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by

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ABSTRACT

Multiple schedules are schedules of reinforcement that are often used to facilitate more manageable rates of a replacement behavior such as a communication response following functional communication training as an intervention for destructive behavior. Commonly, reinforcement schedule thinning involves multiple fading steps that can take more than 100 sessions to achieve therapeutic goals. The purpose of this experiment was to evaluate a method for rapidly achieving fading steps in a multiple schedule by including competing items during the extinction interval. Four children diagnosed with autism successfully reached the terminal extinction interval with a ≥80% reduction in problem behavior. Two of the four participants reached the terminal extinction interval during a systematic assessment to identify an appropriate initial extinction interval. This study produced two important findings. First, the inclusion of competing items successfully and rapidly achieved the terminal extinction interval in a multiple schedule. Second, a novel use of a systematic assessment procedure identified participants for whom the competing items were unnecessary to rapidly achieve the terminal extinction interval.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

Introduction

Background. Children with intellectual and developmental disabilities often display severely destructive behavior (Bird, Dores, Moniz, & Robinson, 1989). For example, some children will engage in self-injurious behaviors such as banging their head against solid surfaces, aggression toward others, or destruction of property, such as breaking mirrors or furniture. Aside from the physical dangers these behaviors pose, reducing problematic behaviors is also important because they often "interfere with the acquisition, generalization, or maintenance of more adaptive repertoires" (Carr & Durand, 1985; Haring & Kennedy, 1990, p. 235).

Treatments designed to reduce the occurrence of such problem behaviors typically begin with an assessment, and then proceed from least-to-most intrusive procedures (e.g., Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998). That is, clinicians typically implement reinforcement-based interventions first, and only proceed to more intrusive or aversive procedures if less intrusive procedures are found to be ineffective.

Substitution. One method of reducing problem behavior through non-aversive procedures is to provide the individual with items or activities that function as competing or substitutable reinforcers (e.g., Piazza et al., 1998). The behavior economics framework has described the principle of substitution in which the availability or unavailability of one commodity decreases or increases the consumption of another commodity, respectively (Hursh, 1984). For example, when the availability and consumption of one reinforcer (Coke™) results in reduced consumption of another stimulus (Pepsi™), the former reinforcer is said to "compete" with or "substitute" for the second reinforcer (Green & Freed, 1993). In a clinical setting, Fisher, DeLeon, Rodriguez-Cutter, and Keeney (2004) used substitution to reduce destructive behavior after conducting an experimental functional analysis (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). They identified the functional reinforcer (adult attention) and provided non-

contingent access to preferred stimuli, even though problem behavior continued to produce its functional reinforcer. Fisher et al. (2004) also identified the items (i.e., toys) that substituted for adult attention using a competing-items assessment. Their arrangement was similar to the one used by Piazza et al. (1998) to identify reinforcers that competed with the automatic reinforcement produced by pica. Fisher et al. sequentially introduced various toys during brief sessions in which destructive behavior continued to produce the functional (social) reinforcer. Using this assessment, they identified toys that the participant interacted with throughout most of the session and that were associated with low rates of destructive behavior (i.e., toys that effectively competed with the functional reinforcer for destructive behavior). The results of this study demonstrated that non-contingent access to arbitrary "competing" or "substitutable" toys quickly and effectively reduced instances of destructive behavior more efficiently than withholding reinforcement alone.

Functional analysis and functional communication training. Other procedures to treat problem behavior involve first identifying the function(s) of destructive behavior (Iwata et al., 1982/1994) and then delivering the functional reinforcer contingent on an appropriate replacement behavior (e.g., Carr & Durand, 1985) and discontinuing reinforcement of destructive behavior (e.g., extinction [EXT]; Mazaleski, Iwata, Vollmer, Zarcone, & Smith, 1993). Functional communication training (FCT) is an effective intervention that focuses on building an appropriate alternative response in the presence of the relevant establishing operation (EO; Michael, 1982) that produces the same functional reinforcer as the destructive behavior (Carr & Durand, 1985; Durand & Carr, 1991; Tiger, Hanley, & Bruzek, 2008). For example, a functional analysis might indicate that a child's aggressive behavior produces attention from adult caregivers. An alternative response might be to teach that child to say "excuse me" to gain attention (e.g., Fisher, Kuhn, & Thompson, 1998). Although the communicative response might provide an efficient method of producing reinforcement for some individuals (Fisher et al., 1993),

additional procedures are often needed to reduce problem behavior when FCT alone does not produce sufficient improvement in rates of challenging behaviors (Fisher et al., 1993; Fisher, Thompson, Hagopian, Bowman, & Krug, 2000; Hagopian et al., 1998; Hanley, Iwata, & Thompson, 2001; Roane, Fisher, Sgro, Falcomata, & Pabico, 2004; Wacker et al., 1990). For example, Hagopian et al (1998) evaluated 21 cases in which FCT was implemented with and without EXT and/or punishment. The authors reported that: (a) FCT did not reduce rates of destructive behavior 90% below baseline if destructive behavior continued to produce the functional reinforcer; (b) FCT + EXT was effective in 11 of 25 applications (44%); and (c) FCT + punishment (with demand fading for one case) was effective in 100% of applications.

Similar to Fisher et al. (2004), providing activities during EXT in FCT has been used to reduce problem behaviors. Hagopian, Contrucci Kuhn, Long, and Rush (2005) identified stimuli that effectively competed with problem behavior. The authors then evaluated the use of those stimuli as competing items during multiple schedule and delay-to-reinforcement schedule thinning. Results showed that when a multiple schedule did not sufficiently reduce rates of challenging behavior, competing items successfully reduced problem behavior to levels specified by the individuals' treatment goals during delay to reinforcement. In addition, they achieved lower rates of destructive behavior during the EXT component of a multiple schedule relative to a condition without competing items. However, the authors did not evaluate the use of competing items to rapidly thin the schedule of reinforcement during the multiple schedule arrangement.

Despite these advances, practical implications have often limited the effectiveness of FCT. For instance, once an individual reliably emits the replacement response, also called the "functional communication response" (FCR), he or she will often continue to do so at excessively high rates (Fisher, Kuhn, et al., 1998; Fisher, Lindauer, Alterson, & Thompson, 1998; Fisher, Thompson, et al., 2000; Hagopian et al., 1998). Reinforcing every emission of the FCR might be

possible in a clinical setting, but it is not practical for caregivers throughout the day in the individual's settings. Caregivers likely have multiple responsibilities and cannot be expected to provide attention every time that it is requested if, for example, they must change the diapers or feed another individual, answer a ringing phone, do chores, or complete errands. Such practical limitations have made it critical for researchers to evaluate procedures to improve the workability of FCT for use in natural settings, such as the child's home and school (Fisher et al., 1993; Hagopian et al., 1998; Sidener, Shabani, Carr, & Roland, 2006; Tiger & Hanley, 2004).

Multiple schedules. Some studies have examined techniques for thinning schedules of reinforcement following FCT to make the treatment more practical for natural settings (Austin & Tiger, 2015; Fuhrman, Greer, Zangrillo, & Fisher, 2018; Hagopian et al., 2005; Saini, Miller, & Fisher, 2016). For example, Hagopian et al. (1998) gradually increased the delay between the emission of the FCR and the delivery of the reinforcer. Results showed that the authors successfully maintained a 90% reduction in problem behavior with an average of a 6 min delay to reinforcement. However, this method of schedule thinning maintained a 90% reduction in problem behavior and reached a practical endpoint for reinforcer schedule thinning for just 11 of 25 applications (44%). A potential limitation of this method of schedule thinning is that delaying the reinforcer weakens the contingency between the reinforcer and FCR, which might ultimately extinguish the newly acquired FCR (Fisher, Thompson, et al., 2000; Hanley et al., 2001).

Fisher et al. (1998) used a multiple-schedule arrangement in which they correlated the presence or absence of specific stimuli with alternating periods of reinforcement and EXT for the FCR. Two participants were taught to request a given reinforcer identified through a functional analysis and preference assessment. A sign indicated the availability or unavailability of the functional reinforcer or the alternative reinforcer, and extinguished all other requests. For example, for one participant, Amy, the response "excuse me please" in the presence of a picture

of Amy and the therapist produced attention from the therapist. In the presence of a picture of toys, the response "I want my toys, please" produced access to her toys. Both participants came to responded discriminatively toward the specific stimuli (i.e., to request each reinforcer only when the discriminative stimulus indicated that it was available). In addition, this study showed that destructive behavior could be maintained at low levels if alternative reinforcers were available, even while requests for the functional reinforcer were on EXT.

Hanley et al. (2001) extended the research on multiple schedules by including a schedule-thinning component in which the EXT component gradually became lengthier than the reinforcement component. The authors implemented a multiple schedule in which a stimulus signaled the availability (S^D) and a separate stimulus signaled the unavailability (S^Δ) of reinforcement. In the first study, the length of the EXT (S^Δ) component began at short intervals (15 s) that the investigators gradually increased to 240 s. Results showed that the communicative response remained stable and consistent in the presence of the discriminative stimulus but occurred at low or near-zero rates in the presence of the EXT stimulus. Furthermore, destructive behavior remained at or near zero during the multiple schedule.

In the second experiment conducted by Hanley et al. (2001), the authors compared a mixed schedule to a multiple schedule, as well as introducing the duration of the terminal component (240 s) at the beginning of the experiment. In a mixed schedule, two or more reinforcement schedules alternate, but no stimuli signal the changing contingencies (Ferster & Skinner, 1957). The comparison of mixed to multiple schedules illuminated the necessity of contingency-correlated stimuli (Betz, Fisher, Roane, Mintz, & Owen, 2013). Probing the terminal EXT duration demonstrated the necessity of fading the duration of the EXT component. The participant showed unacceptably high rates of the FCR as well as destructive behavior when the multiple schedule began at the terminal EXT interval of 240 s (4 min). The results suggested

that the multiple schedule was more effective if the experimenters faded the duration of the EXT component gradually. Other studies have continued to evaluate multiple schedules (Saini et al., 2016) in the reduction of destructive behavior (e.g., Betz et al., 2013; Bijou & Orlando, 1961), in larger classroom settings (Cammilleri, Tiger, & Hanley, 2008), to promote social behavior (Tiger, Hanley, & Heal, 2006), and to facilitate discriminated manding (Tiger & Hanley, 2004).

Although Hanley et al. (2001) showed that introducing the terminal multiple schedule interval at the onset of discrimination training resulted in high rates of destructive behavior, establishing discriminative control over responding in relatively short components might circumvent the need for slowly fading the EXT component of multiple schedules. The ability to rapidly increase the EXT component to the terminal schedule or identify if an individual will tolerate the terminal EXT interval while maintaining low rates of destructive behavior would increase the efficiency of multiple schedule training by reducing the number of needed trials and steps.

Betz et al. (2013) extended the research on multiple schedules by answering this question. Betz et al. implemented the multiple schedule that alternated 60 s periods of reinforcement with 60 s periods of EXT. Once they established strong discriminative control of the FCR and destructive behavior, they rapidly increased the EXT interval to the terminal length of 240 s for all 4 participants without producing a significant increase in destructive behavior. Results further showed that the participants responded discriminatively during the multiple schedule arrangement without any response bursting patterns of either the communicative response or the problem behavior even though the duration of the EXT interval increased from 60 s to 240 s. However, one potential limitation to the general applicability of these procedures is that some of the participants could follow some of the stated rules, which may have facilitated the

rapidity of the schedule effects (cf. Catania, Matthews, & Shimoff, 1982). Thus, their procedure may not work as efficiently for individuals with limited verbal repertoires.

Fuhrman, Greer, Zangrillo, and Fisher (2018) further extended research on competing activities during multiple schedules. The authors evaluated alternative activities with two participants. For Alan, a 3-year-old child diagnosed with autism spectrum disorder, the authors provided a less preferred item during the EXT interval of the multiple schedule. For Jacob, a 6-year-old diagnosed with unspecified, impulse control, and conduct disorder, they evaluated demand fading and therapist attention as competing activities for his destructive behavior. They demonstrated that these alternative activities were successful at reducing rates of destructive behavior while maintaining high rates of the FCR.

Call et al. (2018) developed a method to determine the initial EXT interval of a multiple schedule by evaluating the rate of previous behavior. Specifically, the researchers calculated the inter-trial interval between the participants' mands during FCT and doubled the average of those intervals. They used the product of that equation as the initial EXT interval, reasoning that this duration was appropriate "because the time between mands during FCT was thought to be a good indicator of how long it took for deprivation of the functional reinforcer to become an EO" (p. 95). This was the first and only instance that this author could find in the peer-reviewed literature that demonstrated a systematic method of determining the initial EXT interval of a multiple schedule. However, this method did not directly measure the rate of destructive behavior at specific intervals. Therefore, a more robust method for determining the initial EXT interval of a multiple schedule could be to examine data on the rate of the participant's destructive behavior at specific intervals.

Extinction bursts and resurgence. Whereas EXT has been shown to be useful and sometimes critical to a successful intervention aimed at reducing problem behavior (Mazaleski et

al., 1993), it often precedes increases in responding that occurs in the absence of reinforcement. This phenomenon is described as "EXT" bursts (Skinner, 1938), response bursting, or EXT-induced resurgence (Epstein, 1983; Hagopian, Toole, Long, Bowman, & Lieving, 2004; Volkert, Lerman, Call, & Trosclair-Lasserre, 2009). Resurgence is different from EXT bursts in that resurgence occurs when a previously reinforced response no longer produces reinforcement (EXT), and another previously reinforced response re-emerges (Epstein, 1983). For example, if a mand for attention (FCR) replaces a child's SIB, and reinforcement for the FCR is subsequently withheld, then the re-emergence of SIB (the previously reinforced response) would be described as resurgence (Briggs, Fisher, Greer, & Kimball, 2018).

Behavior momentum theory describes extinction bursts (hereafter referred to as "response bursting") during EXT as a two-component process during which the response rate and resistance to change in rate (Nevin, 1992) occur during the highest rate of reinforcement context (Mace et al., 2010). Mace et al. evaluated a clinical case in which there was a resurgence of problem behavior during EXT after differential reinforcement of alternative behavior training (DRA). The investigators then tested a potential solution to mitigate the effects of resurgence by extinguishing the behavior in a separate context using laboratory nonhuman animals. Finally, they tested the procedure from the animal model in a clinical setting, and results showed less resurgence relative to when communication training and EXT occurred in the same stimulus contexts.

Response restriction and response topography. An additional consideration for the implementation of FCT using multiple schedules is the modality of the response. Some have suggested that FCT should reduce problem behavior by providing individuals with the ability to control the delivery of reinforcement, as well as a more efficient method of obtaining reinforcement (Carr, 1988; Carr & Durand, 1985; Day, Horner, & O'Neill, 1994; Durand & Carr, 1991; Kahng, Iwata, DeLeon, & Worsdell, 1997). Indeed, there is some evidence suggesting that

the form of the alternative response affects whether other procedures are needed to reduce problem behavior during FCT and whether problem behavior will resurge if EXT procedures are needed (Wacker, Wiggins, Fowler, & Berg, 1988). Derosa, Fisher, and Steege, (2015) compared an alternative vocal response to a card touch response on the acquisition of the response and the rate of problem behavior. Results showed that the participants acquired the card touch response more quickly than the vocal response. In addition, the children displayed more problem behaviors during the acquisition of the vocal response than the card touch response. These results suggest that the easiest appropriate topography will facilitate rapid acquisition of the alternative response and may prevent the occurrence of problem behavior during acquisition of the response.

Research evaluating reinforcement-based interventions that use EXT procedures has been limited by issues in practicality and treatment integrity because of resurgence and response bursting. In addition, further research combining findings from the literature on competing items, FCT, and multiple schedules might improve the efficiency of those interventions, as well as increase their practical utility for parents and caregivers (Saini et al., 2016). Thus, research is needed to evaluate whether the availability of competing items during the EXT interval of a multiple schedule would prevent response bursting and resurgence of problem behavior and promote maintenance and generalization of treatment effects. Therefore, the purpose of the current study was to (a) evaluate the utility of an assessment procedure to determine the longest possible EXT interval that did not produce response bursting, or else identify individuals for whom we could immediately introduce the terminal EXT interval, (b) conduct discrimination training for the FCR at the terminal schedule (as did Hanley et al., 2001) across three contexts: a multiple schedule at a brief EXT interval, the terminal extinction interval (240 s), and the terminal extinction interval with competing items present, and (c) determine steps for systematically fading out the competing items if necessary.

Method

Participants and Setting

The participants were four individuals with intellectual disabilities referred for the treatment of severe destructive behavior and who displayed socially reinforced destructive behavior. That is, we enrolled only individuals whose behaviors produced attention, access to tangible items, or escape from non-preferred tasks. Participants' ages ranged from 3 to 8 years-old. Participants attended outpatient clinic visits two to five days per week for 5 to 8 total hours per week. Brian was a 5-year-old boy diagnosed with autism spectrum disorder who engaged in self-injurious behavior and aggression. Mark was a 3-year-old boy diagnosed with impulse control and conduct disorder who engaged in property destruction. Wayne was an 8-year-old boy diagnosed with autism spectrum disorder and unspecified disruptive impulse control and conduct disorder who engaged in aggression and disruption. Keith was an 8-year-old boy diagnosed with autism spectrum disorder and ADHD who engaged in property destruction and aggression. Brian, Mark, and Wayne all had limited vocal verbal repertoires and demonstrated few vocal mands. Keith engaged in rudimentary verbal behavior and could engage in basic 1-5 word vocal-mand phrases.

There were two session locations: one was a padded 2.74 m by 2.74 m room with a one-way observation mirror and the other was a non-padded 3.35 m by 4.57 m room with a clear observation window behind which therapists collected data. Session materials included oversized shirts of varying color, three 7.62 cm by 12.7 cm laminated colored cards (with a different color on each side totaling six colors), computers for data collection, pen and paper for data collection and note-taking, preferred snacks, and a table and chairs for the therapist and participant. We selected items to test for preference and for the competing-items assessment from the Reinforcer Assessment for Individuals with Severe Behavior (RAISD; Fisher, Piazza, Bowman, & Amari,

1996). Next, we conducted a paired choice preference assessment (Fisher et al., 1992) to identify a hierarchy of items to use during functional-analysis conditions and the competing-items assessment. We conducted a brief MSWO preference assessment (DeLeon et al., 2991; DeLeon & Iwata, 1996) prior to daily sessions to identify other potential reinforcers and accommodate shifts in participant preferences. Therapists wore protective equipment (Fisher, Rodriguez, Luczynski, & Kelley, 2013) if participant aggressive had the potential to produce injury.

Dependent Variable

The primary dependent variables included the rate of problem behavior and the rate of the FCR. We defined problem behavior individually for each participant. For Brian, the target behaviors were self-injury in the form of banging his head into solid objects, aggression toward others, and property disruption in the form of throwing objects, knocking them to the ground, or overturning them. For Mark, target behaviors were primarily self-injury, but we also observed and recorded aggression toward others and property destruction. For Wayne, the primary target behavior of concern was disruption in the form of banging, throwing, overturning, or tearing objects. For Keith, target behaviors were dropping to the floor, screaming, and stealing. Keith engaged in these topographies when he appeared to be alone with his mother (couldn't see the therapists), but relatively few of these topographies when the trained therapists were in the room. However, in the presence of therapists he postured in a precursor behavior topography. In the presence of his mother he demonstrated these same precursors prior to escalating to higher magnitude destructive behaviors. Therefore, we reinforced target response topographies *and* all relevant precursors during the FA. We also defined FCRs individually for each participant, but they generally involved a mand (Skinner, 1957) that matched the function of the participant's problem behavior. Because of their limited vocal repertoires, we taught Brian, Mark, and Wayne to touch a white laminated card (touching a break card for a participant whose problem behavior

is reinforced by escape from demands). Because Keith had a more sophisticated vocal repertoire, we taught him to ask, "may I have the [*relevant object*], please?"

We measured and analyzed problem behavior and FCRs separately for each context. Specifically, during the functional analysis, we collected data individually on problem behaviors that occurred during each test and control condition. During the competing-items assessment, we collected data individually on duration spent engaged with an item and rate of problem behavior. During FCT, we collected data on the rate of problem behavior, prompted FCRs, independent FCRs, and duration of time spent consuming the functional reinforcer. During the multiple schedule, we collected data on problem behaviors that occurred during the EXT component (hereafter referred to as the S_{Δ} component) or S_D components. We also scored FCRs that occurred in the presence of the S_D as correct and FCRs that occurred in the presence of the S_{Δ} as incorrect. We calculated rates of the correct FCRs only during times when a correct FCR was possible (e.g., in the presence of the S_D). For example, nine FCRs in a 5-min session with 3 min of exposure to the S_D component would be a rate of three per minute ($9 \div 3 = 3$). In the final comparison of the three separate multiple schedule contexts (terminal EXT interval with and without competing items and the brief EXT interval), we calculated the rate of problem behavior and FCRs identical to the aforementioned multiple schedule condition.

Integrity and Interobserver Agreement

A second independent observer collected data either during sessions or by reviewing a video recording. We collected data in this manner for a minimum of 17% for each client and each condition. Exact-agreement coefficients were calculated using a computer program, which added the number of agreements per 10 s interval and divided this number by the number of agreements plus disagreements and then multiplied by 100. We evaluated the agreement for every response topography individually and at the aggregated level. For the sake of brevity, we

only report the aggregated scores here. For Brian, we collected IOA on 35.6% of FA sessions with an average agreement of 99.2% (range 81.5 to 100), for 26.7% of FCT sessions with an average agreement of 98.4% (range 50 to 100), and for 38.6% of multiple schedule sessions with an average agreement of 97.6% (range 62.6 to 100). For Mark, we collected IOA on 47.6% of FA sessions with an average agreement of 98.4% (range 83.3 to 100), for 37.5% of FCT sessions with average agreement of agreement of 99.8% (range 93.3 to 100). For Wayne, we collected IOA for 17.4% of FA sessions with an average agreement of 98.4% (range 67.4 to 100), for 33.3% of FCT sessions with an average agreement of 97.4% (range 90.8 to 100), and for 53.3% of multiple schedule sessions with an average agreement of 98.6% (range 92 to 100). For Keith, we collected IOA on 27.6% of FA sessions with an average agreement of 98.5% (range 66.7 to 100), and for 26.3% of FCT sessions with an average agreement of 96.2 (range 74.68 to 100). All observers recording the same number of target responses in an interval was an agreement (e.g., each recording two problem behaviors; or each recording zero problem behaviors). A data collector's data did not contribute toward IOA until that data collector demonstrated 80% or higher agreement with a primary data collector for three consecutive sessions. We scored treatment integrity by comparing the data collected using laptops as well as a written checklist of activities the therapists must perform. We collected integrity data on a minimum of 25% of sessions and conditions for each child. The percentage of correct responses was calculated by summing the number of correct responses and dividing that number by the total number of opportunities for correct response and multiplying that quotient by 100. Only therapists who demonstrated 80% or higher treatment integrity were able to run sessions.

Functional Analysis

We conducted a functional analysis similar to the arrangement described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994). The functional analysis consisted of three

tests and one control condition to identify environmental variables that occasion and reinforce the target destructive behavior (Carr, 1977). The three test conditions assessed whether attention, access to tangible items (i.e., social positive reinforcement), escape from non-preferred tasks (i.e., social negative reinforcement), or sensory stimulation (i.e., automatic reinforcement) maintained problem behavior. A therapist was present in the room for all conditions.

The initial phase served as a screener for automatically maintained behavior for Brian and Keith. The screening consisted of three to five consecutive no-interaction sessions with no attention, demands, or additional stimuli (Querim et al., 2013). During this no-interaction condition, the therapist waited in the room with the child with no other toys or activities and withheld all forms of attention to the child. If destructive behaviors occurred during this screening condition, this would suggest a possible automatic reinforcement function and the participant likely would have been ineligible to participate.

Following the extended no-interaction conditions, we implemented a standard functional analysis with a modification of 5 min sessions instead of 15 (Hanley, Iwata, & McCord, 2003). We conducted a tangible condition only if the caregivers indicated that problem behavior might produce access to tangible items (e.g., a favorite toy) or if the evocative conditions of the functional analysis did not show high rates of problem behavior (e.g., Hagopian, Wilson, & Wilder, 2001). Repeated demonstrations with elevated rates of problem behavior in one condition over rates of problem behavior in the control condition and other test conditions was considered an indication of a functional relation between the behavior and the specific consequence. Analysis of the data determined whether one or multiple evocative situations and consequences were most likely to produce and maintain problem behavior.

In the escape condition, the therapist delivered instructions continuously (approximately every 2-5 s) unless the child engaged in the target response. If the child engaged in the problem

behavior, then the therapist stopped placing demands and informed the child that he or she no longer needed to comply (e.g., with the verbal response "OK you don't have to"). Any contingent break from demands lasted 20 s, the end of which was signaled to the therapist by the data collector who was watching the time. If the child did not comply, then the therapist prompted the child to comply using three-step guided compliance (i.e., verbal prompt, model prompt, physical prompt).

The attention condition tested whether contingent attention reinforced destructive behavior. An item identified as being moderately preferred via a paired-choice preference assessment was present and continuously available to the child. The therapist began by engaging with the child with highly interactive play for approximately 1 min. The therapist instructed the child to play with the moderately preferred toy while the therapist did some "work." The therapist read something (e.g., magazine, newspaper) or otherwise engaged in some innocuous task and avoided eye contact, physical, or verbal attention unless the child engaged in the target response. Contingent upon the emission of the target response, the therapist delivered 20 s of attention, usually in form of worry (e.g., "Oh no! Are you okay?"), or reprimand (e.g., "We do not hit, that is not okay"). We modified the form of attention delivery for each child depending on the caregiver's report of the kind of attention that they might deliver for that type of problem behavior in the home or school setting.

The play condition served as a control condition during which there was putatively no motivation for problem behavior because all reinforcers were available independent of the problem behavior (Fahmie, Iwata, Querim, & Harper, 2013; Thompson & Iwata, 2005). Furthermore, problem behavior that continued to occur during the play and no-interaction conditions might have indicated that automatic reinforcement maintained that problem behavior.

Finally, the tangible condition assessed whether access to preferred items primarily reinforced the problem behavior. The therapist allowed the child to play with the preferred item for one minute prior to the beginning of the session. The therapist then removed the item and played with it by themselves or simply kept it out of reach unless the child engaged in the target response. If the child engaged in the target destructive behavior, then the therapist returned the item to the child. Contingent access to preferred items lasted for 20 s. After the 20 s interval elapsed, the therapist again removed the item.

The rates of problem behavior were recorded and graphically depicted for visual inspection (see Figure 1) across conditions in a multielement design (Sidman, 1960; Ulman & Sulzer-Azaroff, 1975). Any data path that represented a condition with rates of problem behavior clearly elevated above the other conditions was identified as the primary consequence maintaining the problem behavior. If all rates were distributed evenly across conditions, then the behavior was either presumed to be maintained by automatic reinforcement, or by multiple consequences.

For Mark, we conducted the FA in a series of pairwise conditions to evaluate the test condition against a play, control condition. The order of the FA conditions were attention, then escape, then access to tangible items respectively (see Appendix 1 figure 1). The caregiver administered the first session of both the escape from demands and tangible conditions. For all intents and purpose, the conditions of the FA were conducted identically to the other participants.

If problem behavior did not occur during these conditions but occurred outside of the session room and the caregiver reported that it persisted, then variations were made to identify a more idiosyncratic function, such as a mand assessment (as was the case for participant 4, Keith; Bowman, Fisher, Thompson, & Piazza, 1997).

If rates of responding during the functional analysis did not yield a clear function, then we implemented a pairwise analysis to clarify the relative role of individual contingencies (Iwata, Duncan, Zarcone, Lerman, & Shore, 1994). For example, Brian demonstrated elevated rates of responding for both tangible and attention functions in the functional analysis. Therefore, we arranged a single test condition (escape) alternating against a control condition (play) in a multielement design (Ulman & Sulzer-Azaroff, 1975). Following that pairwise, we evaluated the other target condition, tangible, using the same procedure. For Keith, no problem behavior was observed across any condition, therefore, the lead investigator conducted an addition caregiver interview to obtain information about specific discriminative stimuli and consequence that might occur in the natural environment. The interview provided information about specific reprimands and antecedents that were likely to occasion problem behavior. The modified condition essentially represented a tangible condition supplemented with various verbal reprimands. This modification facilitated a more conclusive analysis. If we could not identify a function whatsoever, then that client would not have been an acceptable candidate for this study. No participants were excluded for this reason.

Competing Stimuli Assessment

Following the functional analysis, we conducted a competing stimulus assessment to identify the extent to which the consumption of one stimulus was associated with a decrease in the consumption of another stimulus (Fisher et al., 2004; Fisher, O'Connor, Kurtz, DeLeon, & Gotjen, 2000). Specifically, the assessment showed whether consumption of an alternative reinforcer was associated with a decrease in the consumption of the concurrently available functional reinforcer identified during the functional analysis. For example, if the functional analysis indicated that attention reinforced the problem behavior, we might have assessed whether one or more toys effectively competed with attention.

Sessions took place in the same room as the functional analysis. Five or more items were selected from the RAISD and evaluated individually for at least two sessions. The child had continuous access to individual toys or activities for 5 min. Following any instance in which the child engaged in the target behavior, the therapist provided the functional reinforcer with the exception of Wayne. Due to high levels of destructive behavior during the competing stimuli assessment and a concomitant lack of engagement with the potential competing items, the assessment was conducted a second time with Wayne with the modification that the therapist placed destructive behavior on EXT. For all participants, we selected the item with the highest level of engagement and reciprocal low levels of destructive behavior as the competing item for the EXT component of the multiple schedule evaluation described later.

Functional Communication Training

We implemented functional communication training (FCT) to teach an alternative response to access the functional reinforcer (Carr & Durand, 1985). For example, Brian gained access to preferred toys by engaging in self-injury and disruption, so we taught him to touch a nearby white laminated card (described in the "materials section") as an alternative to those destructive behaviors that produced access to the functional reinforcer: his DVD player. We implemented the functional-analysis condition with elevated levels of destructive behavior to establish baseline. We then implemented discrete trial teaching in 10-trial blocks with prompt-fading to teach the FCR. During the free-operant FCT condition, the therapist implemented the evocative situation and physically prompted the child to emit the FCR (e.g., touching or exchanging a card). This was a modeled vocal response ("may I have [*specific toy*], please") for Keith similar to participant Alan in Fuhrman, Greer, Zangrillo, & Fisher, (2018) using a progressive prompt delay of 0 s, 5 s, and 10 s. We required two sessions with 80% independent FCRs and an 80% reduction in problem behavior from baseline at each prompt delay before

increasing the delay. Once the child emitted the FCR at stable rates with low rates of problem behavior for two consecutive sessions, then the skill was considered mastered. If the child failed to demonstrate the FCR and continued to engage in destructive behavior at rates similar to baseline, then we would have reduced the prompt delay to 0 s for additional training. Throughout FCT, any emission of destructive behavior received no programmed consequence (EXT). FCT was evaluated using an ABAB withdrawal design.

Multiple Schedule Comparison

Pre-evaluation assessments. Two assessment procedures were implemented to identify (a) whether multiple schedule or response restriction (Fisher, Greer, Querim, & DeRosa, 2014) would be more appropriate for each participant, and (b) a progressive interval assessment (PIA; Findley, 1958; Fisher, Greer, Fuhrman, Saini, & Simmons, 2018; Fisher et al., 2019) to determine the most auspicious duration of the initial EXT interval in the brief multiple schedule.

Response restriction or multiple schedule evaluation. Each participant experienced three to five 5-min sessions of a response restriction evaluation. For this experiment, methods reflected those of Fisher et al. (2014). Participants selected from two concurrently available colored cards that were available for 60 s and unavailable for 15 s. One card produced reinforcement, and the other did not. Afterward, each participant was exposed to three to five 5-min sessions of a traditional multiple schedule with a 60-s S^D and 15-s S^Δ (S^D/S^Δ durations are the symbolic representation of the multiple schedule for the remainder of this paper. For example, a 60/15 is a 60-s S^D and 15-s S^Δ). We used a 5-s changeover delay (COD) to prevent adventitious reinforcement throughout the multiple schedule (Herrnstein, 1961). If participants allocated 90% of responses to the correct card in the response restriction protocol but did not demonstrate discriminated responding to the schedule-correlated stimuli in the traditional multiple schedule, then we proceeded with the response restriction arrangement rather than the multiple schedule. If

participants demonstrated discriminated responding to reinforcement-producing stimuli across both response restriction and the traditional multiple schedule, then we used the traditional multiple schedule procedure for the remainder of the experiment.

Progressive interval assessment. We assessed the initial duration of the EXT component of the multiple schedule in either a response restriction or multiple schedule arrangement (as previously described) with a progressively increased EXT component using procedures similar to that described in Fisher, Greer, Fuhrman, Saini, and Simmons (2018). We conducted trials during a single session with no set duration. A single trial consisted of one S^D interval and one S^Δ interval and the session began with 1 minute of the S^D condition. The therapist presented the establishing operation (EO; e.g., removal of attention, presentation of demands, or removal of preferred items). During this step, the FCR produced 20 s of access to the functional reinforcer on an FR1. After the S^D duration elapsed, the therapist presented the S^Δ stimulus and the EO. After the S^Δ duration elapsed, the therapist presented the next S^D/S^Δ trial with the next EXT interval. The EXT component increased after two sessions of 2 s, 5 s, 10 s, 20 s, 40 s, and 60 s with zero instances of destructive behavior per trial. After the EXT interval elapsed, the therapist presented the S^D stimulus. We implemented a 5-s delay between trials. If the participant engaged in problem behavior during the EXT interval, then the length of that component was repeated for four consecutive sessions without destructive behavior before proceeding to the next EXT length (e.g., if problem behavior occurred during the 20 s EXT interval, then we repeated four trials with the 20-s EXT interval without problem before increasing the EXT interval to 40 s). If problem behavior occurred during two EXT intervals of the same length, then we terminated the session and selected the next highest duration of EXT for the multiple schedule comparison. For example, if the participant engaged in destructive behavior during two 40 s EXT intervals, then the 20 s EXT interval would have been chosen for the comparison (thus, the multiple schedule comparison would proceed as a 60/20). Mark and Keith completed all trials without

demonstrating sufficient rates of destructive behavior to select an interval for the brief EXT interval of the multiple schedule. This indicated that the competing items were unnecessary to introduce the multiple schedule at the terminal interval for these individuals. Mark was eligible to participate in another study, so we terminated his participation in this investigation. For Keith, we evaluated increased EXT interval durations and implementation with novel therapists and the caregiver and then terminated his participation in the study.

Comparison evaluation. Brian and Wayne were the only two participants to proceed with the remaining phases of the investigation because they both demonstrated destructive behaviors during the initial EXT interval assessment. First, a baseline condition established rates of problem behavior using the most evocative condition from the functional analysis relevant for each participant. We then compared three different multiple schedule conditions in three different contexts (A, B, and C, each correlated with distinct, colored stimuli). We examined the relative rate of problem behavior concurrently using a multielement design in which we rotated each condition three or more times until we observed stable rates of responding in each condition.

First, we wanted to evaluate a common multiple schedule arrangement (brief EXT interval; condition A described below) against the terminal EXT interval to demonstrate that introducing a multiple schedule at the terminal EXT would produce elevated rates of problem behavior (condition B, described below; e.g., Hagopian et al., 2005; Hanley et al., 2001; Volkert, Lerman, Call, & Trosclair-Lasserre, 2009). Most studies have faded the initial EXT interval to a terminal EXT interval to avoid resurgence of destructive behavior at the initial interval (e.g., Hanley et al., 2001; Saini et al., 2016).

Condition A was a two-component multiple schedule with a 60-s S^D and relatively short S^Δ (determined from the results of the pre-evaluation PIA). The therapist wore an oversized monochromatic red shirt associated with that condition (the shirt matched the color of the

laminated S_{Δ} card). Condition A included a laminated white FCR card (7.62 cm x 12.7 cm) and a double-sided laminated card (7.62 cm x 12.7 cm) with green construction paper on one side (S_D) and red construction paper on the other side. Condition A was unlikely to result in destructive behavior because that condition had already been shown to produce little or no destructive behavior during the PIA. During condition A, sessions began in the S_D condition. The therapist presented the evocative condition from the FA relevant for each participant. The FCR produced 20 s access to the reinforcer for Brian because the duration of the brief EXT interval was 5 s. The FCR produced 30 s access to the reinforcer for Wayne because the duration of the brief EXT interval was 120 s (see table 1). Thus, the most efficient rate of correct FCRs during condition A was 3 per minute for Brian and 2 per minute for Wayne.

Condition B was the terminal EXT interval with no competing items. Condition B was procedurally identical to condition A except that the S_{Δ} condition was 240 s (4 min). The therapist wore a blue shirt for condition B. For this condition, the S_D was yellow and the reverse side (S_{Δ}) of the card was blue to match the color of the therapist's shirt. That is, the participant experienced only 60 s of the S_D interval at the beginning of the session, followed by 240 s of the EXT component.

We also evaluated the relative rates of problem behavior during the terminal EXT interval of a multiple schedule with and without competing items to establish differentiated rates of problem behavior with the only difference being the presence or absence of competing stimuli. Condition C reflects the competing items comparison. Throughout the treatment evaluation, we kept the duration of reinforcement at a ratio of 4:1 to the duration of EXT alone (see table 1), but no less than 20 s. If the participants demonstrated elevated rates of responding that were undifferentiated between conditions A and B (brief EXT interval vs terminal EXT interval), then

this would indicate that the PIA was unsuccessful at determining a starting interval for the multiple schedule and we would have had to identify a new initial interval.

Condition C was procedurally identical to Condition B (i.e., 60/240 multiple schedule) except that the competing activity identified during the competing-items assessment was continuously available during the EXT interval of the multiple schedule. The therapist wore a pink shirt for condition C. The S_D card was black and the reverse side (S_Δ) was pink, again matching the therapist's shirt. During the S_D interval, the FCR produced 20 s access to the reinforcer as there were supplemental activities available during the 240-s EXT interval. During the EXT interval, the therapist presented the evocative condition of the FA relevant for each participant, then immediately provided access to the competing activity. For both Brian and Wayne, the therapist said, "we are all done with that," and removed the tangible item. For Brian, the therapist added, "we can play instead," and spent the rest of the EXT interval playing. For Wayne, the therapist added, "you can have these instead," and handed him animal magazines.

If the participant engaged in elevated rates in both conditions B and C (competing and no competing-items), that would have indicated that competing items were unsuccessful at reducing rates of problem behavior and that fading the EXT interval was necessary. However, we observed differentiated rates of responding across all conditions.

A secondary therapist collected data on rates of problem behavior and FCRs, kept time, discretely signaled condition changes to the session therapist (e.g., the end of the reinforcement interval, changing the S_D to the S_Δ). Any emission of the FCR during the S_D condition produced 20-s of access to the functional reinforcer. That is, if the participant exchanged the FCR card, then the therapist immediately delivered the functional reinforcer. At the end of 20 s, the secondary therapist signaled that time allotted for reinforcement had elapsed, and the therapist removed access to the reinforcer. Any problem behavior produced no programmed consequence

(EXT). After 60 s of the S_D condition, the secondary therapist signaled for the session therapist to switch conditions. The primary therapist flipped the S_D/S_Δ card to the reverse side (i.e., pink). At the end of the EXT interval (240 s, or the brief interval) the secondary therapist again signaled a change back to the S_D condition. Any emission of the FCR during the S_Δ condition produced no programmed consequence (EXT).

Sessions were 5 min in length. After a minimum of three sessions demonstrating differentiated responding across conditions, and no significant trends in a condition, the conditions returned to baseline. The second baseline condition was identical to the first baseline condition.

Competing Items Fading. Following the second baseline, we systematically reduced the availability of competing items while maintaining low rates of problem behavior. Procedures for reducing the availability of non-contingent access to the alternative activities were similar to those described by Hagopian, Fisher, and Legacy (1994; cf. Slocum, Grauerholz-Fisher, Peters, & Vollmer, 2018). We faded the duration of access to the competing items initially by randomly selecting a brief interval during each EXT component. We maintained the duration of reinforcement delivery at a 4:1 ratio with the amount of time that reinforcement and competing items are unavailable, but no less than 20 s (see Table 1 for the fading steps and corresponding reinforcement durations). The criterion to advance the duration of unavailability was two consecutive sessions below an 80% reduction in problem behavior from baseline. We evaluated the terminal duration of unavailability following every two steps of the reduction. If the rate of problem behavior reduced to the 80% criterion during a terminal duration probe, then additional sessions at the terminal duration were conducted until three consecutive sessions met the 80% criterion with no competing items available.

Probe sessions were conducted for multiple participants after they demonstrated low rates of problem behavior during the terminal multiple schedule with competing items. We examined the multiple schedule procedure outside of the therapy room for Brian in several different contexts that more closely approximated his routine environment (e.g., a playroom). We also trained caregivers to implement the multiple schedule procedure in those contexts. Similarly, because Keith did not engage in any problem behavior during the PIA, but maintained rates of the FCR, we implemented two more versions of the multiple schedule at the terminal EXT interval without competing items. First, a novel therapist conducted the terminal EXT interval (60/240) session without competing items. Then, we increased the EXT interval to 540 s with another novel therapist. Finally, we trained the caregiver to implement the multiple schedule procedure at the 60/540 interval in the treatment room, and then probed again in an environment more closely approximating his routine environment (a living room-like area). The results for Brian and Keith are described more thoroughly later.

Results

Functional Analysis

Figure 1 displays the results from the functional analyses for all four participants. Brian demonstrated both an escape function (M = 1.97 per min) and a tangible function (M = 2.57 per min). Due to the elevated rates of destructive behavior in the tangible condition relative to the escape condition, and parents reporting difficulty around tangible items in Brian's common contexts, we selected the tangible function for intervention. The functional analysis results for Mark demonstrated the highest rates of destructive behavior in the escape condition (M = 2.65 per min) and second highest in the tangible condition (M = 2.45 per min). We targeted the tangible function as the escape function was better suited for a different study that Mark participated in after his enrollment in this study. The functional analysis results for Wayne demonstrated the

highest rates of destructive behavior in the tangible condition (*M* = 2.92 per min). Therefore, we pursued the tangible function for Wayne. Finally, Keith demonstrated no destructive behavior during the traditional functional analysis arrangement, so we conducted a supplemental caregiver interview. We subsequently evaluated a modified tangible condition with a specific type of vocal reprimand ("no phone on the weekend" or "you cannot have that right now") in a pairwise comparison against the "play" (control) condition. The modified tangible resulted in rates of problem behavior comparable to those reported by the caregivers (*M* = 1.5 per min).

Competing Stimuli Assessment

During the competing-items assessment, each participant demonstrated some systematic pattern of low rates of problem behavior relative to high rates of engagement for at least one activity in the evaluation even while the functional reinforcer was available contingent on problem behavior. In summary, the conditions with the highest rates of engagement and lowest rates of problem behavior were therapist attention for Brian, the iPad for Mark, animal magazines for Wayne, and therapist attention for Keith. We implemented a supplemental control condition for Mark that was identical to the evocative condition for the functional analysis. However, magnitude and rate of self-injury was so high that we terminated that condition for safety reasons and did not implement this condition with other participants.

Functional Communication Training

The data from the discrete trials are not represented in this document but are available upon request. Following the discrete trials, the individuals completed several 5-min free-operant FCT sessions. All participants' responses demonstrated clear discrimination of the conditions with high, efficient rates of the FCR with corresponding low rates of destructive behavior when

the FCR was available on an FR1. This pattern was reversed with a baseline and reversed back with the reintroduction of the FR1 condition.

Response Restriction Versus Traditional Multiple Schedule Comparison

All participants performed at acceptable levels with the successive discrimination in the multiple schedule (60/15 S_D/S_Δ interval), so additional data are not depicted here but are available upon request.

Progressive Interval Assessment

Figure 2 displays data from all four participants in the PIA. Brian demonstrated problem behavior during the 10 s duration of the EXT interval. Therefore, we selected the 5 s interval as the comparison for the multiple schedule evaluation. Mark engaged in problem behavior once during the 5 s, 10 s, and 180 s EXT interval, but tolerated subsequent tests at each interval such that he was able to reach the terminal EXT interval of 240 s without competing items. Wayne engaged in destructive behavior at elevated rates only at 150-s interval, so we selected 120 s as the initial EXT interval for the multiple schedule comparison. Keith did not engage in any problem behavior throughout the entire initial EXT interval assessment up to 240 s, so two additional probes were conducted up to 540 s with novel therapists and the caregiver to demonstrate replication of this effect. Although problem behavior did occur intermittently during these probes, it remained below 80% reduction from baseline.

Multiple Schedule Comparison and Competing Items Fading

Figures 3 and 4 display the results of the multiple schedule comparison for Brian and Wayne as these were the only two who engaged in sufficiently high rates of destructive behavior to evaluate the multiple schedule with competing items. Both participants demonstrated rates of

problem behavior in baseline comparable to the functional analysis. Both demonstrated elevated rates of destructive behavior during the terminal EXT interval without competing items, but rates below the 80% reduction from baseline for both the brief EXT interval and the terminal EXT interval with competing items. The return to baseline for both participants demonstrated elevated rates of problem behavior. For Brian, it took 33 sessions progressing from 2-210 s fading the availability of the competing item to fade out competing activities while maintaining rates of problem behavior below the 80% reduction criteria. The topography of destructive behavior changed during the fading steps such that Brian was tossing the FCR card into the air and watching it drift to the floor (he was playing with it). Thus, at the 210 s interval, we attached the FCR card to a retractable lanyard. This modification resulted in the final decrease in problem behavior below the 80% reduction. Based on a transition to using a communication application in school, we transferred the FCR to the communication application, and data are labeled to indicate when this took place. Finally, Wayne demonstrated consistent low rates of problem behavior (below 80% reduction from baseline) during the fading steps, and consistently high rates of problem behavior (comparable to and often much higher than rates at baseline) during the terminal probes without competing items until session 57. At that point, the removal of competing items had to be reduced to 30 s of unavailability during the EXT interval and then re-faded back to the 240 s criteria, which then only took eight trials to reach termination criteria. Similar to Brian, we probed novel contexts and therapists with this procedure before finally terminating sessions as successfully completed. There was an initial increase in the rate of destructive behaviors during novel context probes, so we once again reduced the unavailability of competing items to only 2 s and then 4s, but at the next terminal EXT interval, rates of destructive behavior remained low.

Discussion

There are two notable features of this study that contribute to the overall literature on the implementation of multiple schedules in clinical settings. The first feature is that competing items successfully facilitated an immediate transition to the terminal EXT interval and were subsequently faded out so that the individuals tolerated a multiple schedule without competing items during the 240 s terminal EXT interval. The second feature is that the PIA is a novel, systematic application to either set the most auspicious initial EXT interval, or otherwise to efficiently determine if an individual needed competing items to achieve the terminal EXT interval.

To the first point, the initial purpose of this study was to evaluate the use of competing items to facilitate rapid (immediate) transition to the terminal EXT interval of a multiple schedule while maintaining low rates of destructive behavior by providing alternative substitution stimulation (i.e., competing items; cf. Fuhrman, Greer, Zangrillo, & Fisher, 2018). We accomplished this in both instances in which we applied the multiple schedule with competing items. That is, the individuals experienced the terminal EXT interval in the first session of the multiple schedule comparison when competing items were present and did not demonstrate a resurgence in destructive behaviors. However, in the context in which the individual experienced the terminal EXT interval without competing items, problem behavior resurged to rates either similar to or higher than rates of problem behavior during baseline. We were then able to successfully fade the presence of competing items such that rates of problem behavior remained below the 80% reduction from baseline.

To the second point, we were surprised to discover that any participants tolerated fading to the terminal EXT interval without competing items or resurgence of problem behavior during the PIA (cf. Briggs et al., 2018; Greer, Fisher, Saini, Owen, & Jones, 2016). This outcome turned

out to be serendipitous because it led to the discovery that this putatively innocuous experimental step was a useful and systematic tool for discovering which individuals did not need any fading steps during reinforcement schedule thinning using a multiple schedule. The implication is that clinicians may benefit from having this assessment protocol that identifies those individuals who need support in a multiple schedule and do not need an extended EXT fading regime.

An alternative hypothesis is that the participants who did complete the initial EXT interval assessment may not have "tolerated" the lack of competing items but were amenable to fading the EXT interval gradually over the course of the assessment. However, this would still imply that fading the terminal EXT interval could be accomplished within a single, 1-hour session rather than across days or weeks. The implications for clinical efficiency might be significant for many practitioners and the individuals whom they serve. We did not expect the PIA to serve any purpose beyond providing information regarding how to proceed with the comparison of the multiple schedule with and without competing items at the terminal or brief EXT intervals for this study but were pleased to discover a potentially more beneficial outcome.

Part of the purpose of this study was to replicate and extend Fuhrman et al. (2018) and Hagopian et al. (2005) in the use of competing items for increasing the practicality and ease of implementing multiple schedules by facilitating rapidly achieving the terminal EXT interval of a multiple schedule (cf. Saini et al., 2016). However, one could argue that rather than decrease the number of steps or create an easier fading paradigm, we simply shifted the burden of fading the EXT interval duration to the competing items and maybe even made the process more complicated. However, it is notable that we were able to accomplish this in fewer (M = 80) total sessions for both participants compared to the number of fading steps required in the literature (255 sessions for Austin & Tiger, 2015; M = 83.5 for Fuhrman et al., 2018; M = 85.7 for Hagopian et al., 2005; M = 130 for Hanley et al., 2001). Furthermore, the use of competing items

more closely approximates the individual's natural environment, in which caregivers are likely to use or be willing to use competing items as "distractions" when the functional reinforcer is not available. The data also seemed to suggest that gradually removing competing items will maintain low rates of destructive behavior (avoiding the resurgence of problem behavior) by providing supplemental substitutable reinforcers while the functional reinforcer is unavailable. Of course, this is in the practitioner and child's best interest as any instance of problematic behavior contributes to both the overall momentum of that topography of behavior in a given context (Saini, Fisher, & Pisman, 2017) and may result in lasting physical trauma.

The probes of the terminal EXT interval without competing items were intended to determine whether competing items could be faded more rapidly than the fading steps that we used. However, both participants required essentially the full scope of graduated fading steps to remove competing items altogether. Thus, future research should address the utility of the probes while fading competing items. Alternatively, the probes might be better situated to provide useful information if they tested a subsequent fading step rather than the terminal fading step, which might be excessive to the individual. For example, the practitioner might find that the probes are more useful in determining if the individual would tolerate fading from 20 s to 60 s without the competing activity rather than fading from 20 s to 240 s.

To fade the competing items, we chose to select random intervals during which we briefly removed the competing items during the EXT interval of the multiple schedule. The rationale for random intervals was to approximate what we believed to be a natural scenario in which the availability of a "distraction" or other substitutable reinforcer was somewhat unpredictable and subject to the availability and whims of the caregiver. It appeared prudent to avoid allowing the schedule of availability of the competing items to control the children's behavior rather than facilitating tolerance of temporary removal of the competing items.

However, we observed that when the interval without competing items coincidentally aligned with the beginning of the EXT interval, the individual was more tolerant to the EXT interval without competing items (i.e., engaged in lower rates of destructive behavior), compared to taking away the competing items once they had been made available. Therefore, future research should investigate if withholding the competing items at the beginning of the EXT interval more readily facilitates fading the availability of competing items than doing so at random times throughout the EXT interval.

We used a response restriction and multiple schedule comparison to determine how to proceed with the evaluation of this study. During the comparison, we used 15 s EXT intervals to determine the extent to which the individual's behavior would come under the conditions of a multiple schedule. A shrewd observer will have noted that this is longer than the shortest interval we used during the PIA and could have facilitated the acquisition of the discrimination of the multiple schedule and potentially confounded, or at least obscured the comparison of the multiple schedule with and without competing items to the brief interval. However, the 15 s was longer than participant Brian tolerated during the terminal EXT interval, demonstrating that resurgence was likely to occur in the first place. Nevertheless, future research should consider omitting the response restriction and multiple schedule comparison to avoid unintended practice effects. Doing so may also facilitate greater efficiency.

Another limitation is that we identified a tangible function for all four participants. Replacement of the specific tangible item(s) that maintained the destructive behavior might not lend itself to the concerns of practical implementation in those settings where no tangible items are available. Furthermore, as pointed out by Fuhrman et al. (2018), "providing alternative tangibles as a competing activity only during periods of reinforcer unavailability is not ideal for individuals with destructive behavior maintained by access to tangibles" (p. 940). Future studies

should evaluate these procedures with behaviors maintained by other reinforcers (e.g., caregiver attention, negative reinforcement). Nevertheless, these procedures were effective for the participants of this study. Clinicians may be able identify individual who display tangible-maintained destructive behaviors who would benefit from these procedures.

Finally, this study evaluated 5-min sessions for most participants. However, this may not be a socially significant duration when considering a caregiver's length of responsibility to the individuals who engage in problem behavior throughout the day. Therefore, future researchers should evaluate extended multiple schedule sessions to determine the generalizability and sustainability of the multiple schedule intervention.

This study demonstrated a systematic way of introducing and subsequently fading competing items during the terminal EXT interval of a multiple schedule and thus achieve rapid schedule thinning while maintaining low rates of destructive behavior. We also coincidentally discovered that one of our assessment tools (the PIA) had more value than intended by providing a means of systematically identifying those individuals for whom fading was either entirely unnecessary or else we could accomplish fading within a single session.

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Table 1. The reinforcement duration and corresponding competing items unavailability duration during fading procedure in the final treatment phase.

Table 1

Reinforcement durations during competing stimulus availability fading

Step	SR Duration (Seconds)	Delay Step (Seconds)
1	20	2
2	20	5
3	20	10
4	20	20
5	20	30
6	20	60
7	20	90
8	30	120
9	30	150
10	40	180
11	50	210
12	60	240

Appendix 1

Figure 1. Functional analysis data for Brian, Mark, Wayne, and Keith. The x-axis represents 5-min sessions. The y-axis represents rates of problem behavior. The symbols indicate the evocative condition being tested.

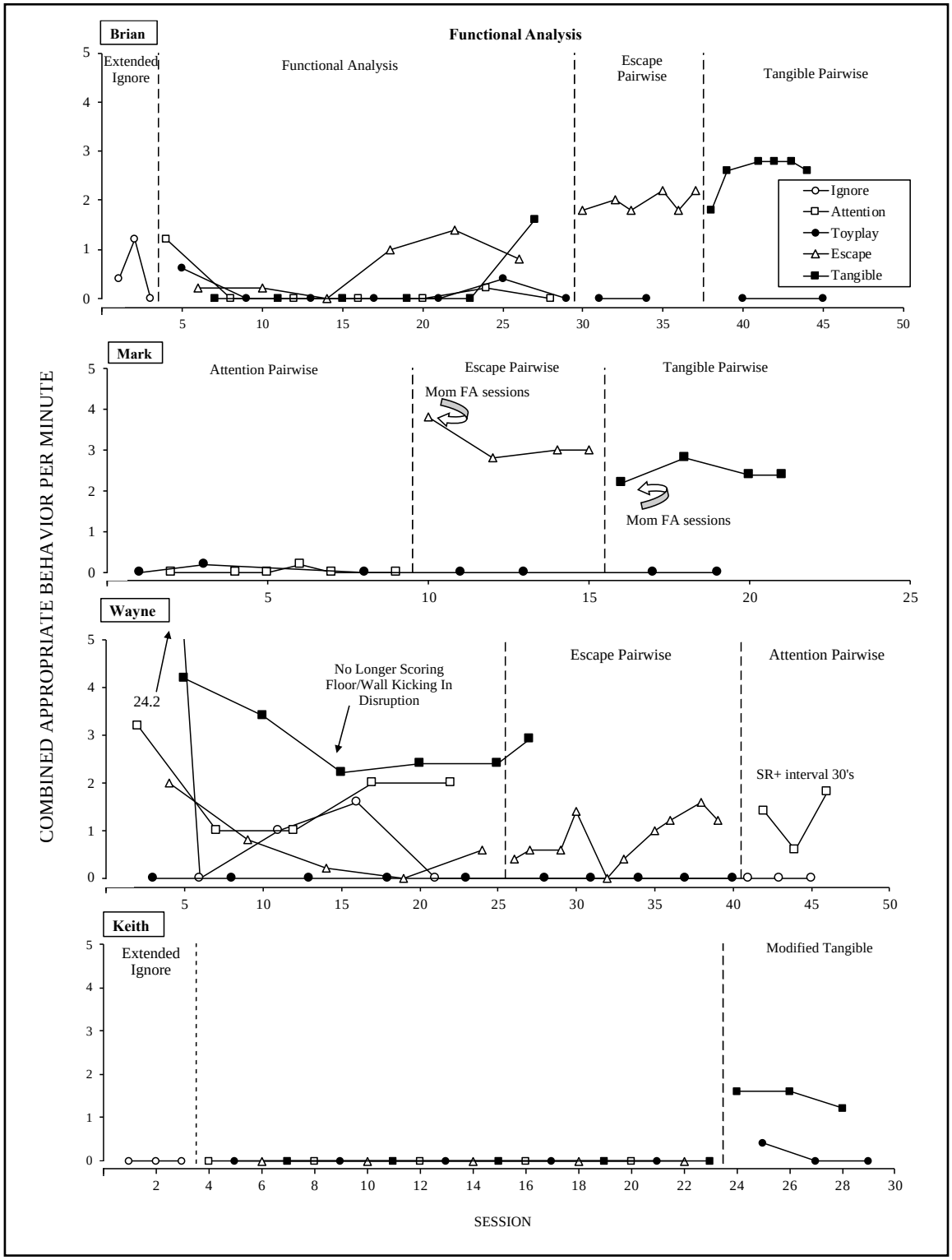

Figure 2. The progressive interval assessment. The x-axis depicts graduating lengths of the EXT interval during the traditional multiple schedule in a single session. The y-axis represents rate per minute of problem behavior during the entire FR/EXT cycle for each EXT interval trial. The white bars correspond to rates of the FCR. The black bars represent rates of problem behavior during that trial. Brian demonstrated rates of problem behavior at the 10 s interval, so 5-s was selected for the "brief" interval of the multiple schedule comparison. Mark demonstrated elevated rates of problem behavior at the 150 s interval, so the 120 s interval was selected as the "brief" interval for the multiple schedule comparison. Wayne and Brian tolerated the increase in the EXT interval without demonstrating sufficiently high rates of problem behavior to select a brief interval.

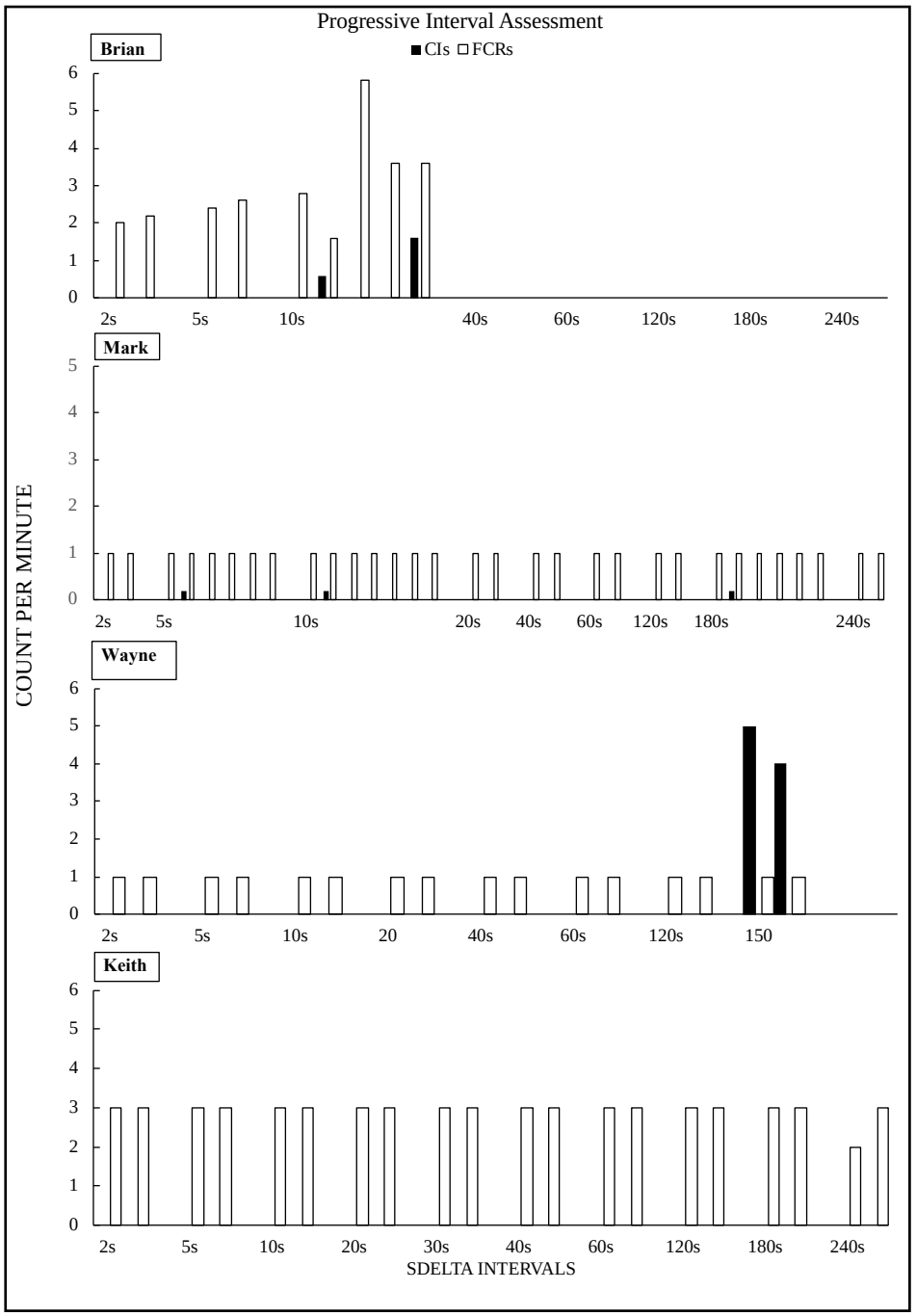

Figure 3. Multiple schedule comparison. These data represent the multiple schedule evaluation for Brian. The top panel depicts rates of destructive behavior across conditions. The bottom panel depicts rates of the functional communication response (FCR). The x-axis depicts sessions. The y-axis depicts rates of destructive behavior per minute on the top panel and FCRs per minute on the bottom panel. Filled squares represent baseline condition, closed circled represent the terminal EXT interval without competing items. Open squared represent the multiple schedule with the "brief" EXT interval identified in the initial EXT interval assessment for each participant. The open circles represent the terminal EXT interval with competing items present during the EXT interval. The times in seconds between the two panel depict the duration that the competing items were unavailable.

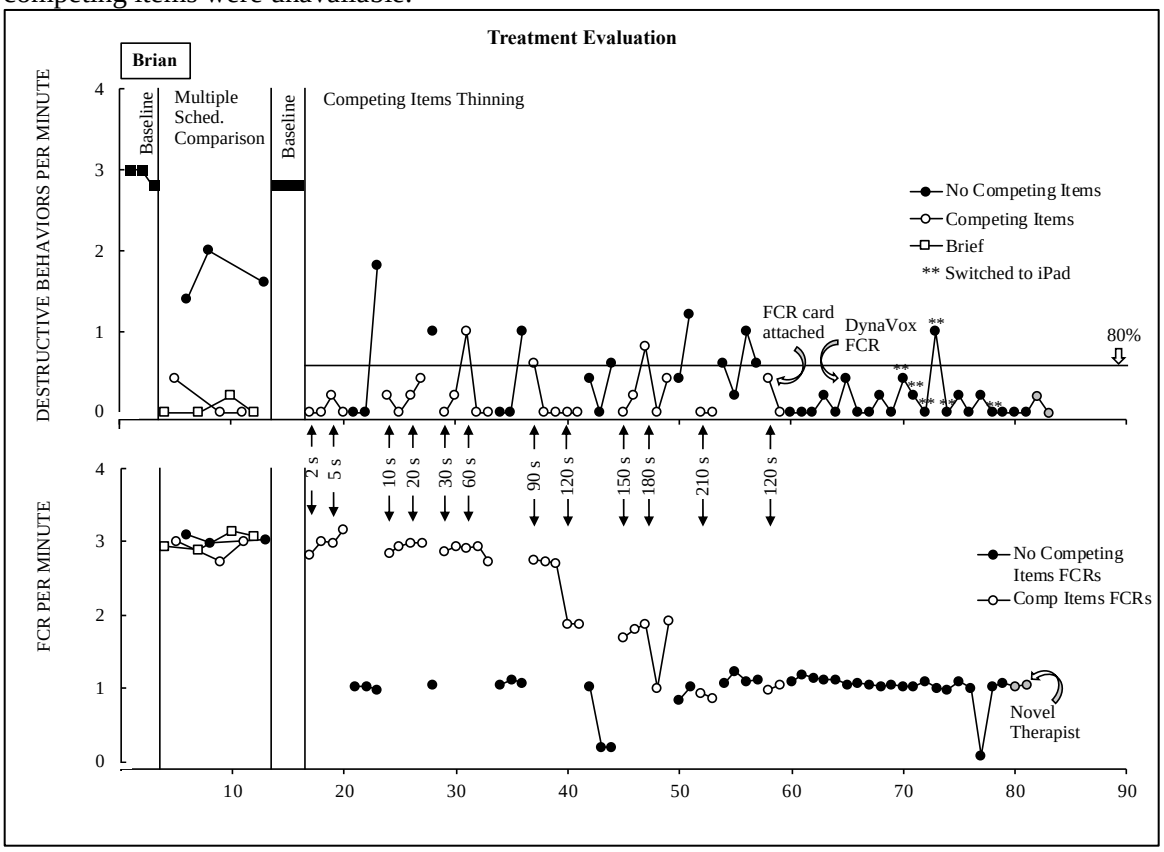

Figure 4. Multiple schedule comparison and treatment evaluation. These data represent the multiple schedule evaluation for Wayne.