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Concurrent schedules of differential reinforcement of alternative behavior in the treatment of problem behavior without extinction

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CONCURRENT SCHEDULES OF DIFFERENTIAL REINFORCEMENT OF ALTERNATIVE BEHAVIOR IN THE TREATMENT OF PROBLEM BEHAVIOR WITHOUT EXTINCTION

By

Chelsea R. Fleck
M. S., Western New England University, 2016

Dissertation
Submitted to the Department of Psychology
and the College of Arts and Sciences at
Western New England University in partial
fulfillment of the requirements for the
Degree of Doctor of Philosophy

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Abstract

Differential reinforcement of alternative behavior (DRA) without extinction is an effective intervention for reducing problem behavior maintained by socially mediated reinforcement, particularly when implementing dense schedules of reinforcement for appropriate behavior. Thinning schedules of reinforcement for an alternative response may result in resurgence of problem behavior. Resurgence may be of particular concern in the treatment of problem behavior without extinction because problem behavior that resurges is also likely to encounter reinforcement and thus can be expected to maintain. In the present investigation, we compared the effectiveness of single and concurrent DRA schedules on decreasing the probability of resurgence when problem behavior continues to produce reinforcement throughout all phases of the evaluation. Concurrent DRA schedules reduced or eliminated the likelihood of resurgence during a treatment challenge compared to a single DRA schedule.

Introduction

A behavior-analytic approach to treating severe problem behavior in individuals diagnosed with autism entails conducting a functional analysis (e.g., Beavers et al., 2013; Hanley et al., 2003), identifying the maintaining reinforcer for the most concerning forms of behavior, and then delivering that reinforcer contingent on more appropriate responses while withholding reinforcement following problem behavior. This approach of reinforcing a different response while putting problem behavior on extinction has been commonly referred to as differential reinforcement of alternative behavior (DRA; Vollmer & Iwata, 1992). The reinforced alternative response may be a mand (Tiger et al., 2008), compliance with educational tasks (Slocum & Vollmer, 2015), toy play (Ringdahl et al., 1997), or participation in important activities such as medical exams (Stuesser & Roscoe, 2020). The reinforcer delivered contingent on the alternative response may be the same as the reinforcer that maintains problem behavior, (e.g., functional communication training or FCT; Carr & Durand, 1985) or the reinforcer may one that competes with the reinforcer that maintains problem behavior (Payne & Dozier, 2013).

Implementing extinction of problem behavior has been shown to be an important component in DRA treatment packages (Hagopian et al., 1998; Hanley et al., 2001; Piazza et al., 1997) in meaningfully reducing levels of problem behavior. Despite its effectiveness when implemented with integrity, there may be cases where it may be impractical or impossible to withhold reinforcement following problem behavior. Escape extinction, for example, has typically been described as the continued presentation of demands, often involving manual guidance of compliance, when problem behavior occurs (Fisher et al., 1993). Depending on the size or strength of the client or the complexity of multi-step tasks, manually guiding compliance may be physically impossible. When escape extinction does not include manual guidance, such as when presenting a vocal verbal task or continuously representing tangible work materials, the severity of the client's behavior may preclude the therapist from continuing in order to

prevent injuries. In the case of problem behavior maintained by positive reinforcers, such as attention or tangibles, caregivers may be compelled to deliver reinforcement if the problem behavior is disruptive (e.g., loud tantrums in a public location) or dangerous (e.g., aggression directed toward young peers or siblings). The size or strength of the client may also be relevant when considering problem behavior maintained by tangible items if the therapist or caregiver finds themselves physically unable to terminate or prevent access to the reinforcer. This relation between client and caregiver behavior, wherein the client's behavior functions to increase or decrease particular responses on the part of the caregiver, has been referred to as *child effects* (Carr et al., 1991). The likelihood of such interactions occurring in the treatment context should be considered when designing interventions.

As behavior analysts have ventured beyond the brief, tightly controlled experimental conditions of early assessment and treatment research, the environments in which problem behavior must be treated have grown increasingly complex, and the continued reinforcement of problem behavior beyond initial treatment sessions may sometimes be inevitable. Over the past two decades, researchers have begun investigating the necessary and sufficient conditions for reducing problem behavior and teaching appropriate behavior without the use of extinction (Athens & Vollmer, 2010; Carter et al., 2010; Fritz et al., 2017; Hoch et al., 2002; Kunnavatana et al., 2018; Lalli et al., 1999; Newman et al., 2021; Piazza et al., 1997; Rogalski et al., 2020). Most studies have involved the manipulation of reinforcement parameters such that the relative quality, magnitude, or immediacy of reinforcement favors alternative behavior over problem behavior, and in most cases, problem behavior can be reduced despite its continued contact with reinforcement during treatment. The contingency landscape in which problem behavior is treated has been conceptualized as a collection of concurrent reinforcement schedules operating on responses simultaneously and independently of each other (Fisher & Mazur, 1997). For this reason and based on the body of research referenced above, Vollmer et al. (2020) recommend the term DRA be applied when "providing greater reinforcement, along at least one dimension, contingent on the

occurrence of one form or type of behavior, while minimizing reinforcement for another form or type of behavior." Thus, designing a DRA intervention for problem behavior without extinction must involve a consideration of the relative reinforcement schedules arranged for problem behavior and other responses.

It may seem intuitive to plan to ignore as much problem behavior as possible and only give up on implementing extinction if behavior becomes severe enough to prevent it. This would likely yield a dense schedule of reinforcement for appropriate behavior and a lean schedule of reinforcement for problem behavior. At face value, providing dense reinforcement for appropriate behavior and allowing the rate of reinforcement for problem behavior to vary as the circumstances dictate may seem like a simple and promising option. However, there are two reasons why this approach may prove to be less than desirable: the first is that variably-implemented extinction is functionally the same as intermittent reinforcement. Worsdell et al. (2000) conducted a study to investigate the outcomes of this sort of variable-integrity extinction, in which they systematically increased the fixed-ratio (FR) schedule of reinforcement arranged for problem behavior while reinforcing appropriate behavior on an FR 1 schedule. For four of five participants, problem behavior persisted at levels equal to or greater than the level of appropriate behavior when the FR schedule for both responses was the same. For one participant, an FR 2 schedule for problem behavior was sufficient to differentially select appropriate behavior and eliminate problem behavior, and for a second participant an FR 3 schedule for problem behavior was sufficient. For two remaining participants, however, problem behavior persisted at levels greater than the level of appropriate behavior until a schedule of FR 20 was reached. The results of the Worsdell et al. (2000) study suggest that the relative ratio necessary to suppress problem behavior is likely to be idiosyncratic and do not suggest that simply arranging an FR 1 schedule for the alternative response guarantees that it will occur more frequently than occasionally reinforced problem behavior.

The second reason why it may be safer to forego intermittent schedules of reinforcement for problem behavior in favor of a continuous reinforcement schedule is that ignoring or implementing extinction for initial instances of problem behavior is likely to result in the occurrence of more severe behavior (Lieving et al., 2004; MaGee & Ellis, 2000). In a recent investigation, Warner et al. (2019) began a functional analysis by reinforcing the first topography of behavior that was observed, which in many cases was a form of vocalization. Then across successive sessions, the researchers implemented extinction for the previously reinforced form of problem behavior and reinforced any other topography that occurred. While the exact topographies observed varied across participants, the order of observed responses tended to escalate from less severe (e.g., whining or negative vocalizations) to more severe (aggression, self-injurious behavior or SIB). This pattern also demonstrated by MaGee & Ellis (2000) and Lieving et al. (2004) may be an outcome of child effects during the planned implementation of extinction. Earlier less-severe responses are easy to ignore and reinforce the caregiver's behavior of continuing to withhold reinforcement and prompting an alternative response. When these responses encounter extinction, the child engages in more severe forms of behavior, which in turn punish the caregiver's efforts and ultimately produce reinforcement anyway. If the more severe form of behavior has the potential to cause injury (e.g. aggression in the form of biting or hair-pulling, SIB in the form of intense head-banging or eye-gouging), it may be safest to reinforce any problem behavior on an FR 1 schedule and instead focus therapeutic efforts on bolstering the reinforcement arranged to establish and support a robust and persistent adaptive repertoire.

Although DRA without extinction in which at least one parameter varies in favor of appropriate behavior tends to be effective when both appropriate behavior and problem behavior are reinforced on an FR 1 schedule (Hoch et al., 2002; Lalli et al., 1999; Slocum et al., 2015; Piazza et al., 1997), arranging a continuous reinforcement schedule for the alternative response may yield harmful outcomes for the client and/or caregivers. A client who is taught to request a break from tasks in the absence of other

interventions may choose to participate minimally in educational instruction, activities of daily living important for her health and hygiene, or medical demands (Marcus & Vollmer, 1995). A child with problem behavior maintained by access to electronic devices whose mands for the item are continuously reinforced may engage with the device to the exclusion of engagement in other activities, such as meaningful social interaction, physical exercise, or educational instruction. A child who is taught to politely request her father's attention may do so excessively and despite her father being available to attend to her. Thus, it is essential that when designing DRA interventions without extinction, there must be consideration for how schedules of reinforcement will be thinned without producing increases in problem behavior which will necessarily be reinforced.

Schedule thinning may entail operating multiple schedules in which periods of reinforcement for the alternative response are alternated with periods of extinction (Hanley et al., 2001) or gradually fading a response requirement (e.g., compliance with tasks) before accessing reinforcement (Hoch et al., 2002; Ghaemmaghami et al., 2016; Piazza et al., 1996). The term *resurgence* describes the reoccurrence of a previously reinforced response when a more recently reinforced response encounters extinction (Epstein, 1983) and has been used to describe the increases in problem behavior observed during schedule thinning after functional communication training (FCT). In a retrospective investigation of the prevalence and characteristics of resurgence, Briggs et al. (2018) found that resurgence occurred during schedule thinning in 76% (N=25) of cases in a study in which destructive behavior maintained by socially mediated reinforcement was treated with FCT plus extinction (Greer et al., 2016). Perhaps due to the fact that problem behavior that resurged did not contact reinforcement, resurgence was observed only temporarily and appeared to be a transient outcome of the thinning procedure. In cases where problem behavior does contact the maintaining reinforcer (as in DRA without extinction), resurgence may be of particular concern because problem behavior might be expected to persist during thinning and interfere with efforts to decrease the total amount of reinforcement the client consumes (Brown et al., 2020; St.

Peter Pipkin, Vollmer, & Sloman, 2010). Further research is warranted on identifying effective strategies for minimizing the likelihood of resurgence during schedule thinning of DRA without extinction.

In resurgence experiments, the sequence of conditions typically begins with reinforcement of a target response (analogous to reinforcing problem behavior during FA), followed by reinforcement of an alternative response while discontinuing reinforcement for the target response (analogous to DRA with extinction), and concluded by a resurgence test in which both responses are placed on extinction and levels of both responses are observed (Volkert et al., 2009). The resurgence test may be viewed as an approximation of what occurs during schedule thinning following DRA. When reinforcement is discontinued for the alternative response, either due to a time-based delay as in multiple schedules or due to the presentation of an alternative task as in response-based fading, the previously reinforced alternative response is encountering extinction. This three-phased approach can be an efficient method for evaluating strategies to decrease the probability of resurgence during schedule thinning (St. Peter, 2015). A few recent translational studies (Diaz-Salvat et al., 2020; Lambert et al., 2015) and a recent study conducted with children with problem behavior (Lambert et al., 2017) show that establishing and reinforcing multiple alternative responses during the DRA with extinction phase decreases the magnitude of resurgence of the target response. In a problem behavior treatment paradigm, entering multiple response topographies into the response class with problem behavior may increase the likelihood that one of those alternative responses resurges during the resurgence test rather than problem behavior. In the treatment of problem behavior without extinction where resurging problem behavior will contact reinforcement and be likely to maintain, this arrangement may be promising only if after carefully considering the arrangement of relative reinforcement contingencies for multiple concurrent operants.

The present study expands on previous research in two ways: first, we extended recent research on serially reinforcing multiple response forms (e.g., manding and task completion) to decrease

resurgence; second, we compared the effectiveness of single and concurrent DRA schedules on decreasing the probability of resurgence when problem behavior continues to produce reinforcement.

Method

Participants, Setting, and Materials

All participants attended a residential school for individuals with ASD and developmental disabilities and were receiving behavior-analytic services for skill acquisition and problem behavior reduction. Sessions were conducted in each participant's familiar classroom, their bedroom, or a quiet area of their residence. Session areas were equipped with a desk and chair, a recording device, and tripod. Based on recommendations from his treatment team, Liam's sessions were conducted while he was seated on his bed. Materials associated with relevant conditions, such as reinforcers and visual stimuli, will be described in Procedures.

Graduate students enrolled in doctoral- or masters-level coursework in behavior analysis functioned as therapists and data collectors.

Declan was a white 14-year-old male diagnosed with autism spectrum disorder (ASD). Declan displayed vocal protesting and aggression. Declan communicated vocally in 3- to 5-word utterances and using gestures to indicate choices between concurrent options. Levi was a white male who was 10-years-old and was also diagnosed with ASD. Levi displayed vocal protesting, aggression, and self-injurious hits to his body. Levi communicated vocally in short phrases and sentences. Liam was a white 19-year-old male diagnosed with ASD and obsessive compulsive disorder. Liam displayed screaming and self-injurious hits to his body. Liam communicated in vocal approximations and by writing simple words. Owen was a white 19-year-old male diagnosed with ASD. Owen displayed screaming and self-injurious hits to his head.

Response Measurement and Interobserver Agreement

The primary dependent measures were problem behavior (responses per min), mands (responses per min), and task completion (% of trials). Specific forms of problem behavior varied across

participants. *Aggression* was defined as any instance of the participant grabbing, hitting, pinching, pushing, or biting directed towards the therapist. *Self-injurious behavior* (SIB) was defined as any instance of the participant hitting their head or body with an open or closed fist, closing their teeth around any part of their body, or hitting their head or part of their body against another object. *Vocal protesting* was defined as any instance of the participant saying or yelling "No" following a vocal directive or when task materials were presented. *Screaming* was defined as any instance of the participant emitting a high-pitched vocalization, which may or may not be paired with crying, and which had been followed by at least 1 s of no vocalizations. *Mands* were defined as the participant touching a picture communication card. *Task completion* was defined as the participant behaving in accordance with a directive from a therapist following the first or second prompt.

Observers watched recorded videos of sessions using a laptop computer or touch-screen smartphone software (InstantData or Countee©) which summarized data within 10-s bins. Data were collected on the frequency of each topography of problem behavior, and response rate was calculated by dividing the total frequency of all problem behavior by the session duration (min). Data were collected on the frequency of mands, and response rate was calculated by dividing the total frequency of mands by the session duration (min). Percentage of tasks completed was calculated by dividing the frequency of task completion with the total number of tasks presented during the session and multiplying by one hundred.

To assess interobserver agreement (IOA), two observers independently viewed videos and collected data on target responses during at least 33% of sessions in each phase and condition. Interobserver agreement for problem behavior, mands, and task completion was calculated using the proportional method in which data from each session were divided into 10-s bins, and the smaller number of responses recorded by one observer was divided by the larger number of responses observed by the second observer within the same interval and multiplied by 100. Mean agreement was then

calculated across intervals, and mean agreement across sessions was calculated for each response. Agreement for problem behavior during the FA averaged 96% (range, 89% to 100%) for Declan, 100 % for Levi, 99% (range, 99% to 100%) for Liam, and 98% (range, 97% to 100%) for Owen. Agreement for task completion during the FA averaged 94% (range, 92% to 97%) for Declan and 98% (range, 97% to 100%) for Levi. Task completion was not measured during the FA for Owen and Liam. Agreement for problem behavior during the treatment analysis averaged 98% (range, 92% to 100%) for Declan, 97 % (range, 76% to 100%) for Levi, 100% for Liam, and 99% (range, 95% to 100%) for Owen. Agreement for mands during the treatment analysis averaged 98% (range, 87% to 100%) for Declan, 95 % (range, 87% to 100%) for Levi, 98% (range, 93% to 100%) for Liam, and 98% (range, 90% to 100%) for Owen. Agreement for task completion during the treatment analysis averaged 94% (range, 81% to 100%) for Declan, 97 % (range, 84% to 100%) for Levi, 97% (range, 91% to 100%) for Liam, and 96% (range, 88% to 100%) for Owen.

Procedure

Pre-experimental Assessments

The purpose of the pre-experimental assessments was to determine the maintaining reinforcer for each participant's problem behavior and to identify several positive reinforcers that would be differentially delivered following appropriate responses.

Functional Analysis.

To determine which establishing operations and reinforcers to test during the FA, an experimenter interviewed two members of each participant's treatment team by asking a series of open- and closed-ended questions. Declan and Levi's clinicians reported that they had previously conducted FAs that indicated problem behavior was maintained by escape from demands. When interviewing their treatment team, the experimenter administered the Negative Reinforcement Rating Scale (NRRS; Wiggins & Roscoe, 2019) to determine which demands to include in the test condition of

the FA. Liam and Owen's clinicians reported that they had previously conducted FAs that indicated problem behavior was maintained by access to tangible items. When interviewing their treatment teams, the experimenter administered an open-ended functional assessment (Hanley, 2012).

For all participants, a functional analysis was conducted consisting of a single test condition and matched control condition which were informed by the results of the previously described interviews (Iwata et al., 1994; Hanley, 2012). This method was selected over traditional multiple-test methods (e.g., Iwata et al., 1982/1994; Iwata & Dozier, 2008) for assessment efficiency (see Hanley, 2012 for a discussion) and because all participants had FAs previously conducted by their respective treatment teams. Escape from demands was tested with Declan and Levi, and access to tangibles (an iPad) was tested for Liam and Owen. All FA sessions were 5 min in duration.

In the test condition of the FA testing for escape from demands, the therapist approached the participant and begin delivering demands. If the participant did not comply with the demand within 3 s, the therapist delivered the demand again accompanied by a model prompt. If the participant still did not comply following the model prompt, the therapist delivered a third prompt accompanied by physical guidance. For demands that could not be physically prompted (e.g., "spell CAT"), the therapist simply repeated the prompt a third time. If the participant complied with the demand, the therapist delivered brief, neutral praise (e.g., "That's right") and presented the next demand. Problem behavior at any point during the demand resulted in the therapist terminating the demand and removing materials (if applicable) for 30 s. Problem behavior during the escape period was ignored. In the control condition for the escape FA, the therapist did not initiate any interactions with the participant and ignored problem behavior if it occurred (Fahmie et al., 2013).

Prior to conducting the test condition of the tangible FA, the therapist delivered the putative reinforcer (iPad) for 2 min. At the onset of the session, the therapist removed the iPad and ignored mands for the iPad if they occurred. If the participant engaged in any problem behavior, the therapist

delivered the iPad for 30 s. Problem behavior during the reinforcement period was ignored. In the control condition, the participant was given access to the iPad at the start of the session, and the therapist remained in proximity to the participant but did not initiate any interactions with the participant.

Preference Assessment.

A paired-stimulus preference assessment (Fisher et al., 1992) was conducted with each participant to identify a few reinforcers to deliver differentially contingent on appropriate responses in subsequent treatment conditions. Each preference assessment consisted of eight items with which each participant had previous exposure. For Declan, Levi, and Liam, items were a combination of four leisure stimuli and four edibles. For Owen, four edibles and four drink items were assessed. A ninth item was added into the assessment for Levi halfway through the treatment phase due to a lack of effectiveness of earlier identified reinforcers. The ninth item (Kindle) was tested by presenting the item concurrently with each of the eight other items twice. Percentage selection was calculated by summarizing the number of trials in which the participant selected each item, divided by the total number of trials in which each item was presented, and multiplied by 100.

Mand Training

Declan, Levi, and Liam typically communicated vocally, while Owen typically communicated using picture-based systems. Each participant was taught a card-touch response to ensure that we could easily prompt (i.e., vocally present demands and point to the mand card simultaneously) and gain control over manding within the experimental arrangement. For all participants, a prompt fading procedure was used to gradually introduce the relevant establishing operation and gradually reduce the therapist's prompts. The purpose of this procedure was to minimize the occurrence of problem behavior during teaching while simultaneously strengthening the alternative response (see Table 2). Across all trials, the schedule of reinforcement for problem behavior was FR 1, resulting in 30-s access to the

maintaining reinforcer (escape for Declan and Levi; the iPad for Owen and Liam). The consequence for both prompted and unprompted mands was 30-s access to the maintaining reinforcer plus the delivery of one moderate-quality (MQ) item from the preference assessment. Additional reinforcement was arranged for the mand to ensure that manding would maintain over problem behavior (Athens & Vollmer, 2010). The therapist advanced to the next prompt level after consecutive trials in which the participant emitted a mand (prompted or unprompted) in the absence of problem behavior and returned to the previous prompt level if problem behavior occurred on three consecutive trials. In trials with no prompts, the therapist continued delivering the establishing operation until either problem behavior or manding occurred. Mand training trials were conducted until each participant emitted 10 unprompted mands in the absence of problem behavior.

For Declan and Levi, the mand card was green and displayed the word “BREAK” in large printed white letters above an illustration of a stick-figure putting their feet up on a table. The antecedent condition was the same as during the FA.

For Owen and Liam, the mand card was green and displayed the word “iPAD” in large printed white letters above a picture of an iPad. The antecedent condition was the same as the FA, except that the participant was also prompted to complete tasks. The purpose of presenting tasks while prompting a mand for the iPad was to ensure that manding would be strengthened in the context of receiving instructions which would occur during the concurrent DRA phase later in the study. During these trials, the therapist presented gross motor instructions (e.g., “touch your shoulders”) while simultaneously prompting the mand for the iPad. Tasks were not presented during the reinforcement period to avoid inadvertently evoking problem behavior by interfering with the participant’s access to the reinforcer.

Alternative Response Establishment

The purpose of this phase was two-fold: to reinforce two qualitatively distinct alternative responses (task completion and manding) in the presence of condition-correlated stimuli, and to

independently verify the effectiveness of each type of DRA on reducing problem behavior without extinction. Across both conditions, problem behavior continued to produce 30-s access to the maintaining reinforcer on an FR 1 schedule, and all sessions were 5 min. Reinforcement for the alternative responses and problem behavior were arranged concurrently and mutually exclusive of each other, such that if problem behavior occurred at the same time that the participant was touching the mand card or complying with a demand, the therapist only delivered reinforcement for problem behavior. Context 1 and Context 2 were conducted in alternation until the alternative response in each context maintained in the absence of problem behavior for three consecutive sessions.

Context 1. In DRA (task completion) sessions, the therapist wore a red t-shirt, and the mand card was absent from the room. The therapist began the session by presenting demands. If the participant complied with the demand, the therapist delivered the maintaining reinforcer plus two high-quality (HQ) reinforcers for 30-s. The purpose of using HQ reinforcers was so that task completion would be differentially reinforced over manding when the two responses would be reinforced concurrently (see below).

Context 2. In DRA (mand) sessions, the therapist wore a green t-shirt and placed the mand card near the participant. The therapist began the session by presenting demands. If the participant complied with the demand, the therapist delivered brief, neutral praise (e.g., “You’re right”) and continued presenting the next demand. If the participant touched the mand card, the therapist delivered the maintaining reinforcer plus the MQ reinforcer for 30-s.

Single vs. Concurrent DRA Without Extinction

The purpose of this phase was to associate Context 2 with a concurrent schedule of reinforcement for both alternative responses, which would serve as the test condition for the relative likelihood of resurgence in the treatment challenge (described below). Context 1 was the same as in the previous phase. Context 2 was the same as described above, except that task completion now produced

reinforcement. Manding continued to produce the maintaining reinforcer plus one MQ reinforcer, and task completion resulted in 30-s access to the maintaining reinforcer plus two HQ reinforcers. The concurrent reinforcement schedules were mutually exclusive, such that if the participant emitted both responses, the therapist reinforced whichever response occurred first. For example, if the demand was "Write your name," and the participant began writing but then touched the mand card before finishing his full name, the therapist delivered reinforcement for the mand. If the participant complied with the demand (e.g., "Spell CAT," "C-A-T") and then touched the card, the therapist delivered reinforcement for task completion.

Treatment Challenge

This phase served to approximate the extinction that occurs when reinforcement schedules for alternative responses are thinned following DRA. One approach to schedule thinning is to gradually increase the number of tasks the participant is required to complete before receiving reinforcement (e.g., chained schedules or demand fading). For the purpose of rapidly assessing whether the single or concurrent DRA schedule would decrease the probability of resurgence when an alternative response encounters extinction, task completion was placed on extinction in both conditions in this phase.

Context 1. The stimulus conditions in Context 1 were the same as described above, and task completion no longer resulted in access to the maintaining reinforcer or HQ reinforcers. If the participant complied with the demand, the therapist delivered brief praise and continued with the next demand. Problem behavior produced 30-s access to the maintaining reinforcer.

Context 2. The stimulus conditions in Context 2 were the same as in the previous phase, and task completion no longer resulted in reinforcement. Problem behavior continued to produce 30-s access to the maintaining reinforcer.

Results

Pre-experimental Assessments

Results of each participant's functional analysis are displayed in Figure 1. For all participants, problem behavior was elevated in the test condition (escape from demands for Declan and Levi; access to tangibles for Liam and Owen) and was low or zero in the matched control condition.

Results of each participant's preference assessment are displayed in Figure 2, and the identified reinforcers are displayed in Table 1. The most-selected edible item and most-selected leisure item from the array were designated as HQ reinforcers for Declan, Levi, and Owen. The leisure item that was selected less often than both HQ reinforcers was designated as a MQ reinforcer. For Liam, the most-selected edible item and most-selected drink item were designated as HQ reinforcers, and the drink item that was selected less often than both HQ reinforcers was designated as a MQ reinforcer. Drinks were included instead of leisure items because his treatment team suggested that he was unlikely to interact with any other leisure items while also accessing his iPad. Since the additional reinforcement would be delivered together with the maintaining reinforcer, we selected drinks to increase the likelihood that Liam would consume the additional reinforcers together with the maintaining reinforcer (iPad).

For Levi, a box of small toys and trains were selected equally as often, so the trains and cheese cracker were designated as HQ reinforcers and the busy box was selected as a MQ. However, this arrangement of HQ reinforcers delivered contingent on task completion was insufficient to suppress problem behavior during the DRA without extinction, so an additional item (Kindle) was added into the array which Levi selected over the eight other items in 100% of trials. The Kindle and cheese cracker were then designated as HQ reinforcers and were delivered contingent on task completion (marked by "new reinf." in the top panel of Figure 5).

Mand Training

Results of each participant's mand training are plotted as a cumulative record of responses across trials in Figure 3. All three participants eventually acquired the card-touch mand and emitted the mand in the absence of problem behavior across 10 consecutive trials.

DRA Without Extinction, Single vs. Concurrent DRA, and Treatment Challenge

The results of Declan's treatment analysis are displayed in Figure 1. Data from the test condition of the functional analysis serve as a baseline for levels of problem behavior maintained by escape from demands. In the second phase, Context 1 and Context 2 were conducted in alternation, and both types of DRA resulted in decreases in problem behavior relative to baseline. Percentage of tasks completed are plotted in the middle panel. Declan complied with 100% of tasks in Context 1 (where task completion produced escape and two HQ reinforcers) relative to variable and moderate levels of task completion in Context 2, in which no reinforcement was arranged. Mands producing escape and a MQ reinforcer occurred at stable rates in Context 2. In the third phase, Context 1 remained the same while both DRAs were arranged concurrently in Context 2., which resulted in an increase in task completion and decrease in mands in Context 2. In the treatment challenge phase, reinforcement for task completion was discontinued in both treatment contexts. Resurgence occurred in both conditions, though at substantially lower levels in Context 2 (previously associated with concurrent DRA). Resurgence in Context 1 also maintained at levels similar to baseline, while resurgence was only briefly observed in the first session of Context 2. Task completion was similar in both conditions, and levels of mands increased in Context 2 relative to the previous phase.

Results for Levi are displayed in Figure 5. The mand DRA in Context 2 initially appeared to be differentially effective at reducing problem behavior relative to the task completion DRA in Context 1. It has been discussed elsewhere that positive reinforcement for compliance is effective at decreasing escape-maintained problem behavior due to competition the value of the positive reinforcer and the aversiveness of demands (Payne & Dozier, 2013). When the new reinforcer was added, task completion

increased to 100% and problem behavior decreased. Task completion was variable and mands occurred at stable rates in Context 2. Results of the treatment challenge were similar for Levi—resurgence occurred in both conditions, but of substantially higher magnitude in Context 1. Resurgence in Context 2, where reinforcement continued to be available for manding, was minimal and did not maintain beyond the first session.

Results for Levi are displayed in Figure 6. Both types of DRA were effective at decreasing problem behavior relative to baseline, and levels of manding and task completion were differentiated according to the relative reinforcement contingencies arranged for each. Resurgence occurred in both contexts but was transient in Context 2, relative to resurgence and maintenance of problem behavior in Context 1.

Results for Owen are depicted in Figure 7. Results of phases two and three were similar to that of other participants. In the treatment challenge, Owen continued complying with tasks at a high rate across both conditions despite reinforcement being discontinued. Resurgence occurred exclusively in Context 1 and initially at very low levels. Because Contexts 1 and 2 were conducted in alternation, and Owen was accessing the iPad in Context 2, we hypothesized that this access may have functioned to abolish the value of the iPad. We then exposed Owen to each context in a reversal design. Resurgence occurred exclusively in Context 1.

Proportion of baseline is depicted in Figure 8 for all four participants and was calculated by dividing the mean rate of problem behavior during each condition of the treatment challenge by the mean rate of problem behavior during the test condition of the functional analysis.

Discussion

The current study replicated previous research showing that multiple alternative responses can decrease the likelihood of resurgence relative to reinforcing a single alternative response (Diaz-Salvat et al., 2020; Lambert et al., 2017). Differential reinforcement of manding and task completion were

effective at decreasing problem behavior without the use of extinction. When reinforcement for one alternative response (task completion) was discontinued, resurgence was avoided or significantly reduced only when reinforcement continued to be available for the second alternative response (manding; see Figure 8).

In studies evaluating resurgence following DRA with extinction, the amount of problem behavior that resurges tends to be impacted by how recently the alternative response was reinforced. In other words, resurgence following DRA with extinction appears to be a transient effect (Muething et al., 2021). The results of the current study expand on previous research by demonstrating that resurgence may persist for longer when problem behavior contacts reinforcement, which may be of particular concern when designing interventions that do not include extinction of problem behavior. The results of this study show that arranging reinforcement for a second alternative response on an FR 1 schedule may be an effective way to avoid resurgence when thinning schedules of reinforcement for task completion, as when implementing chained schedules or demand fading. The present study only compared the effects of single to concurrent DRA without extinction on resurgence but did not directly compare the persistence of resurgence after DRA with and without extinction. Future researchers may be interested to learn whether reinforcing an additional alternative response improves the transiency of resurgence to patterns similar to that which is observed following DRA with extinction.

The treatment challenge arrangement implemented in the current study represents an approximation of what may occur during schedule thinning but is not necessarily representative of a meaningful terminal reinforcement schedule, limiting the generality of the present findings. The purpose of arranging the treatment challenge in this way was to rapidly assess the differences in levels of resurgence between the two conditions. Based on the consistency of outcomes we observed across participants, we can predict that the concurrent-DRA arrangement would likely be effective at reducing the likelihood of resurgence during a typical schedule thinning procedure in which task completion

continues to produce reinforcement according to a gradually increasing FR schedule. A concurrent schedule in which mands and problem behavior are reinforced on an FR 1 but task completion goes unreinforced entirely is unlikely to result in a meaningful level of task completion (e.g., Levi exclusively emitted mands and did not complied with any tasks when reinforcement for task completion was discontinued in Context 2 during the treatment challenge; see figure 2). All four participants continued emitting mands for the maintaining reinforcer in Context 2, which fails to address the challenges associated with continuous reinforcement of an alternative response (i.e., excessive consumption of reinforcers and/or nonparticipation in instruction). Future research may address this limitation by evaluating a concurrent DRA during schedule thinning until a terminal schedule is reached which produces a relative distribution of mands and task completion that meets the needs of the client, their caregiver, and the context in which treatment is occurring.

Another limitation of the present study is that we did not empirically evaluate the relative magnitude or quality of additional reinforcement necessary to select appropriate behavior away from problem behavior. When arranging DRA without extinction, delivering equal reinforcement for both problem behavior and the alternative response is unlikely to be effective (see Trump et al., 2020 for a review). In order to maximize the likelihood of suppressing problem behavior quickly, we manipulated multiple parameters of reinforcement in addition to delivering the maintaining reinforcer. We also arranged higher quality and a greater number of reinforcers for task completion relative to manding. The purpose of this stratification was to: (a) ensure that both responses would maintain over problem behavior, and (b) to increase the likelihood that task completion would occur at higher levels than manding when both schedules were arranged concurrently. As previously described, high-rate manding, especially when reinforced on an FR 1 schedule, can be disruptive to caregivers and ongoing activities. By arranging more reinforcement for task completion in a concurrent-DRA schedule thinning preparation described above, it may be possible to arrive at an outcome in which participants most

often complete tasks, emit an appropriate mand when the establishing operation for the maintaining reinforcer is strong, and be least motivated to engage in problem behavior. The reinforcement intervals in this study were relatively brief (30 s), which can be tedious for caregivers to implement. Thus, more research is needed on determining the necessary and sufficient parameters of differential reinforcement and on identifying practical ways of arranging them within concurrent DRA schedules.

A final limitation is that we delivered demands during treatment for participants with tangible-maintained problem behavior (Liam and Owen), but we did not conduct an FA to determine whether problem behavior may have also been maintained by escape from demands. Thus, we cannot rule out the possibility that problem behavior that resurged during the treatment challenge may have been due to repeated, inescapable exposure to demands rather than due to resurgence of tangible-maintained behavior. However, demands were also presented during earlier phases of the study when levels of problem behavior were low. Problem behavior only resurged and maintained when task completion that was previously producing access to the maintaining reinforcer (iPad) was placed on extinction and in the absence of a concurrently available alternative response (Context 1). Both Liam and Owen also complied with a high percentage of tasks across all phases of the study, even when task completion was not producing reinforcement, suggesting it is unlikely that the tasks themselves were aversive. Alternatively, both participants with escape-maintained problem behavior (Declan and Levi) engaged in lower levels of task completion when it was not producing reinforcement, which may suggest that the tasks were aversive, and the value of escape was increased when additional reinforcement was not arranged.

The results of this study represent a promising method for reducing the likelihood of resurgence when thinning schedules of reinforcement in DRA without extinction. By concurrently reinforcing a mand and gradually thinning the schedule of reinforcement for task completion, it may be possible to maintain treatment effects under leaner and more manageable schedules. The current study also adds to the growing body of evidence supporting the use of DRA in treating severe problem behavior without

the need for extinction, which may be difficult or impossible to implement with integrity under some circumstances. Future researchers should consider assessing the social acceptability of these procedures among caregivers who are likely to implement them, practical schedules of reinforcement, and variables relevant to implementation across different contexts (e.g., home vs. school).

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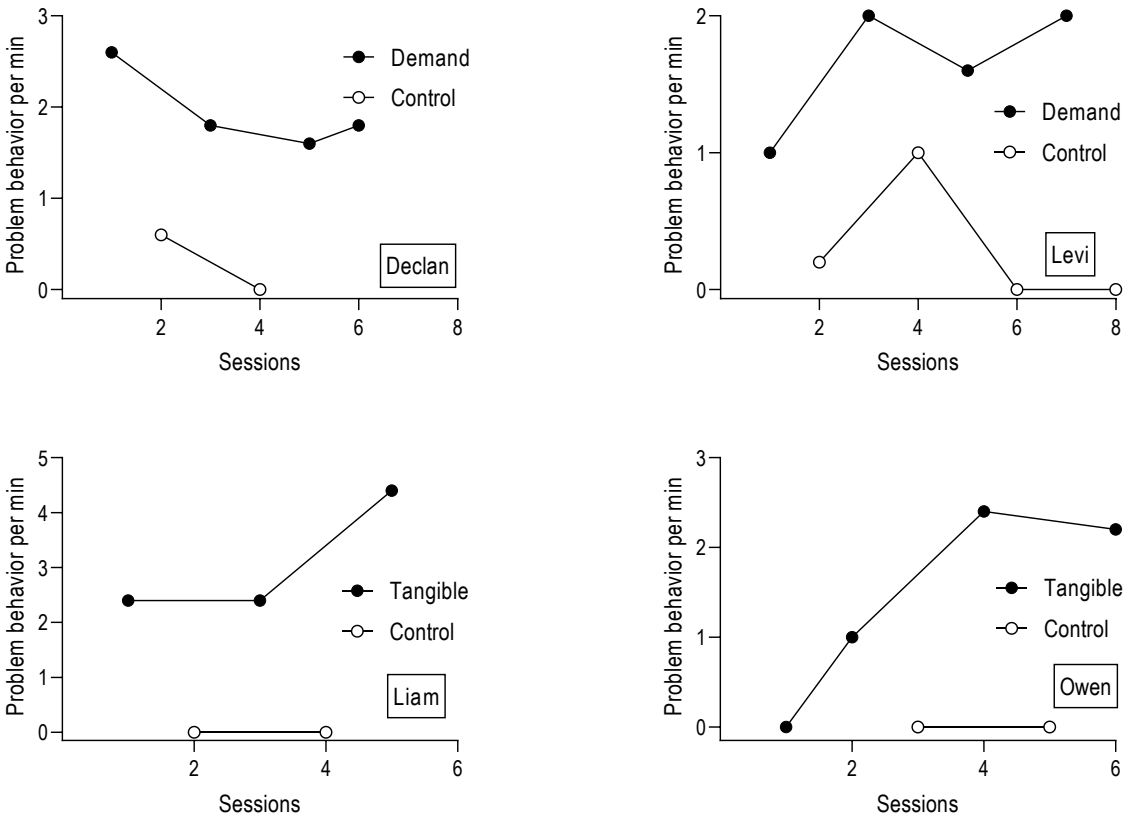

Figure 1. Results from functional analyses for all four participants. Problem behavior in the test condition (closed circles) and in the control condition (open circles) are plotted as responses per min.

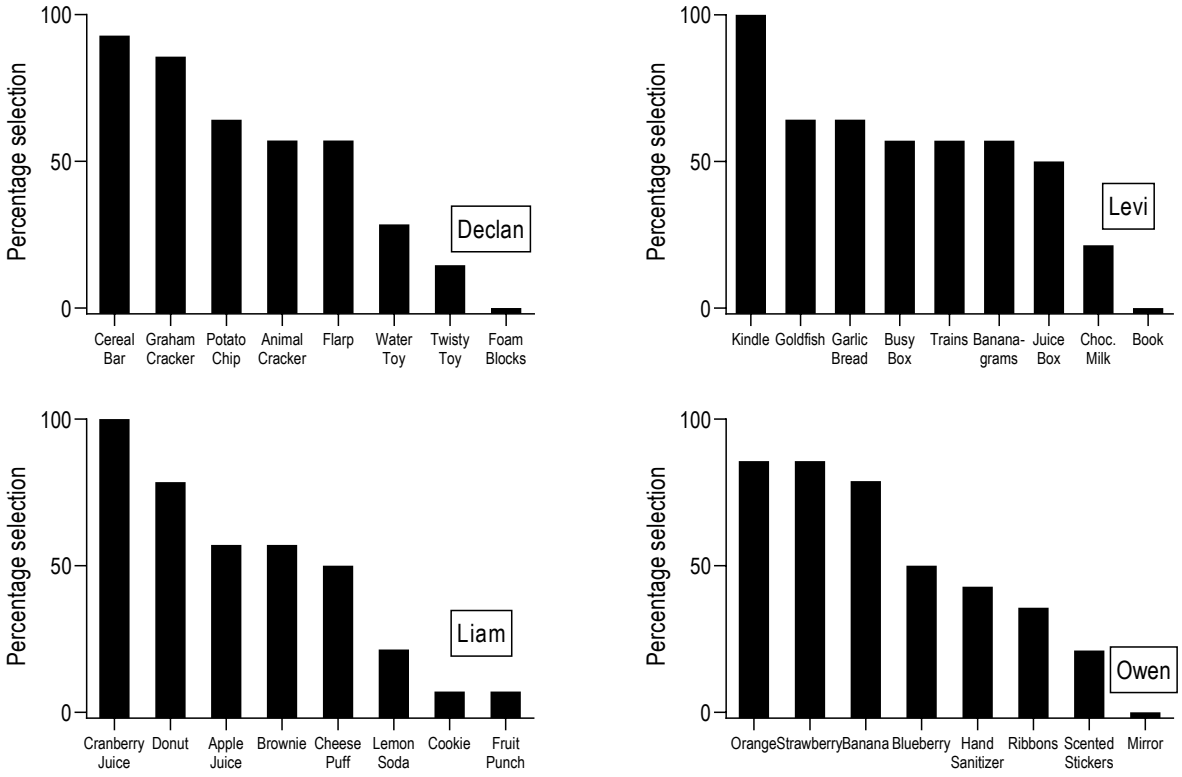

Figure 2. Results from paired-stimulus preference assessments for all four participants. Filled bars represent the percentage of presentations in which the participant selected the item.

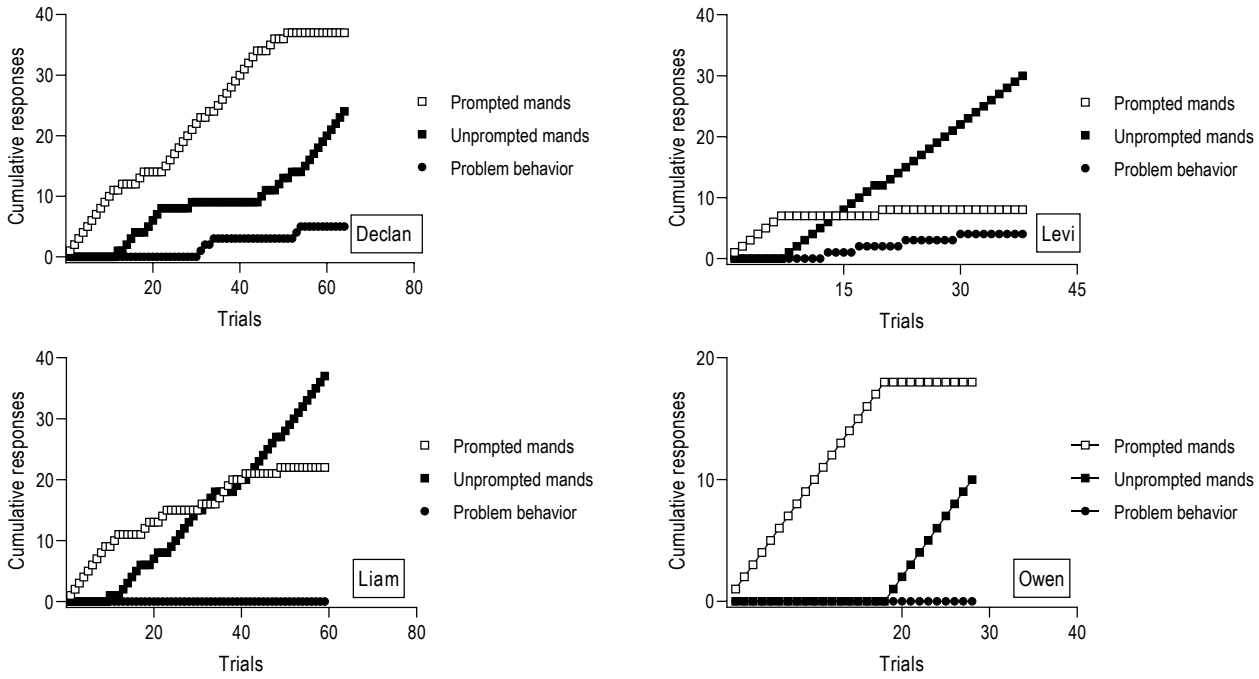

Figure 3. Results from mand-establishment trials for all four participants. The occurrence of prompted mands (open squares), unprompted mands (closed squares), and problem behavior (closed circles) is plotted cumulatively across trials.

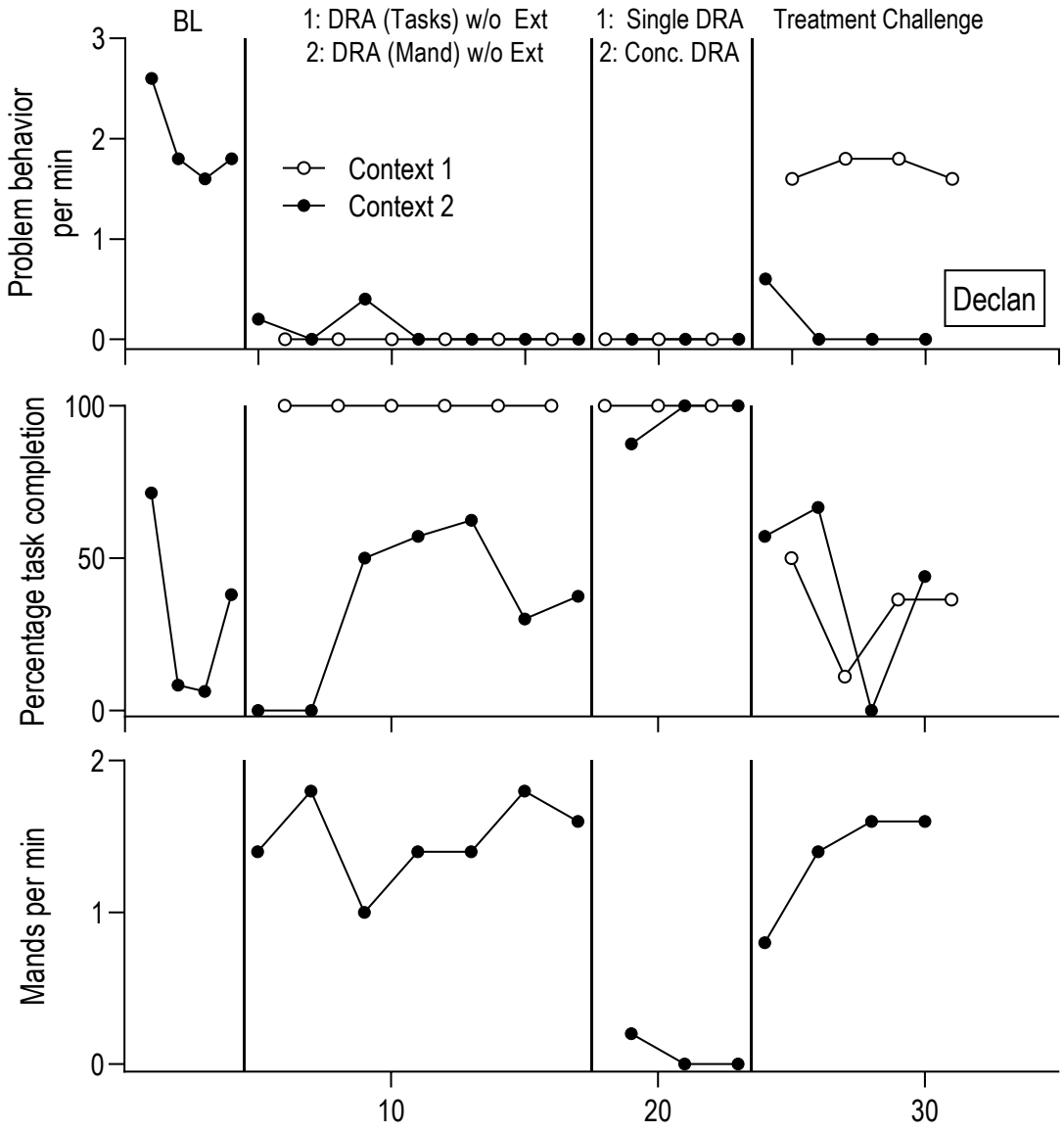

Figure 4. Results of the treatment comparison analysis for Declan. Problem behavior is plotted in the top panel as responses per min across context 1 (open circles) and context 2 (closed circles). Percentage of trials with task completion are plotted in the middle panel. In the bottom panel, mands are measured and plotted for context 2 only.

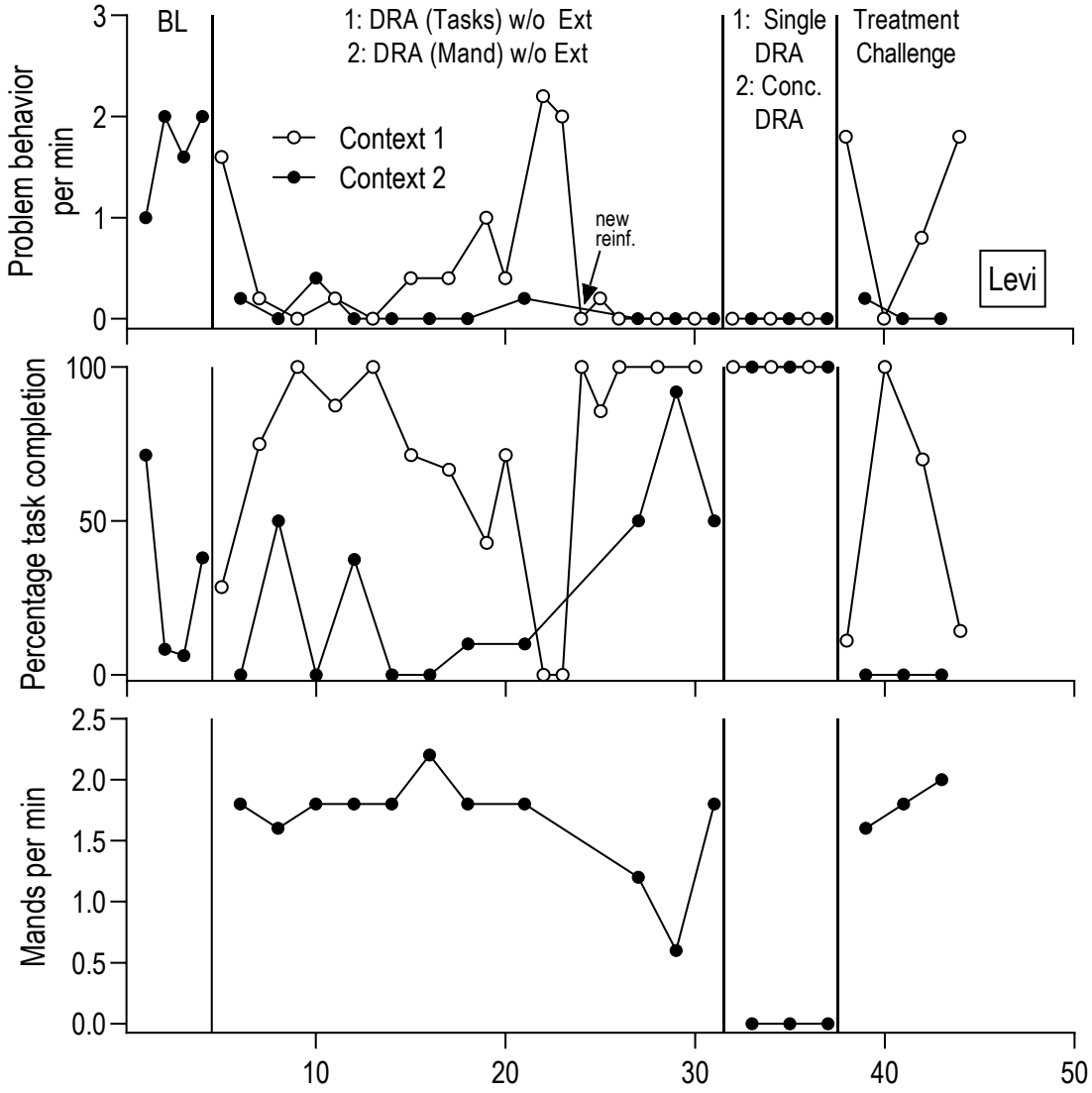

Figure 5. Results of the treatment comparison analysis for Levi.

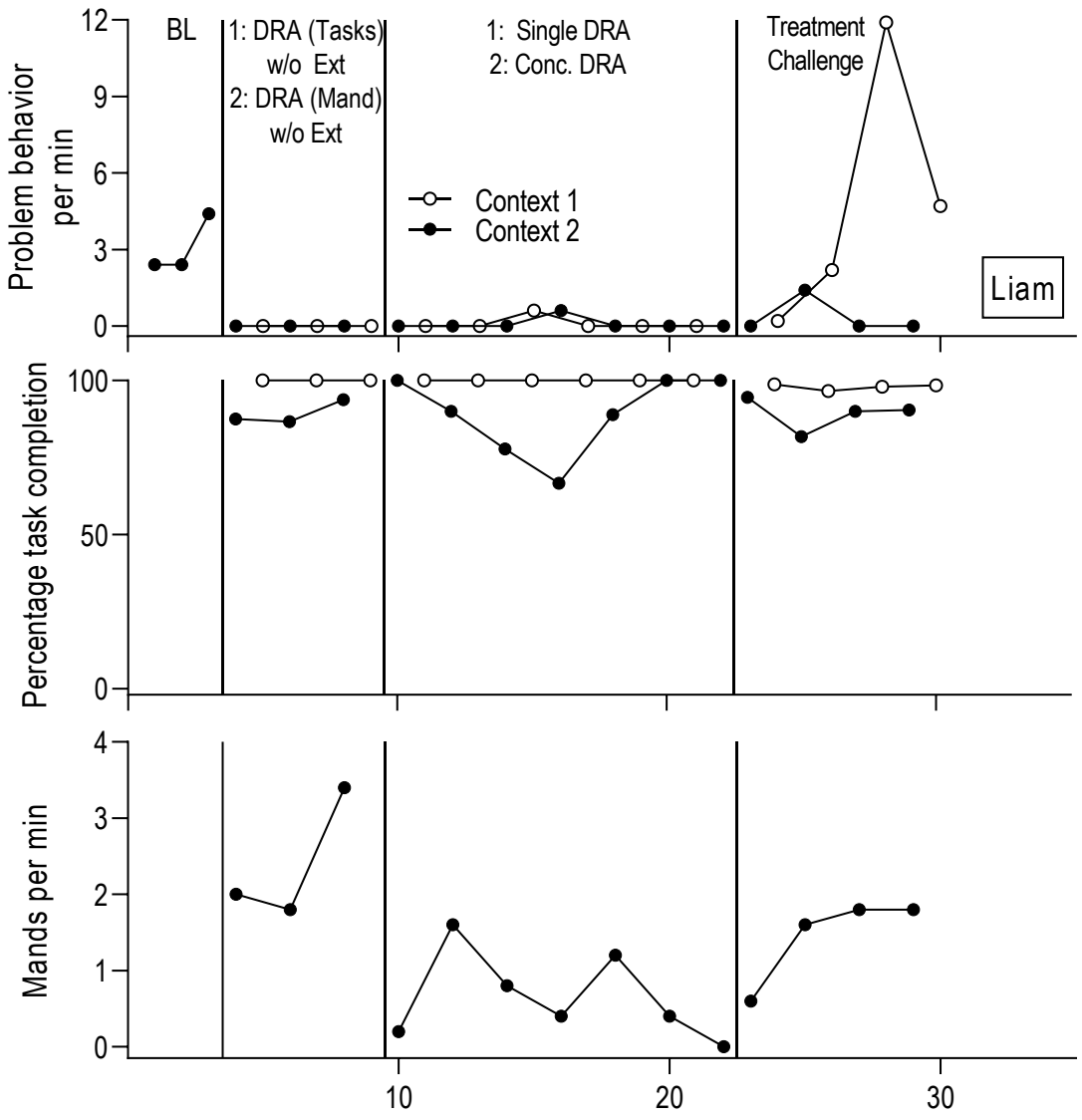

Figure 6. Results of the treatment comparison analysis for Liam.

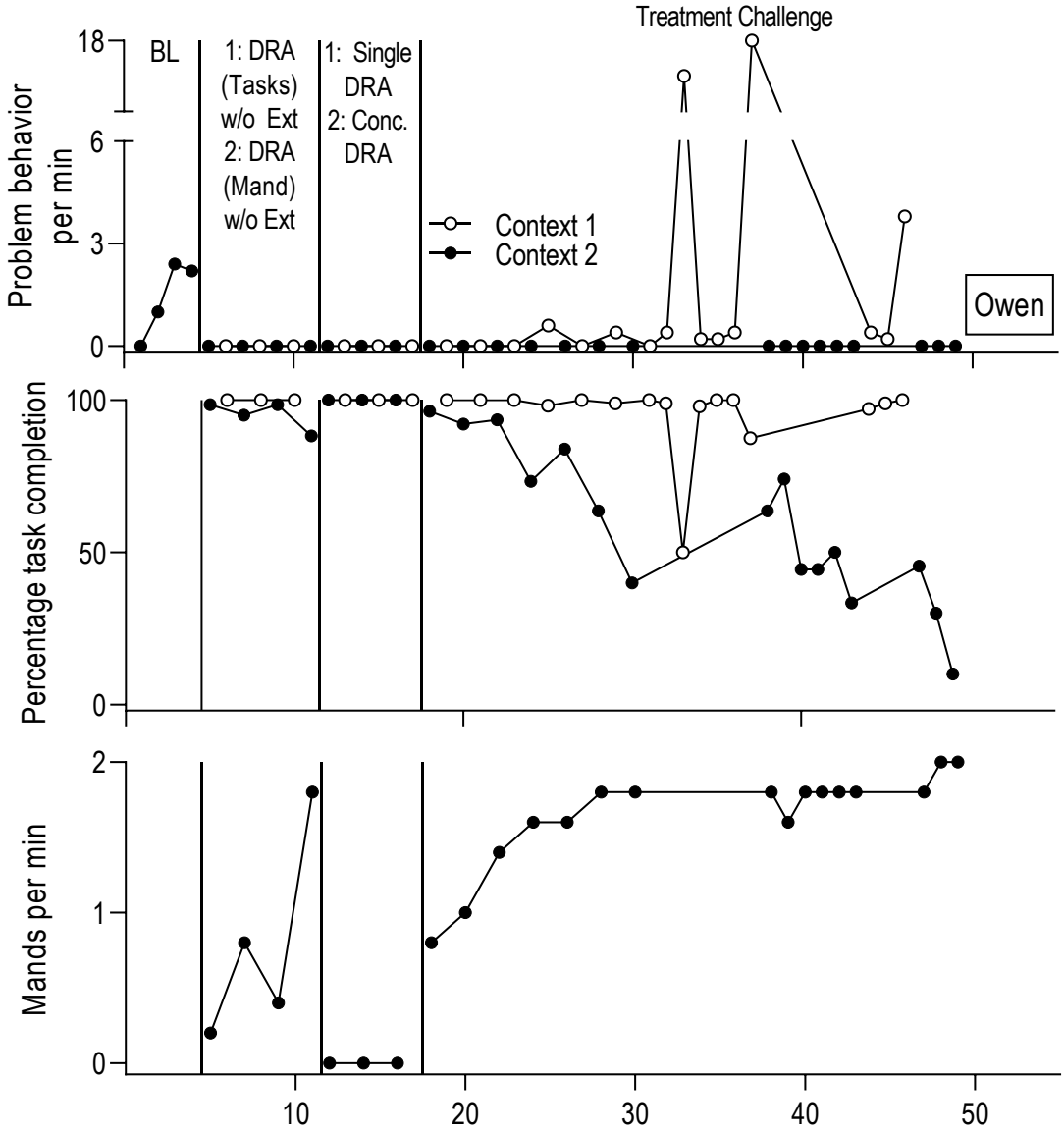

Figure 7. Results of the treatment comparison analysis for Owen.

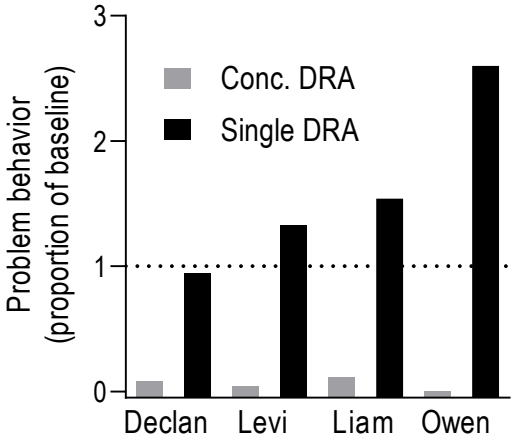

Figure 8. The dotted horizontal line represents a value of 1, whereby the rate of problem behavior during the treatment challenge is exactly equal to the rate of problem behavior during baseline. Bars below the line indicate a decrease in problem behavior during the treatment challenge compared to baseline, and bars above the line indicate problem behavior increased during the treatment challenge relative to baseline.

Table 1

Participant Characteristics and Identified Reinforcers

		Problem Behavior		Differential Reinforcement	
Name	Age	Topographies	Maintaining reinforcer	HQ	MQ
Declan	15	Aggression, protesting	Escape	Cereal bar, water toy	Slime
Levi	10	Aggression, SIB, protesting	Escape	Kindle, cheese cracker	Busy box
Liam	19	SIB, screaming	Tangible	Cranberry juice, donut	Apple juice
Owen	19	SIB	Tangible	Lotion, orange slice	Ribbon

Table 2

Prompt Fading Procedure for Establishing Mands

Step		Establishing Operation	Point Cue
1			
	Tangible	Remove iPad	Simultaneous
	Escape	None	Immediate
2			
	Tangible	Remove iPad + Present demand	1-s delay
	Escape	Present demand	
3			
	Tangible	Remove iPad + Present demands	2-s delay
	Escape	Present demands	
4			
	Tangible	Remove iPad + Present demands	3-s delay
	Escape	Present demands	
5			
	Tangible	Remove iPad + Present demands	No prompt
	Escape	Present demands	