist reintroduced all EOs. FCRs and other reinforcer requests were placed on extinction. I concluded baseline data collection after a minimum of three sessions in which the participant showed stable or counter-therapeutic trends in rates of problem behavior.

Intervention

General Procedures. Across intervention phases, I manipulated parameters of reinforcement using concurrent schedules for problem and appropriate behaviors such that conditions favored appropriate behaviors without the use of extinction. Therapists reinforced both problem behavior and break requests on an FR-1 schedule. However, problem behavior was reinforced with a low-quality break (i.e., 10-s break without access to preferred items or activities). During S^D, therapists reinforced break requests with high-quality reinforcement (e.g., 45-s break); when the S^Δ component was introduced during chained schedules, therapists reinforced break requests with low-quality reinforcement. Therapists reinforced requests for other preferred items or activities during high-quality breaks only (i.e., during S^D). Problem behavior and FCRs that occurred during breaks were coded, but did not result in additional break time. Prior to the first session of each day, when intervention procedures changed, and following sessions with problem behavior or without independent FCRs, the therapist reviewed the rules and provided exposure to the contingencies in place.

Functional Communication Training (FCT) + Concurrent Schedules. The first phase of intervention was FCT. The purpose of FCT was to reduce problem behavior by teaching a functionally-equivalent replacement behavior. Therapists taught at least two replacement behaviors during FCT within the same session. They first taught both participants to request a break (FCR). They also taught both participants to request tangible items and taught Mira to request attention.

Prior to the first session of each day, the therapist reviewed the rules and provided exposure to intervention contingencies. For example, she showed the green card and said, “It’s green; you do not have to do work. Say, ‘break, please,’ [prompted FCR and provided a break]

Say, “play, please,” [prompted FCR and provided toys]. The therapist initiated an FCT session by putting the baseline EO in place (i.e., placing demands, restricting access to tangible items, and changing the type of attention from playful to neutral) and prompted FCRs using a system of least prompts (West & Billingsley, 2005). She waited 3 s after putting the baseline EO in place to provide an opportunity for the participant to independently emit the FCR. If the participant did not respond after 3 s, the therapist provided a gestural prompt (e.g., pointed at the FCR card). If the participant did not respond after another 3 s, the therapist provided a vocal prompt (e.g., “break, please”). The therapist reinforced prompted and independent vocal and picture card requests by immediately providing a break. After providing a break, the therapist waited 3 s. If the participant did not request tangible items, the therapist prompted this request using the same procedure. If Mira did not request attention 3 s after a break or tangible request, the therapist provided a verbal reminder that she could ask for attention (e.g., “you can say hug please, if you want a hug”). Following a decreasing trend in the rate of independent FCRs and other requests for Mira, (see Tier 2 in Figure 3), the therapist added a physical prompt as a third level of prompting 3 s after the model prompt if Mira still had not requested a break or tangible items (physical prompts were only provided for break and tangible requests).

During all FCT sessions, the therapist continued to reinforce problem behavior with low-quality reinforcement (10-s break). She prompted the participant to ask for a break when initiating low-quality reinforcement (e.g., therapist said, “break” and immediately provided one). To move to the next phase of intervention, rates of independent FCRs needed to exceed rates of problem behavior and there needed to be a zero-celerating or decreasing trend in problem behavior for three consecutive sessions.

Chained Schedule with Demand Fading. The second phase of intervention was only implemented with Price due to school closures. This phase used a chained schedule of reinforcement to (1) teach the participant when work was required and when high-quality reinforcers were available, and (2) progressively increase the participant's tolerance for conditions that previously evoked problem behavior. The chained schedule had two components signaled with correlated stimuli: (1) an S^{Δ} component, which signaled high quality reinforcers were unavailable and the participant was expected to complete academic work, and (2) an S^{D} component, which signaled high quality reinforcers were available contingent on the FCR and that further work completion was optional. The S^{D} component became available contingent on meeting work requirements during the S^{Δ} component. Sessions were comprised of five trials, or five chained schedule completions, which began with S^{Δ} followed by S^{D}. Throughout the chained schedule condition, we planned to terminate sessions if the participant received more than 10 low-quality breaks due to problem behavior occurring during S^{Δ} (this never occurred). Prior to starting the first chained schedule session of each day and following sessions with problem behavior or FCRs during S^{Δ}, the therapist conducted a brief contingency review reminding the participant "when it was red" (red card is present, S^{Δ}), they needed to work. When they finished their work, it "switched to green" (S^{D}). During green, they could ask for a break and the things they wanted and the therapist would deliver them. The participant practiced the FCR and tangible request when the green card was present.

Because chained schedule sessions were trial-based and the amount of work was scheduled to progressively increase throughout the chained schedule phase, we anticipated session durations would vary. The S^{D} component was initially set at 45 s but we planned to increase this duration as work requirements increased. The initial work requirement was based

on the amount of work the participant completed, on average, during baseline without engaging in problem behavior. Because Price did not complete any work during baseline, the initial work requirement was one task.

The correlated stimulus for S^{Δ} was a 4x6 laminated red card with a large circle printed on it. During S^{Δ}, the therapist prompted the participant to complete a pre-determined amount of academic work. We used a system of least prompts for work completion. We provided a gestural prompt 3 s after a therapist directive if the participant did not respond or immediately following an incorrect response. For continued incorrect responding (or no response) we provided a model prompt, repeating gestural and model prompts every 3 s as needed. The therapist reinforced FCRs and problem behavior on an FR 1 with low quality reinforcement (i.e., 10-s break). As during FCT, when providing low-quality reinforcement for problem behavior, the therapist prompted the participant to request a break (e.g., therapist said, "break" and immediately provided one). Completing the work requirement initiated the S^{D} component.

The correlated stimulus for S^{D} was a 4x6 laminated green card. During S^{D}, the participant could request a break and then request items and attention. Work materials remained present and demands continued until the participant requested a break. The participant could choose to complete work, but this work completion was optional and was not associated with additional reinforcement. The therapist reinforced all appropriate and reasonable requests on an FR 1. These reinforcers were available for the remainder of the break. The therapist prompted FCRs and other requests using the same system of least prompts as during FCT.

I planned to begin demand fading following the first two chained schedule sessions without problem behavior and to continue to increase the work requirement every three consecutive sessions without problem behavior. I also planned to intermittently program lower

work requirements (e.g., every 3-5 sessions) to guard against a potential across-session punishment contingency (i.e., the consequence of completing work in one session is an increase in the work requirement in a subsequent session). To determine the demand fading progression, I collaborated with Price's special education teacher to set a terminal work requirement based on her experience with Price and the levels of work completion and problem behavior observed during sessions. His terminal work goal was completing work for approximately 5 min (e.g., 3 folder activities with 8–15 items each). I used this goal to inform eight intermediate levels for increasing the work requirement (i.e., FR 1, FR 4, FR 6, FR 10, FR 16, FR 24, FR 32, FR 40). Price's teacher and I agreed to adjust the terminal goal as needed based on Price's performance using the levels of problem behavior and work completion to inform adjustments.

After eight chained schedule sessions, problem behavior continued to show an increasing trend. We returned to FCT until re-establishing mastery criteria with two procedural modifications. We made these modifications because Price engaged in problem behavior during S^D when FCRs and requests were not *immediately* reinforced (it took the therapist a moment to remove work and return Price's items). The first modification was to require Price to remove the picture card from the Velcro attachment in his picture book and hand it to the therapist, rather than only pointing to it. However, the therapist still reinforced vocal requests. Price often emitted vocal and picture card requests at the same time. The second modification was to require Price to have "ready hands" (hands flat on the table on top of each other) before reinforcing FCRs and requests. These modifications were designed to teach Price to tolerate brief delays between appropriate requests and reinforcement delivery without engaging in problem behavior and to increase the feasibility of intervention implementation (i.e., to help the therapist more easily manage materials). Once the rates of independent FCRs exceeded rates of problem behavior and

there was a zero or decreasing trend in problem behavior for three consecutive sessions, we returned to the chained schedule, keeping the modifications made during FCT.

I planned to initiate demand fading following two chained schedule sessions without problem behavior, and to continue fading demands until the student reached the terminal work criterion set in collaboration with the teacher. Once the participant was within the final two levels of demand fading, I planned to begin generalizing the intervention to one classroom activity. I planned to conduct the final levels of demand fading in a generalization setting. However, demand fading was not initiated for either participant due to school closures.

Generalization. Once the participant reached the pre-determined level for initiating generalization, I planned to transfer the intervention from a separated area of the classroom to a classroom activity the teacher was leading. When I initially planned to transfer the intervention to a classroom activity, the teacher would have provided instructional demands and I would have implemented other aspects of the intervention (i.e., managing correlated stimuli, delivering reinforcement, responding to problem behavior) until rates of problem behavior were low and stable. Then, I would have asked the teacher or paraprofessional to begin implementing the remaining aspects of the intervention.

To descriptively measure whether participants made appropriate requests and completed their work outside of sessions during the rest of the school day, a member of the school team completed a brief REDcap survey once per week (see Appendix F). This survey asked the respondent whether they observed any appropriate requests that day, and if so, what type of requests (i.e., requests for a break; requests for preferred activities; requests for adult attention; requests for peer attention; requests for food, drinks, or snacks). It also asked the respondent to

estimate the percentage of assigned work the student completed that day using a dropdown menu ranging from 0%–100% in 10% intervals.

Teacher Training. I planned to train the teacher on the intervention prior to generalization. I planned to use a behavioral skills training approach (Hogan, Knez, & Kahng, 2015) in which I would have first given them an overview of the intervention, then modeled it, and then role-played with the teacher while giving them feedback. I expected these activities to take place during a 30–45 min meeting. We also would have role-played co-implementing the intervention together to prepare for the initial generalization sessions in which the teacher would have delivered instructional demands and I would have implemented other intervention components. I would have explained that once the teacher felt comfortable and rates of problem behavior remained low and stable, I would then ask them to implement all intervention components. At this stage, I would have provided in-vivo feedback and support until rates of problem behavior were again low and stable.

Procedural Fidelity

Procedural fidelity is summarized in Table 2. I collected procedural fidelity across all participants for at least 50% of sessions in each condition (see Appendix B for fidelity forms). I measured procedural fidelity using a checklist to code correct or incorrect implementation of set-up materials (e.g., red vs. green card, worksheets) and session duration and using event recording to measure motivating operation implementation and consequence delivery for problem behavior and requests. Observers coded each opportunity for a variable to occur (e.g., the child engaging in problem behavior is an opportunity to deliver a consequence for problem behavior) as correct or incorrect based on therapist behavior.

Table 2

Procedural Fidelity

	FA		Baseline		FCT		Chained Schedule	
Participant	Fidelity	Fidelity IOA	Fidelity	Fidelity IOA	Fidelity	Fidelity IOA	Fidelity	Fidelity IOA
Price	100	–	100	–	99.7	98.8	100	–
Mira	100	–	100	100	100	–	–	–

The variables coded during FA and baseline session were: (1) pre-session access to purported reinforcers, (2) correct materials present/absent, (3) EO implementation, (4) access to other reinforcers as programmed (e.g., high preferred items restricted during escape conditions), (5) FCRs and other requests ignored, (6) consequence delivery for problem behavior, (7) consequence delivery duration for problem behavior, and (8) session duration. FA and baseline procedural fidelity was 100% for both participants.

During FCT, I measured the same variables as FA and baseline, except FCRs were not ignored and observers coded the following additional variables: (1) contingency review as programmed, (2) prompting procedure for FCRs and requests, (3) reinforcers delivered following FCRs and requests, and (4) reinforcer duration following FCRs. Average procedural fidelity during FCT was 99.7% (94%–100%) for Price and 100% for Mira.

During chained schedule sessions, I measured the same variables as FCT, except observers coded all direct count variables by schedule component (S^D and S^Δ) and coded whether the correct amount of work was assigned. Procedural fidelity was 100% for Price.

For formative evaluation, I calculated correct implementation by variable by dividing the number of correct implementations by the number of opportunities and then calculating a percentage. During the chained schedule phase, I also calculated separate percentages of opportunities with correct implementation by schedule component (S^D and S^Δ) to address

implementation errors that only occurred during one type of schedule component. If procedural fidelity fell below 85% for any variable, in any schedule component, in two consecutive sessions, I met with the research team to troubleshoot behaviors with low fidelity and role-played those behaviors until therapists performed them correctly.

For summative evaluation, I calculated procedural fidelity by session by dividing the number of opportunities with correct implementation by the total number of opportunities. I then calculated a percentage of opportunities with correct implementation.

Interobserver Agreement on Procedural Fidelity

A second observer collected procedural fidelity data as resources allowed (7% of all sessions for Mira and 13% of all sessions for Price). I prioritized IOA on dependent variables and primary procedural fidelity data over IOA on procedural fidelity. I coded agreements and disagreements for each variable, and calculated a session agreement percentage by dividing the smaller number by the larger number and multiplying by 100. If agreement fell below 80% in a single session, we planned to pause data collection to discuss disagreements before collecting more data (this did not occur). Average IOA on procedural fidelity was 98.8% (96.7%–100%) for Price and 100% for Mira.

Social Validity

I planned to collect social validity data from student and teacher participants. Following the chained schedule evaluation and prior to generalization, the therapist would have conducted a concurrent chains preference assessment with each participant in which they could choose between an intervention session or returning to class activities. Prior to beginning preference assessment sessions, the therapist would have provided a forced-choice exposure to each

alternative. The therapist would have begun preference assessment trials by asking the participant if they wanted to work for reward time with [therapist name] or return to [current class activity]. They would have presented the choices in a neutral location (e.g., the hallway) and used materials associated with each context to represent each condition. For example, the therapist would have shown the participant the green/red card and the worksheet they would complete during an intervention session and the materials from the current class activity they would complete if they returned to the class activity. Contingent on making a selection (voicing a selection or touching materials for one of the choices), the therapist would have provided access to the selection for 5 min before returning to the neutral location to present the next trial. If the participant did not make a selection within 5 s of the initial therapist prompt, the therapist would have re-presented the choices. If the participant did not make a selection after 10 s, data collectors would have scored no choice and the therapist would have presented the next trial. The therapist would have conducted a minimum of three trials and continued until establishing a consistent preference (e.g., three consecutive selections of the same condition) or after completing 10 trials. I planned to identify the condition (intervention or classroom activity) selected across more trials as the preferred condition.

Finally, I planned to collect social validity data from the teacher using a researcher-created questionnaire adapted from multiple sources (Elliott & Treuting, 1991; Gresham & Lopez, 1996; Kelley et al., 1989). This survey was designed to inform the acceptability, feasibility, and utility of the goals, procedures, and effects of the study (see Appendix G for questionnaire). I planned to ask teachers to complete these forms twice to inform how direct experience may have influenced the social validity of the intervention. They would have completed the form once after observing the research team implement the intervention, but

before implementing it themselves and then again after implementing the intervention. I planned to summarize these data in tables with means and ranges for each closed-ended question.

CHAPTER 3

RESULTS

Figure 1 depicts functional analysis results by participant. During Price's FA, we modified test conditions by moving to a synthesized test condition (i.e., escape to tangible and attention) following the first tangible session. This was due to prolonged problem behavior outside of session when we restricted tangible items to begin the first escape session. Price's FA results showed shorter latencies to problem behavior during the test condition relative to the play (control) condition, though problem behavior did occur in two of five control sessions. These data suggest problem behavior was maintained by escaping demands to access attention and tangibles. During Mira's FA, latencies to problem behavior were shorter during attention, tangible, and escape conditions relative to the play condition, though problem behavior also occurred in two of four control sessions. These data suggest problem behavior was maintained by access to attention, access to tangibles, and escape from demands. Both participants proceeded to FCT after confirming problem behavior was in part maintained by escape.

Figure 1

Functional Analysis Results

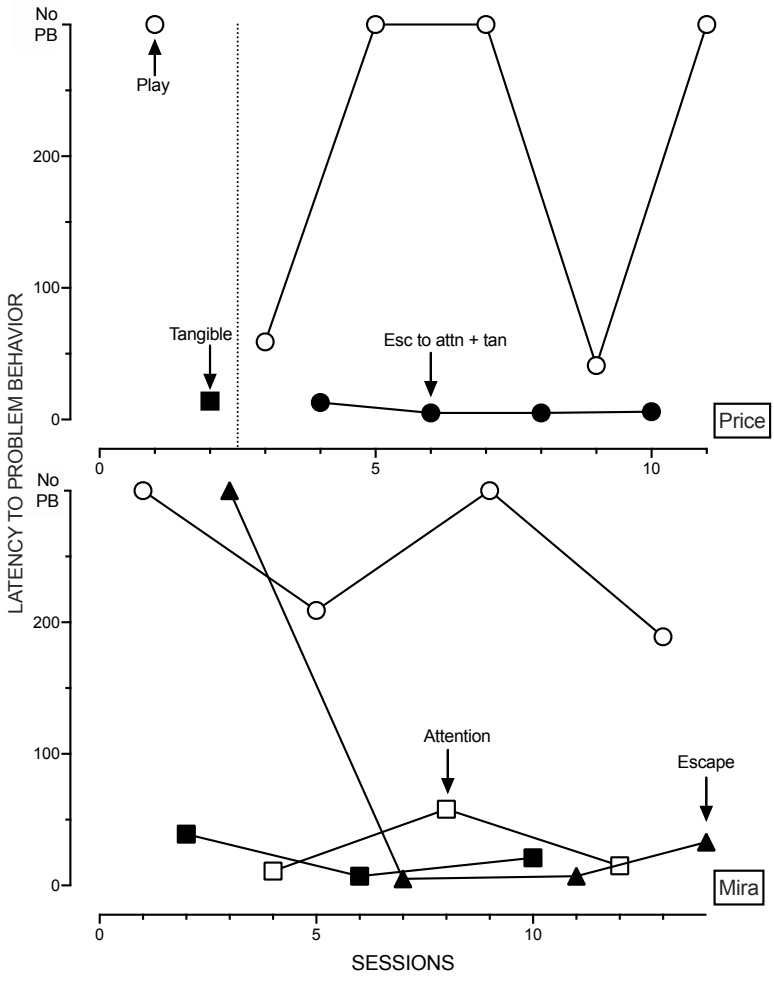
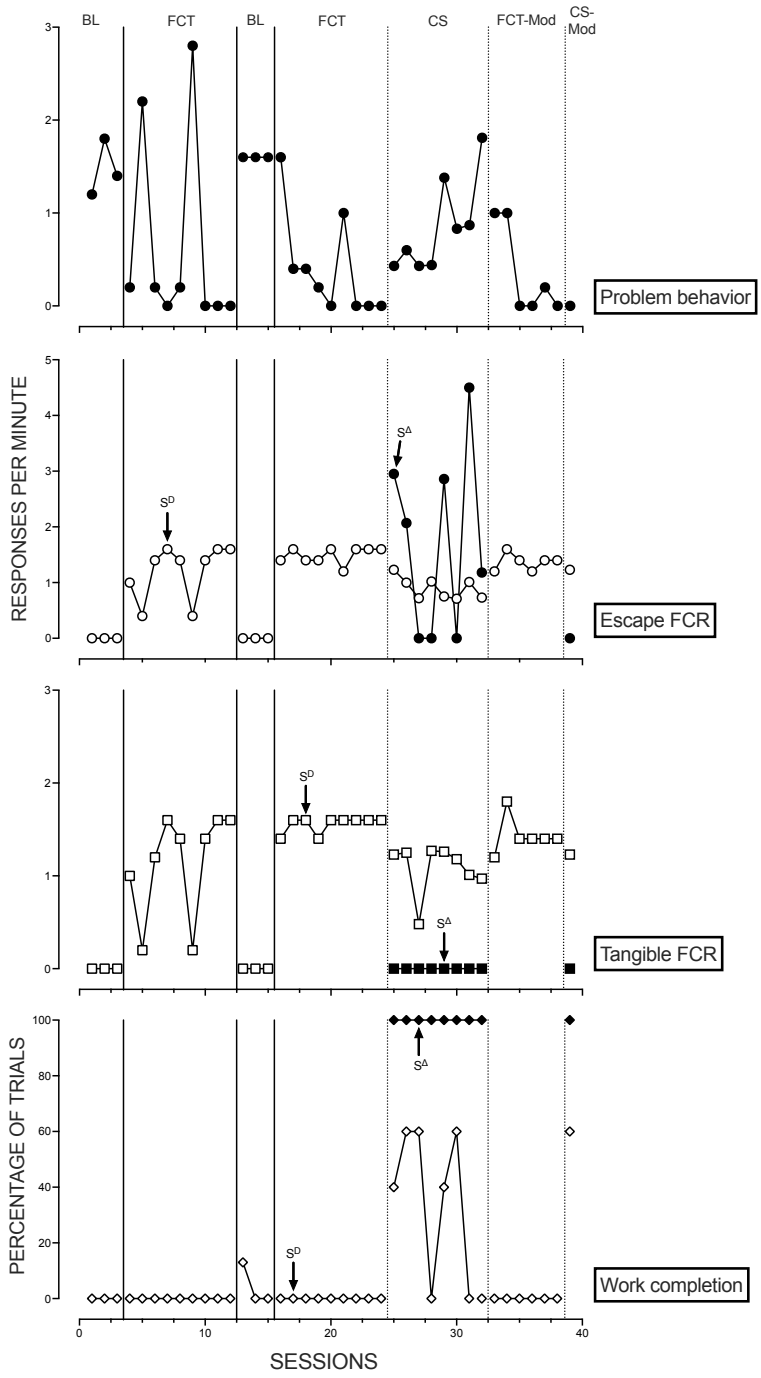


Figure 2 depicts treatment results for Price. Relative to baseline, Price engaged in lower, but variable rates of problem behavior and higher rates of FCRs and requests during FCT phases. FCT phases show decreasing trends in the rates of problem behavior and relatively stable rates of FCRs and requests. Price engaged in zero rates of work completion across baseline and FCT phases. Based on three demonstrations of effect, we concluded FCT + concurrent schedules was effective in reducing Price's problem behavior and in establishing FCRs and requests for tangibles.

Figure 2

Price's Treatment Evaluation Results



Note. BL = baseline, FCT = functional communication training, CS = chained schedule, FCR = functional communicative response.

The introduction of the chained schedule produced an immediate increase in rates of work completion during S^{Δ}. While rates of work completion slightly increased during S^{D}, levels of work completion were consistently higher during S^{Δ} relative to S^{D}. These data indicate the chained schedule was effective in differentially increasing Price's rates of work completion. During S^{D}, Price engaged in escape FCRs and tangible requests at slightly lower rates and with a slight decreasing trend relative to FCT. During S^{Δ}, Price engaged in highly variable rates of FCRs and zero-rates of tangible requests. These data suggest tangible requests came under stimulus control, but FCRs did not. Across schedule components, Price engaged in increasingly high rates of problem behavior; thus, the decreased rates of problem behavior achieved during FCT did not maintain during chained schedules. We returned to FCT and made minor procedural modifications (see description on page 26) to re-establish low rates of problem behavior. When we reintroduced the chained schedule, the first data point shows a low level of problem behavior and differentiated levels of work completion, escape FCRs, and tangible requests. More data are needed to fully address research questions 2–3, which evaluate the effects of chained schedules with demand fading on problem behavior and differentiated rates of work completion, FCRs, and other requests. The current data suggest chained schedules were effective in increasing work completion and obtaining stimulus control over tangible requests using an FR-1 work requirement, but not effective in maintaining decreases in problem behavior or in obtaining stimulus control over FCRs. I was not able to address the effects of these procedures with response requirements greater than one task.

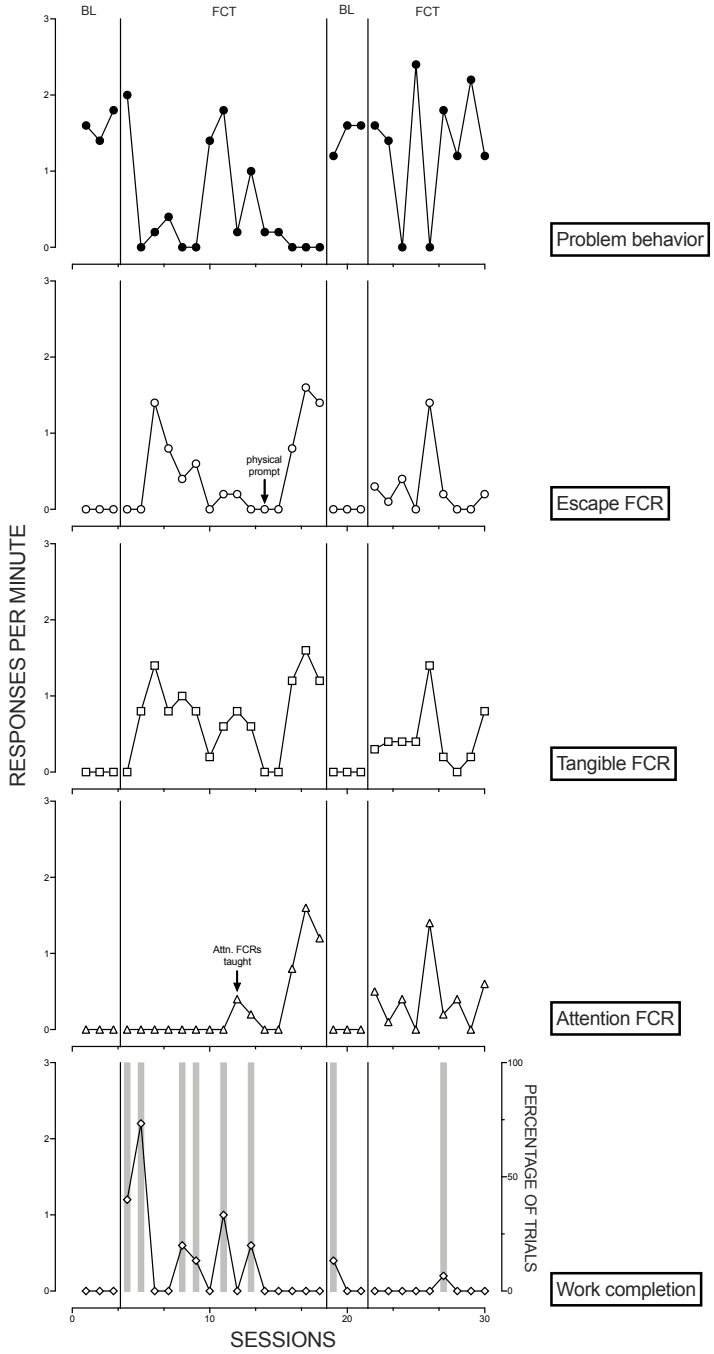
Figure 3 depicts treatment results for Mira. During baseline conditions, Mira engaged in high rates of problem behavior and zero rates of FCRs and work completion. During the initial FCT phase, problem behavior was variable with a decreasing trend in the latter half of the phase.

Rates of escape FCRs and tangible requests initially increased relative to baseline but showed decreasing trends. Prior to session 12, we introduced an attention request by adding it to the contingency review. This was because Mira frequently hugged the therapist and data collectors during and in between sessions and because she had acquired the other two requests. Due to continued decreasing trends in requests, we added a physical prompt in session 14 as a third level of prompting. This was done to provide a controlling prompt to ensure Mira accessed reinforcement following a prompted request (if she did not emit a request following gestural or verbal prompts). After the introduction of the physical prompt, FCRs and requests showed increasing trends. In the initial FCT phase, rates of work completion immediately increased relative to baseline but showed a decreasing trend across sessions, eventually stabilizing at zero.

Following a return to baseline, Mira engaged in variable and relatively high rates of problem behavior during the reintroduction of FCT. She engaged in variable rates of FCRs and requests at similar levels as the prior FCT phase and higher levels relative to baseline. Near-zero rates of work completion were observed in the second FCT phase. These data suggest FCT + concurrent schedules was not effective in decreasing Mira's problem behavior but was effective in establishing FCRs and requests, albeit inconsistently. I planned to modify FCT procedures during the next study appointment to attempt to decrease problem behavior and to obtain more stable rates of FCRs and requests (see Discussion). I was not able to answer research questions 2–3 for Mira because I did not identify a functional relation between FCT and problem behavior.

Figure 3

Mira's Treatment Evaluation Results



Note. In the bottom tier, gray bars show the percentage of trials with work completion and white diamonds show the rate of work completion. BL = baseline, FCT = functional communication training, FCR = functional communicative response.

CHAPTER 4

DISCUSSION

The first purpose of this study was to evaluate the effects of FCT + concurrent schedules on problem behavior and appropriate requests for children with IDD and escape-maintained problem behavior in classroom settings. FCT + concurrent schedules was effective in reducing problem behavior and establishing FCRs and other requests for one of two participants. Price showed lower rates of problem behavior and higher rates of requests for escape and tangibles with FCT relative to baseline. Mira, however, continued to engage in high rates of problem behavior when FCT was reintroduced following a return to baseline. Her rates of requests for escape, tangible, and attention were highly variable across FCT conditions, although at higher rates relative to baseline.

In this study's concurrent schedules arrangement, I manipulated two parameters of reinforcement: magnitude and quality. This was based on research showing that during schedule thinning, enhancing both of these dimensions was required to maintain earlier treatment effects (Briggs et al., 2019). However, Mira's data suggest I may not have sufficiently enhanced the duration of reinforcement for FCRs relative to problem behavior to obtain therapeutic effects. It is possible FCT may have been more effective for Mira with an additional increase in the duration of reinforcement for FCRs. If I had been able to continue data collection with Mira, I would have increased the duration of reinforcement for FCRs from 30–45 s to 60–75 seconds.

Alternatively, repeated presentation of the synthesized EO (i.e., presentation of task demands, restriction of toys, and diverted attention) may have led to a level of distress that

prevented Mira from accessing new skills. Research suggests negative emotions, such as frustration and anxiety, may inhibit a child's use of higher order cognitive processes (Blair, 2002; Graziano et al., 2007) and disrupt performance (Langan-Fox et al., 2002). Graziano et al. suggested poor emotional regulation might prevent a child from attending to and retaining novel information. Anecdotally, Mira independently emitted FCRs and other requests during contingency reviews with little to no problem behavior. During these contingency reviews, the therapist provided excited, playful attention when she asked Mira to practice requesting breaks, play time, and hugs. While the therapist did begin to restrict access to toys and present work during contingency reviews, she continued talking to Mira throughout (e.g., "Show me how you ask for a break!"). This was different from during sessions when the therapist restricted attention, except for prompts, until Mira emitted a request to play. During sessions, following the presentation of the synthesized EO, Mira often became visibly upset, engaging in problem behavior and whining, pouting, and running away from the therapy area. It might have been that when the synthesized EO included motivation for all three functions of problem behavior, Mira was unable to remain calm enough to use this newly acquired communication skill compared to when the condition included only some EOs for problem behavior (e.g., escape and tangible). If increasing the duration of reinforcement did not sufficiently reduce rates of problem behavior, I would have conducted a new baseline condition that included EOs for escape and tangible, but not attention. I would then conduct FCT targeting escape and tangible requests, while providing noncontingent high-quality attention throughout. Later in treatment, I would fade the schedule of reinforcement for attention and re-introduce attention requests.

The second purpose of this study was to evaluate the effects of chained schedules with demand fading on differentiated rates of work completion, FCRs, and requests for other

reinforcers. I evaluated this research question (albeit without demand fading) for one participant, Price. The data for Price suggest chained schedules were effective in producing differentiated rates of work completion and tangible FCRs. Chained schedules were somewhat effective in producing differentiated rates of escape FCRs. Price consistently emitted FCRs during S^D, but also sometimes emitted high rates of FCRs during S^Δ (he also had sessions with no FCRs during S^Δ). This might have been due to the reinforcement of FCRs during both schedule components, despite the higher magnitude and quality of reinforcement during S^D relative to S^Δ).

Observed patterns of work completion align with results of previous studies evaluating chained schedules. In studies comparing conditions with equal reinforcement for problem behavior and work completion to more advantageous reinforcement for work completion over problem behavior, participants completed more work during the advantageous reinforcement condition relative to the equal reinforcement condition (Briggs et al., 2019; Hoch et al., 2002). While this study adds to the evidence that chained and concurrent schedules increase work completion, the intervention was not effective in maintaining low rates of problem behavior. With more time to collect data, I would have continued to evaluate the effects of chained schedules with the modifications made during the return to FCT (i.e., requiring Price to have ready hands and to hand the therapist the picture card to access reinforcement). These modifications were designed to teach Price to tolerate a brief delay between FCRs and reinforcement delivery and to increase feasibility of therapist implementation. I expected these changes to decrease problem behavior and FCRs during S^Δ by teaching tolerance skills and promoting discrimination between schedule components (i.e., increasing the salience of S^D versus S^Δ by providing the therapist with time to call attention to the change to 'green' before Price emitted an FCR).

The third purpose of this study was to evaluate the extent to which low levels of problem behavior maintained throughout chained and concurrent schedules with demand fading. While more data are needed to draw definitive conclusions about the effects of chained schedules on Price's problem behavior, the existing data show chained schedules were initially ineffective in maintaining low levels of problem behavior relative to FCT. After making two procedural modifications for FCRs, chained schedules may have been more effective in reducing problem behavior, but with only one data point following these modifications, the effects remain largely unknown. Price's high rates of problem behavior prevented us from meeting criteria to initiate demand fading. The data suggest chained and concurrent schedules were insufficient in attaining work requirements that are practical for educators to implement in classrooms. They also suggest that modifications such as extinction may be necessary during demand fading to maintain low rates of problem behavior for some children. This is the first study to evaluate this combination of procedures (i.e., chained and concurrent schedules with FCT) for children with IDD in classrooms. While previous studies have demonstrated maintenance of low levels of problem behavior with demand fading, these studies were either conducted in clinic settings (three of four participants in Briggs et al., 2019; Davis et al., 2018) or conducted using DRA for compliance, rather than FCRs (Briggs et al., 2019; Hoch et al. 2002). These differences may have contributed to differences in treatment outcomes.

Another important distinction between this study and previous studies is that we taught multiple appropriate requests in the same session during FCT. Teaching participants to separately request a break and other reinforcers (i.e., tangibles, attention) provided the benefit of reinforcing break requests on an FR 1 across chained schedule components. This way, participants did not need to engage in problem behavior to access a break during S^{Δ}; they could

access a break by requesting it at any time. Requests for tangible and attention increased the quality of breaks, and were only reinforced during S^D (the S^D was in place for the duration of FCT sessions). Previous studies have implemented DRA + concurrent schedules by either only teaching one FCR (e.g., "break, please") (Davis et al., 2018) or reinforcing a single alternative behavior, like compliance (Briggs et al., 2019; Hoch et al., 2002). It is possible that requiring the child to emit multiple responses to access high-quality reinforcement contributed to the continuation of problem behavior during FCT for Mira and chained schedules for Price. However, anecdotally, both participants seldom emitted only one request at a time. Instead, they generally emitted an FCR and an other request (e.g., "break, please. Toys, please. Hug, please.") in rapid succession, suggesting they were able and willing to emit multiple requests to access high quality reinforcement.

Because I was unable to complete data collection due to school closures, I plan to recruit additional participants and continue data collection for this project next year. I would consider making several procedural modifications with future participants. First, I would increase the duration of low-quality breaks from 10 to 15 s and high-quality breaks from 30–45 s to 45–60 seconds. It was difficult for therapists to resume presenting demands after only a 10-s break following problem behavior, and Mira's data suggest the high-quality break may not have been long enough to motivate her to request a break rather than engage in problem behavior.

Second, it was difficult for research and school staff to entirely restrict attention during low-quality breaks due to safety concerns in the classroom (e.g., attempts to destroy classroom materials or climb on furniture). For future participants, I would consider programming low-quality attention following problem behavior to address the safety constraints in the classroom environment. For example, during low-quality breaks, the therapist could stay physically close to

the participant to block dangerous problem behavior (we did use this procedure in the current study), label how the participant was feeling, and remind them they were on a break (e.g., "I see you're upset. We're taking a break."). These procedures more closely resemble a reasonable therapeutic response to dangerous problem behavior in a classroom setting.

Finally, in future studies addressing multiply maintained problem behavior, I would consider conducting FCT for positively reinforced problem behavior prior to synthesizing EOs that include the motivation for escape. FCT for escape-maintained problem behavior includes a negative reinforcement contingency in which the therapist removes an aversive stimulus contingent on an FCR. In contrast, during FCT for positively reinforced problem behavior (e.g., attention or tangible maintained), the therapist presents a desirable stimulus contingent on an FCR. Conducting FCT for positive reinforcement first would allow the therapist to pair themselves with reinforcement, conditioning themselves as a reinforcer and building a history of reinforcement for FCRs with the participant. After establishing mastery of tangible or attention FCRs, the therapist could then introduce the escape condition in a synthesized EO to teach the participant to emit escape FCRs prior to attention or tangible FCRs. Synthesizing EOs after already mastering at least one FCR might decrease the aversiveness of the synthesized EO because the child would already have experience and success with one component of the EO. These modifications might have decreased Mira's problem behavior during FCT.

The results of the current study should be interpreted in light of three primary limitations. First, data collection ended prematurely due to COVID-19 school closures. While I planned to replicate this study across three participants and to collect sufficient data to inform the presence or absence of functional relations, I collected data for only two participants, one of whom progressed to chained schedules. This limits confidence in conclusions drawn from the data

about the effects of FCT + concurrent schedules for Mira and the effects of chained schedules for Price. A premature end to data collection also resulted in being unable to evaluate the effects of demand fading, generalization outcomes, or the social validity of intervention procedures.

Second, for Price, we modified FA conditions from isolated tests to a single synthesized test due to concerns about multitreatment interference (i.e., continued problem behavior following restricted tangible items). Thus, FA results do not inform which aspects of the synthesized test condition (escape to attention and tangibles) maintained problem behavior. It is possible problem behavior was only maintained by part of the test condition (e.g., accessing tangibles). This possibility could partially explain the variability in escape FCRs during chained schedules. However, results from the pre-assessment interview and observation, as well as the increase in problem behavior during chained schedules, provide support for the hypothesis that Price's problem behavior was maintained by escaping academic demands.

Third, I did not conduct a reinforcer parameter sensitivity assessment prior to intervention (Kunnavatana et al., 2018). Prior research suggests there are individual differences in sensitivity to certain parameters of reinforcement and that these differences influence treatment effects (Briggs et al., 2019; Kunnavatana et al., 2018). I may not have sufficiently enhanced reinforcement for appropriate behavior to decrease problem behavior for Mira during FCT and for Price during chained schedules. However, I enhanced both the quality and magnitude of reinforcement for appropriate behavior over problem behavior, which has been shown to maintain treatment effects during demand fading in other studies (Briggs et al., 2019; Davis et al., 2018; Lalli et al., 1999; Piazza et al., 1997). I would consider adding a reinforcer parameter sensitivity assessment in future studies.

A primary goal of the intervention package evaluated in this study was to decrease problem behavior and increase appropriate behaviors without the use of extinction in classrooms. For Price, FCT with concurrent schedules was effective in decreasing problem behavior and increasing FCRs and other reinforcer requests, but problem behavior recurred when work was introduced during chained schedules. For Mira, FCT with concurrent schedules was not effective in reducing problem behavior. These results suggest further modification of these intervention components is necessary to obtain therapeutic effects without the use of extinction in classrooms. They also raise the possibility that extinction may sometimes be necessary to achieve therapeutic outcomes. The results of this study, while incomplete, have encouraged me to continue to evaluate the effects of chained and concurrent schedules with demand fading following FCT. As I continue to pursue this work, I plan to evaluate methods for addressing multiply maintained problem behavior using FCT and chained schedules. These methods might include individualizing manipulations of reinforcement parameters and altering the sequence in which functions of problem behavior are addressed.

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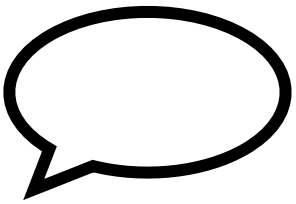
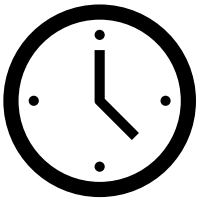
Appendix A

Example Picture Cards

 Will you talk to me, please?	 Break, please?
 Computer, please?	

Appendix B

Procedural Fidelity Forms

Latency-based FA: Play Condition
Procedural Fidelity Form

Instructions: Tally whether the therapist correctly (yes) or incorrectly (no) implemented the given variable *each time there is an opportunity* to implement it. Use a *two-second tolerance window* for variables that involve correct timing (e.g., reinforcing PB, demand timing)

Participant ID:	**Date:**	**Data collector:**	**Prim or Reli** (circle one)

Session #						
	Yes	**No**	**Yes**	**No**	**Yes**	**No**
Highly preferred items available throughout						
Therapist attention available throughout (remains in close proximity, responds to student bids for attention)						
No demands						
All PB ignored (tally)						
Session duration at least 5 min						
PF score = (yes)/(yes + no) x 100						

Notes:

Latency-based FA: Tangible Condition
Procedural Fidelity Form

Instructions: Tally whether the therapist correctly (yes) or incorrectly (no) implemented the given variable *each time there is an opportunity* to implement it. Use a *two-second tolerance window* for variables that involve correct timing (e.g., reinforcing PB, demand timing)

Participant ID:	**Date:**	**Data collector:**	**Prim or Reli** (circle one)

Session #						
	Yes	**No**	**Yes**	**No**	**Yes**	**No**
30 s access to HP item(s) prior to session						
HP item(s) removed at session onset						
HP items restricted unless PB occurs						
Therapist attention available throughout (remains in close proximity, responds to student bids for attention)						
No demands						
Tangible FCRs ignored						
If PB: HP item(s) delivered within 3 s of PB						
If PB: access to HP item(s) for at least 30 s						
If no PB: session duration at least 5 min						
PF score = (yes)/(yes + no) x 100						

Notes:

Latency-based FA: Escape Condition
Procedural Fidelity Form

Instructions: Tally whether the therapist correctly (yes) or incorrectly (no) implemented the given variable *each time there is an opportunity* to implement it. Use a *two-second tolerance window* for variables that involve correct timing (e.g., reinforcing PB, demand timing)

Participant ID:	**Date:**	**Data collector:**	**Prim or Reli** (circle one)

Session #						
	Yes	**No**	**Yes**	**No**	**Yes**	**No**
Demand materials present at session onset						
Demands/work presented throughout (no more than 5 s elapses without demands/work; demands are still considered 'present' if student is working to complete them)						
HP items restricted throughout						
Therapist attention only relates to demands						
Escape FCRs ignored						
If PB: Break delivered within 3 s of PB						
If PB: Break lasts at least 30 s						
If no PB: session duration at least 5 min						
PF score = (yes)/(yes + no) x 100						

Notes:

Latency-based FA: Attention Condition
Procedural Fidelity Form

Instructions: Tally whether the therapist correctly (yes) or incorrectly (no) implemented the given variable *each time there is an opportunity* to implement it. Use a *two-second tolerance window* for variables that involve correct timing (e.g., reinforcing PB, demand timing)

Participant ID:	**Date:**	**Data collector:**	**Prim or Reli** (circle one)

Attention Condition

Session #						
	Yes	**No**	**Yes**	**No**	**Yes**	**No**
30 s attention delivered prior to session						
Attention restricted/ diverted at session onset						
Attention restricted unless PB occurs						
HP items restricted throughout (access to moderately preferred item/activity if programmed)						
No demands (having optional work activity ok if programmed)						
Attention FCRs ignored						
If PB: Attention delivered within 3 s of PB						
If PB: Access to attention for at least 30 s						
If no PB: session duration at least 5 min						
PF score = (yes)/(yes + no) x 100						

Notes:

Baseline Condition: Escape to Tangible + Attention
Procedural Fidelity Form

Instructions: Tally whether the therapist correctly (yes) or incorrectly (no) implemented the given variable *each time there is an opportunity* to implement it. Use a *two-second tolerance window* for variables that involve correct timing (e.g., reinforcing PB, demand timing)

Participant ID:	**Date:**	**Data collector:**	**Prim or Reli** (circle one)

Session #						
Checklist Variables						
30 s access to HP item(s) and attention prior to session	Y N		Y N		Y N	
Correct materials present	Y N		Y N		Y N	
Session duration at least 5 min	Y N		Y N		Y N	
Tally Variables						
	Yes	**No**	**Yes**	**No**	**Yes**	**No**
Demands (independent work with minimal attention) presented throughout (no more than 5 s elapses without work present for student to complete)						
If PB: Break + HP item(s) + attn delivered within 3 s of PB						
If PB: Break + HP item(s) + attn for 30-45 s						
If PB: EO reinstated after 30-45 s of reinforcement						
FCRs ignored						
PF score = (yes)/(yes + no) x 100						

Notes:

Baseline Condition: Escape to Tangible
Procedural Fidelity Form

Instructions: Tally whether the therapist correctly (yes) or incorrectly (no) implemented the given variable *each time there is an opportunity* to implement it. Use a *two-second tolerance window* for variables that involve correct timing (e.g., reinforcing PB, demand timing)

Participant ID:	**Date:**	**Data collector:**	**Prim or Reli** (circle one)

Session #						
Checklist Variables						
30 s access to HP item(s) prior to session	Y N		Y N		Y N	
Correct materials present	Y N		Y N		Y N	
Therapist attention only relates to demands	Y N		Y N		Y N	
Session duration at least 5 min	Y N		Y N		Y N	
Tally Variables						
	Yes	**No**	**Yes**	**No**	**Yes**	**No**
Demands presented throughout (no more than 5 s elapses w/out demands; demands are still considered 'present' if student is working to complete them)						
If PB: Break + HP item(s) delivered within 3 s of PB						
If PB: Break + HP item(s) for 30-45 s						
If PB: EO reinstated after 30-45 s of reinforcement						
FCRs ignored						
PF score = (yes)/(yes + no) x 100						

Notes:

Functional Communication Training (Concurrent Schedules)
Procedural Fidelity Form

Instructions: Tally whether the therapist correctly (yes) or incorrectly (no) implemented the given variable *each time there is an opportunity* for he/she to implement it. Use a *two-second tolerance window* for variables that involve correct timing (e.g., reinforcing PB, demand timing)

Participant ID:	**Date:**	**Data collector:**	**Prim or reli** (circle one)

Session #						
Checklist Variables						
30 s access to reinforcers prior to session	Y N		Y N		Y N	
Correct materials (including S^D card)	Y N		Y N		Y N	
Session duration at least 5 min	Y N		Y N		Y N	
Contingency review	Y N n/a		Y N n/a		Y N n/a	
Tally Variables						
	Yes	**No**	**Yes**	**No**	**Yes**	**No**
Correct MOs maintained (one tally per trial)						
Correct prompting procedure for FCRs and other requests (two tallies per trial)						
If FCR/request: Reinforcer delivered within 3 s (independent or prompted; one tally per request)						
If FCR: EO reinstated after 30-45 break						
If PB: break w/o other reinforcers delivered for PB within 3 s (one tally per PB)						
If PB: EO reinstated after 10 s break						
PF score = (yes)/(yes + no) x 100						

Chained Schedules (+ Concurrent Schedules)
Procedural Fidelity Form

Instructions: Tally whether the therapist correctly (yes) or incorrectly (no) implemented the given variable *each time there is an opportunity* for he/she to implement it. Use a *two-second tolerance window* for variables that involve correct timing (e.g., reinforcing PB, demand timing).

Participant ID:	**Date:**	**Data collector:**	**Prim or reli** (circle one)
Session #:	**Work requirement:**	**Type of work:**	

Checklist Variables			
Correct materials (including S^D/S^Δ)	Y N	Contingency review	Y N n/a
Session duration is 5 trials	Y N	30 s access to reinforcers prior to session	Y N

S^Δ			**S^D**		
Tally Variables					
	Yes	**No**		**Yes**	**No**
Correct amount of work			Correct amount of work		
Correct MOs maintained			Correct MOs maintained		
Low quality reinforcer delivered within 3 s of FCR			High quality reinforcer delivered within 3 s of FCR		
Low quality reinforcer delivered within 3 s of PB			No differential consequence for PB		
Rule reminder for first other reinforcer request, ignore subsequent requests			Other reinforcers delivered within 3 s of request		
Correct prompting procedure for FCRs (only following PB)			Correct prompting procedure for FCRs		
If PB or FCR: EO reinstated after 10 s break			If FCR: EO reinstated after programmed break duration		
PF score = (yes)/(yes + no) x 100			PF score = (yes)/(yes + no) x 100		
Overall PF score (average of SD + SΔ) =					

Appendix C

Example Work Completion Data Sheet

Participant ID:	**Date:**	**Session #:**	**Schedule:** FR 5

76 + 5	93 + 6	38 + 7	39 + 5	46 + 3

Place a checkmark below to indicate each problem accurately completed.

Tally error corrections provided for each problem below.

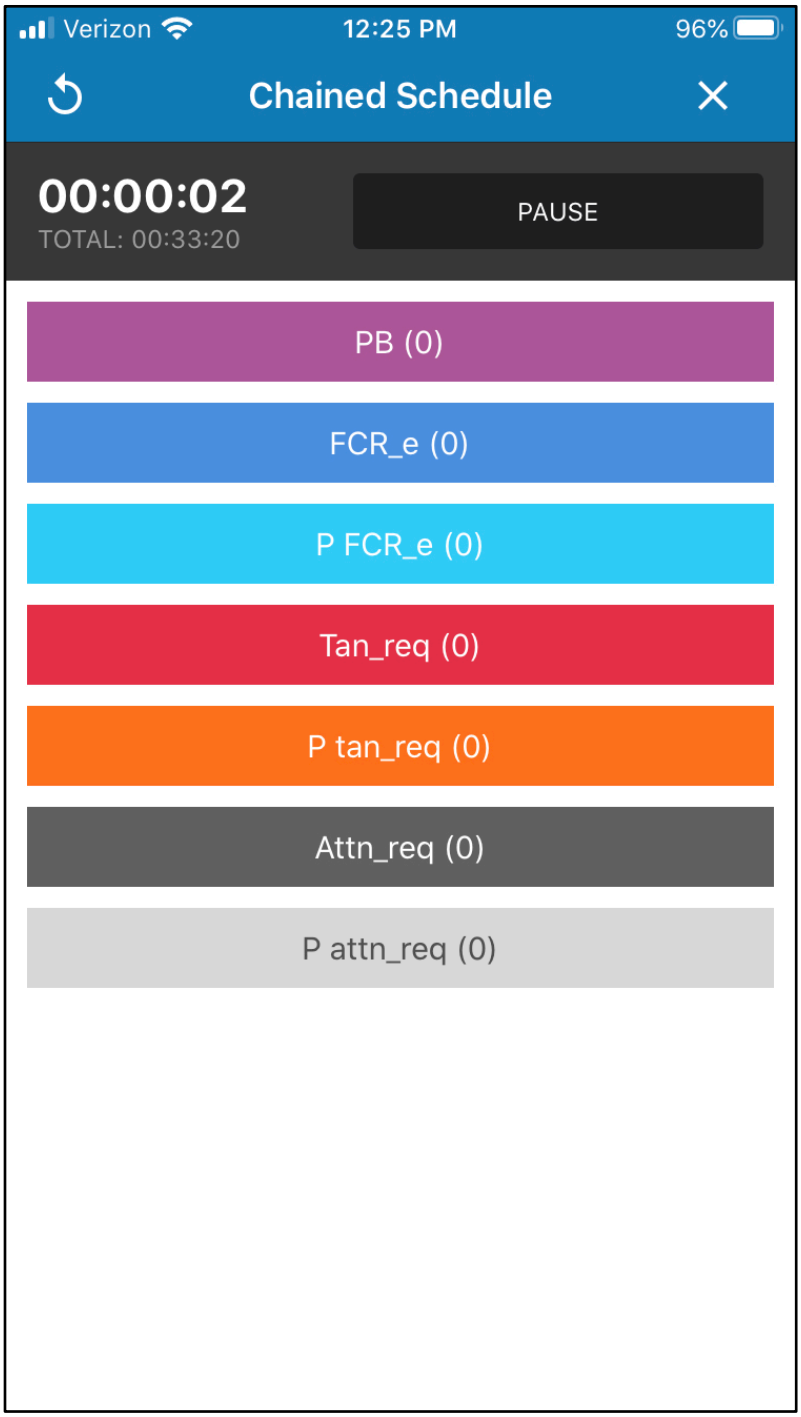
58 + 2	80 + 2	66 + 3	88 + 7	88 + 6

Place a checkmark below to indicate each problem completed.

Tally error corrections provided for each problem below.

Appendix D

Example Countee Data Collection Template



Appendix E

Teacher Interview Protocol

Participant ID:	Date:	Respondent:

Participant Demographics

Age:	DOB:
Male/Female	SPED classification(s):
Other diagnoses:	

Background Information

1. Describe their language abilities.
2. Describe their play skills and preferred toys or leisure activities.
3. What else do they prefer?

Functional Assessment Interview

1. What are the problem behaviors? What do they look like?
2. How often does it happen and how long does it typically last?
3. Do the different types of problem behavior tend to occur in bursts or clusters and/or does any type of problem behavior typically precede another type of problem behavior (e.g., yells preceding hits)? (or: Are there any warning behaviors that precede it?)
4. Under what conditions or situations are the problem behaviors most likely to occur? Or, do the problem behaviors reliably occur during any particular activities? Or, what seems to trigger the problem behavior?
5. Does problem behavior occur when you break routines or interrupt activities? If so, describe.
6. Does the problem behavior occur when it appears that he/she won't get his/her way? If so, describe the things that the child often attempts to control.
7. How do adults and peers react or respond to the problem behavior?
8. What do you and others do to calm him/her down once he/she engaged in the problem behavior?
9. What do you and others do to distract him/her from engaging in the problem behavior?
10. What do you think he/she is trying to communicate with his/her problem behavior, if anything?

11. If I could give you a million dollars to make the problem behavior start right now, what would you do? What are the things you avoid saying and doing because you know it will lead to problem behavior?

12. If I could pay you a million dollars to make the problem behavior stop right now, what would you do?

13. What strategies have already been attempted? Were they effective? Why or why not?

Academic Background Information

1. What is the student's current level of academic functioning?

2. What are some current educational goals?

3. In what areas of instruction does the student most need additional behavioral support?

Adapted from Hanley (2009)

Appendix F

Weekly Generalization Survey

Please complete the survey below.

Thank you!

Student's first initial

Did you observe any appropriate requests today? (e.g., "break, please;" "play, please.")

- (•) Yes
- ( ) No

reset

What type of requests?

- [ ] Requests for a break
- [ ] Requests for preferred activities
- [ ] Requests for adult attention
- [ ] Requests for peer attention
- [ ] Requests for food, drinks, or snacks

Please estimate the percentage of assigned work the student completed today.

Submit

Appendix G

Social Validity Survey for Teachers

Treatment Acceptability Survey

1. I would suggest the intervention to other teachers.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

2. I liked the procedures used in the intervention.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

3. The intervention was beneficial for my student.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

4. I saw a noticeable improvement in my student's behavior with the intervention.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

5. I find this treatment to be an acceptable way to deal with the student's problem behavior.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

6. The benefits of this intervention outweighed any negative side effects.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

7. I would implement this intervention again with another student with similar behavioral concerns.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

8. Which parts of the intervention did you like the most?

_____

9. Which parts of the intervention did you *least* like?

_____

10. Which parts of the intervention were most difficult to implement? Why?

_____

Adapted from Elliot & Treuting, 1991; Gresham & Lopez, 1996; Kelley et al., 1989