PARAMETRIC EVALUATION OF THE DIFFERENTIAL REINFORCEMENT OF ALTERNATIVE BEHAVIOR PROCEDURE

By

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The purpose of this study was to determine if children who exhibit problem behavior would allocate responding according to the differences in reinforcement following appropriate and problem behavior. Relative reinforcer values were manipulated in relation to the parameters of reinforcement using a differential reinforcement of alternative behavior (DRA) procedure without an extinction (EXT) component. A total of 6 individuals diagnosed with developmental disabilities who engaged in severe problem behavior participated.

In Experiment I, functional analyses were conducted for all 6 participants to identify the reinforcers for problem behavior. Results showed that problem behavior was sensitive to social positive reinforcement in the form of access to tangible items for two participants and access to attention for one participant, social negative reinforcement in the form of escape from instructional demands for two other participants, and social positive reinforcement in the form of attention and social negative reinforcement in the form of escape from instructional demands for the sixth participant. Two individuals participated in each subsequent experiment. In Experiments II-V, concurrent variable-interval (VI) schedules of reinforcement were in place for problem and appropriate behavior. In Experiment II, problem behavior resulted in access to a relatively lower quality reinforcer, and appropriate behavior in access to a relatively higher

quality reinforcer. In Experiment III, problem behavior resulted in a relatively shorter duration of access to a reinforcer and appropriate behavior in a relatively longer duration of access to a reinforcer. In Experiment IV, problem behavior was followed by reinforcement after a delay, and appropriate behavior resulted in immediate access to a reinforcer. In Experiment V, problem behavior resulted in delayed access to a relative lower quality reinforcer for a shorter duration, and appropriate behavior resulted in immediate access to a relatively higher quality reinforcer for a longer duration. Results showed that problem behavior was reduced even though extinction was not in effect.

CHAPTER 1
INTRODUCTION

Overview

Differential reinforcement is a fundamental principle of behavior analysis that has led to the development of a set of procedures used as treatment for problem behavior (Cooper, Heron, Heward, 1987). One of the most frequently used of these procedures is the differential reinforcement of alternative behavior procedure (DRA). Differential reinforcement of alternative behavior typically involves withholding reinforcers following problem behavior (extinction, EXT), and providing reinforcers following appropriate behavior (Deitz & Repp, 1983). An example of a DRA treatment might involve ignoring the behavior of a child who is throwing his toys, and providing attention following an appropriate behavior, such as when the child says, “Let’s play.” The success of DRA treatments appears to be at least partially dependent on pre-treatment identification of the reinforcers maintaining problem behavior. Identifying reinforcers allows EXT procedures to be effectively utilized in that the therapist will know which reinforcer or reinforcers to withhold following the occurrence of problem behavior (Iwata, Pace, Cowdery, & Miltenberger, 1994). In addition, the same reinforcer can be delivered contingent on the occurrence of an alternative, more appropriate response. Under these conditions DRA procedures have been largely successful at reducing problem behavior (Vollmer & Iwata, 1992). When the response-reinforcer contingency is not severed following problem behavior, however, DRA has been found to be less effective at decreasing problem behavior (Fisher et al., 1993; Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998).

While EXT is an important and powerful component in the DRA procedure, it is unfortunately not always possible to implement EXT. Of prime concern are cases in which treatment integrity failures with EXT may be inevitable. For example, in the event of escape-maintained behavior, a caregiver may be physically unable to prevent escape with a large or combative individual, leading to compromises in treatment integrity. Similarly, it would be difficult to completely withhold reinforcement for behavior maintained by attention in the form of physical contact if physical blocking is required to protect the individual or others. For example, if an individual's attention-maintained eye gouging is a threat to his eyesight, caregivers may have to intervene in order to protect his vision. It is also likely that in the natural environment, caregivers may not always implement EXT procedures accurately (Shores et al., 1993).

Given the potential integrity failures associated with implementing EXT, several researchers have examined variations of the DRA procedure that exclude the EXT component. Differential reinforcement procedures have been conceptualized in terms of a concurrent-operants arrangement (e.g. Fisher et al., 1993; Mace & Roberts, 1993). Concurrent schedules are two or more schedules simultaneously in effect. Each schedule independently arranges reinforcement for different responses (Ferster & Skinner, 1957). In this arrangement an individual can engage in either an appropriate response or problem behavior to produce the same reinforcer. When the rate and immediacy of reinforcement of the two responses are equivalent under this arrangement, the response that is less effortful should occur. Research has indicated that the appropriate response is not necessarily the less effortful (Hagopian et al., 1998; Horner & Day, 1991). Thus, several researchers have manipulated the parameters of reinforcement such that the consequences following appropriate behavior are of a greater value along some dimension than the consequences following problem behavior (Piazza, 1999). Variables that have been shown to affect relative response rates in concurrent-operants arrangements include response effort or difficulty, and reinforcer delay, amount, rate, magnitude, and quality (Mazur, 1994). Research evaluating the effectiveness of parametric manipulations of reinforcement during DRA procedures has been mixed, such that additional research is required (Hoch, McComas, Thompson, & Paone, 2002; Piazza et al., 1999). The present study was designed to evaluate DRA when providing some combination of higher quality, longer duration, or more immediate reinforcers for appropriate behavior relative to some combination of lower quality, shorter duration, or less immediate reinforcers for problem behavior. In the event that initial parametric manipulations failed to result in a therapeutic decrease in problem behavior, further experimental manipulations were conducted in order to increase the difference between reinforcement following appropriate behavior and reinforcement following problem behavior.

Historical Overview

In one early example of a differential reinforcement procedure without a programmed EXT component, Russo, Cataldo, and Cushing (1981) examined the effects of providing reinforcement following compliance to requests and following problem behavior. In baseline conditions, no consequences were provided following compliance with requests, while problem behavior resulted in the therapist moving away from the participant. In treatment conditions, problem behavior continued to result in the therapist moving away; compliance resulted in the delivery of a small piece of food, physical contact, and verbal praise. Results for 3 participants showed that, relative to baseline conditions, compliance increased and problem behavior decreased during treatment conditions. One limitation of the experiment, however, was that Russo et al. did not confirm that escape was in fact a reinforcer for problem behavior. Research on functional analysis methods (see Hanley, Iwata, & McCord, 2003, for a comprehensive review) demonstrates the utility of identifying events as reinforcers before implementing differential reinforcement. In fact, previous research has indicated that a failure to accurately identify the reinforcer or reinforcers maintaining problem behavior could lead to inaccurate execution of EXT (Iwata, Pace, Cowdery, & Miltenberger, 1994). Given the lack of identification of the reinforcers maintaining problem behavior in the Russo et al. experiment, it cannot be said conclusively that EXT was not in place for problem behavior. In addition, in some cases problem behavior decreased prior to the start of treatment, further limiting the conclusions drawn from the treatment results.

In another example of DRA without EXT, Parrish, Cataldo, Kolko, Neef, and Egel (1986) used a differential reinforcement procedure to examine response covariation. In initial treatment conditions, problem behavior resulted in social reinforcement in the form of statements of concern and disapproval; compliance to verbal requests resulted in no programmed consequences. Under these conditions, problem behavior occurred at a high rate and compliance at a low rate. In a brief test condition for 1 of the 4 participants, however, Parrish and colleagues found that when problem behavior resulted in social disapproval and compliance in social praise, occasionally edible reinforcers, and physical attention, problem behavior decreased and compliance increased. Interestingly, these results were similar in comparison to a condition where problem behavior was ignored (extinction), and compliance was reinforced with praise and edible reinforcers. The only noted difference was variability in the rate of compliance when EXT was not programmed following problem behavior. Unfortunately, there was no functional analysis of problem behavior for this participant, and no attempt was made to assess the generality of these findings via replications within or across subjects.

More recently, Fisher and colleagues (1993) evaluated a specific type of DRA procedure, functional communication training (FCT), alone and combined with EXT, punishment, or both. Functional communication training typically involves placing problem behavior on EXT, and providing the functional reinforcer contingent on an appropriate communicative response.

Results showed that when FCT was introduced without an EXT or punishment component for problem behavior, the pre-determined goal of a 70% reduction in problem behavior was met with only 1 of 3 participants. It is important to note, however, that each of the participants had prior histories with EXT or punishment. It is unclear how this history may have affected responding in the absence of EXT or punishment.

Shirley and colleagues (1997) conducted a similar component analysis of the FCT procedure, but with the addition of an analysis of training procedures to establish manual signing. Results of this study indicated that when both problem and appropriate behavior resulted in reinforcement, there was initially no decrease in problem behavior for any of the 3 participants, and no acquisition of the appropriate response. As an additional analysis, following acquisition of the appropriate response and exposure to FCT with EXT, the effect of FCT without EXT was assessed again. Results indicated that, for all 3 participants, the appropriate response was maintained; however, the effects of the intervention on problem behavior were less consistent. For only 1 participant was there exclusive preference for the appropriate response; 1 participant showed an initial increase in problem behavior followed by a decrease; 1 participant showed continuous shifts in responding across alternatives. These results suggest that it may be difficult to establish alternative behavior if inappropriate behavior continues to be reinforced, but that, when established with a history of EXT for problem behavior, alternative behavior might compete successfully with ongoing contingencies of reinforcement for inappropriate behavior.

Hagopian et al. (1998) conducted an extensive replication of the previous examinations of FCT treatment packages to further examine the contribution of EXT and punishment components. These researchers found that a pre-determined goal of a 90% reduction in problem behavior was not achieved with any of 11 participants exposed to FCT without EXT. None of these individuals had a previous experimental history of either punishment or EXT.

Collectively, the majority of research on DRA without EXT has shown a bias in responding toward problem behavior when the rate and immediacy of reinforcement of problem and appropriate behavior are equivalent under a concurrent-operants arrangement. This research characteristically examines DRA without EXT following baseline conditions where problem behavior is reinforced continuously (i.e. on fixed-ratio [FR] 1 schedules) and appropriate behavior is placed on EXT. It is unclear what effect, if any, this has on the results. Previous research has shown that human behavior will co-vary based on rate and quality of reinforcement, with responding favoring the alternative associated with a higher reinforcement rate, greater quality of reinforcement, or both (Conger & Killeen, 1974; Mace, McCurdy, & Quigley, 1990; Martens & Houk, 1989; Neef, Mace, Shea, & Shade, 1992). Based on this finding, several researchers have recently manipulated the parameters of reinforcement such that the rate, quality, immediacy, or magnitude of reinforcement is not equivalent across response alternatives during treatment for problem behavior. For example, in a case study on the treatment of multiply controlled problem behavior, Lalli and Casey (1996) examined the affects of reinforcement schedule. Appropriate behavior was reinforced on a FR 1 schedule, and problem behavior on a concurrent variable-ratio (VR) 5 schedule. Under this concurrent reinforcement schedule, appropriate behavior increased and problem behavior decreased. Unfortunately, the participant's problem behavior appeared sensitive to both escape and attention as reinforcement. During treatment, appropriate behavior produced both reinforcers, and problem behavior produced escape only. Given this, it is not clear which component of the treatment (schedule or quality of reinforcement) produced the results.

Piazza et al. (1997) extended the Lalli and Casey (1996) study by examining the effects of increasing the quality of reinforcement for compliance relative to reinforcement associated with problem behavior. Three individuals whose problem behavior was sensitive to negative reinforcement (break from tasks) and positive reinforcement (access to tangible items, attention, or both) participated. Piazza and colleagues systematically evaluated the effects of reinforcing appropriate behavior with one, two, or three of the reinforcing consequences (a break, tangible items, attention), both when problem behavior produced a break and when it did not (escape extinction). For 2 of the 3 participants, appropriate behavior increased and problem behavior decreased when appropriate behavior produced a 30-s break with access to tangible items, and problem behavior only produced a 30-s break. The authors suggested that one potential explanation for these findings is that the relative rates of appropriate behavior and problem behavior were a function of the relative value of the reinforcement produced by escape. It is unclear, however, whether the intervention would be effective with individuals whose problem behavior was sensitive to only one type of reinforcement.

Piazza et al. (1999) assessed FCT without EXT when a more effective reinforcer followed appropriate behavior relative to the reinforcer following problem behavior. This analysis took place with 1 participant engaging in problem behavior maintained by attention in the form of verbal reprimands. As part of the initial analysis, the reinforcing properties of two types of attention (e.g. physical and verbal) were examined in a concurrent operants arrangement. This analysis showed physical attention was a more effective reinforcer than verbal attention. Piazza and colleagues then examined an FCT without EXT procedure that consisted of delivery of a verbal reprimand contingent on problem behavior, and physical attention or praise contingent on appropriate behavior. Results indicated that when praise and verbal reprimands were available concurrently for appropriate and problem behavior respectively, responding was allocated almost exclusively toward problem behavior. When physical attention followed appropriate behavior and verbal reprimands followed problem behavior, however, responding was allocated almost exclusively toward appropriate behavior. These results supported previous research showing that responding will favor the alternative associated with a higher quality reinforcer. Based on the results, the authors suggested EXT may be a critical treatment component only when the alternative forms of reinforcement used in treatment do not effectively compete with the reinforcement contingent on problem behavior. Unfortunately, these procedures were assessed with only 1 participant, limiting the generality of the results.

Vollmer, Roane, Ringdahl and Marcus (1999) exposed participants to DRA that was implemented at less than optimal parameters. For example, during DRA some problem behavior was reinforced, and some appropriate behavior was not reinforced. After a baseline condition, individuals were exposed to a traditional DRA procedure in which problem behavior was never reinforced, and appropriate behavior was always reinforced. Participants showed a bias toward appropriate behavior at perfect implementation. Lower levels of treatment implementation eventually reduced treatment efficacy if the schedule favored inappropriate behavior, however participants showed a general bias toward appropriate behavior. While this study showed that EXT was not a required component for DRA, it is unclear if the bias toward appropriate responding seen during treatment challenges would have been obtained if the participants had not been exposed to perfect treatment implementation prior to the introduction of treatment challenges.

Lalli and colleagues (1999) showed that EXT was not necessary in the treatment of escape maintained behavior when positive reinforcement was made contingent on appropriate behavior. They compared the effects of reinforcing appropriate behavior with either positive reinforcement in the form of edible items or negative reinforcement in the form of a break from demands with 5 participants whose problem behavior was maintained by escape. These procedures were assessed both with and without EXT of problem behavior. Results showed that, for all participants, appropriate behavior increased and problem behavior decreased when appropriate behavior resulted in positive reinforcement rather than negative reinforcement. These results were achieved without the use of EXT.

Worsdell, Iwata, Hanley, Thompson and Kahng (2000) examined the effect of reinforcement rate on response allocation. Five individuals whose problem behavior was reinforced by social positive reinforcement were first exposed to a baseline FCT condition in which both problem and appropriate behavior were reinforced on fixed-ratio (FR) 1 schedules. During subsequent FCT conditions reinforcement for problem behavior was made more intermittent (e.g. FR 2, FR 3, FR 5, etc.), while appropriate behavior continued to be reinforced on a FR 1 schedule. Results indicated that a shift in response allocation from problem behavior to appropriate behavior occurred with 1 of the participants during the initial baseline FCT condition. The remaining participants showed shifts in response allocation to appropriate behavior as the schedule of reinforcement for problem behavior became more intermittent. It was noted, however, that for at least 2 of the participants, small errors in reinforcement appeared to compromise treatment effects. There were several limitations to this research. For example, reinforcement rate was faded in the same order for each participant. Given this, reductions in problem behavior may be due in part to sequence effects. In addition, the reinforcement schedule was thinned to FR 20 for 2 individuals. For these 2 participants, reinforcement for problem behavior was rarely contacted. The schedule in these cases may have been functionally more equivalent to EXT than intermittent reinforcement. Overall, these results suggest that individuals might acquire alternative responses during FCT in spite of inconsistencies in the application of EXT, although even small errors in reinforcement may compromise treatment effects.

Manipulations of magnitude of reinforcement have been also shown to produce shifts in response allocation to the response alternative that provides the greater magnitude of reinforcement, relative to that concurrently available for other alternatives (Catania, 1963). Magnitude of reinforcement can take the form of intensity, number, or duration. For example, Lerman, Kelley, Vorndran, Kuhn, and LaRue (2002) examined the effects of magnitude of reinforcement on positively reinforced screaming of an adult woman with severe mental retardation. Lerman and colleagues arranged two separate concurrent schedules, both of which programmed EXT for screaming. In one arrangement, a mand produced 10-s access to the functional reinforcer (toys) and in the other, the mand produced 60-s access to toys. The results demonstrated equivocal mands across the two schedule arrangements, but fewer occurrences of screaming in the schedule in which mands produced the greater magnitude of reinforcement. Similar findings have been found when magnitude and quality of reinforcement are manipulated during play activities; that is, the dimensions of magnitude and quality of reinforcement influenced choice responding in favor of playing near a peer or sibling rather than playing alone when the reinforcement favored playing near peers or siblings (Hoch, McComas, Johnson, Faranda, & Guenther, 2002).

Hoch, and colleagues (2002) conducted a parametric analysis of DRA without EXT with 3 participants who engaged in problem behavior maintained by negative reinforcement in the form of escape from tasks. These researchers found that when both problem and appropriate behavior produced a break from tasks, problem behavior for each participant occurred at high rates and few tasks were completed. In contrast, when problem behavior produced a break and task completion produced both a break and access to preferred activities, problem behavior was eliminated and task completion increased. The effects were maintained when the response requirement was increased and the reinforcement schedule was thinned. One limitation to the design, however, is the order of experimental conditions. Specifically, the condition where breaks were provided for both problem and appropriate behavior never preceded conditions where breaks followed problem behavior and breaks plus preferred activities followed appropriate behavior. It is unknown whether the escape-alone contingency would have been sufficient to decrease problem behavior had participants not had a history of escape with access to preferred activities for task completion.

Most recently, Borrero (2006) examined response allocation in relation to experimentally arranged reinforcement rates. Participants were 3 individuals whose problem behavior was multiply controlled by both social positive reinforcement (access to tangibles or attention) and social negative reinforcement (escape from demands). Throughout the experiment, concurrent schedules of reinforcement were in place for both problem behavior and appropriate behavior. In some conditions, reinforcement schedules favored problem behavior, in others, reinforcement schedules favored appropriate behavior. Results showed that relative rates of responding on both alternatives approximated the relative rates of reinforcement available for each response. For all participants, however, full treatment evaluations of DRA with EXT were conducted to reduce problem behavior to clinically significant levels. While it was outside the scope of the Borrero study, future research should extend on this and previous investigations to evaluate whether concurrent schedules of reinforcement can be manipulated in such a way as to obtain a therapeutic reduction in inappropriate behavior without the use of EXT.

One component the Borrero (2006) study brought to the experimental analyses of responding on concurrent reinforcement schedules during a treatment for problem behavior was an analysis of responding using the matching law as a conceptual framework. The matching law was first introduced by Herrnstein (1961), who provided a quantitative description of responding on concurrent schedules of reinforcement. Generally, the matching law states that the relative rate of responding on one alternative will approximate the relative rate of reinforcement provided on that alternative. Baum (1974a) provided an alternative formulation of the matching law, known as the generalized matching law, which accounted for deviations from strict matching by incorporating a bias parameter and a sensitivity parameter. The matching law has provided a conceptual framework for addressing differences in responding across alternatives, including alternatives where the quality, delay, or duration of reinforcement available for each response differs.

The matching law has been evaluated in a number of investigations using both nonhumans (Baum, 1974b; Baum, 1979; Belke & Belliveau, 2001; Crowley & Donahoe, 2004; Herrnstein & Loveland, 1975; MacDonall, 1988; McSweeney, Farmer, Dougan, & Whipple, 1986) and humans (e.g., Borrero & Vollmer, 2002; Mace, Neef, Shade, & Mauro, 1994; Martens & Houk, 1989; Neef, Mace, Shea, & Shade, 1992; Oliver, Hall, & Nixon, 1999; Symons, Hoch, Dahl, & McComas, 2003; Vollmer & Bourret, 2000). A number of applied studies have evaluated naturally occurring situations using the matching law. Of particular importance to the current study are experimental investigations on the matching law with humans when reinforcement available for each response form is manipulated.

Neef et al. (1992) conducted an investigation to demonstrate that (a) human behavior is sensitive to concurrent schedules of reinforcement when reinforcer quality is held constant, as suggested by the matching law, and (b) the matching relation would not occur when reinforcer quality was not equal, and that a bias for the higher quality reinforcer would occur. The participants were individuals diagnosed with emotional disturbances and learning difficulties. Before each session, the participant was asked if she preferred to work for nickels or tokens. During each session identical stacks of arithmetic problems were placed in front of the participant; each stack of cards was associated with a variable-interval (VI) schedule of reinforcement (e.g., VI 30-s, VI 120-s), and correct responses resulted in reinforcement (e.g., nickels or tokens) delivered according to the schedule in place for that alternative. Sessions were first conducted to identify the participants' sensitivity to the VI schedules of reinforcement, and a timer was included to signal the amount of time remaining in the reinforcement interval. Neef and colleagues then evaluated two additional conditions: (a) equal-quality reinforcers, during which two stacks of cards were presented on concurrent VI schedules, and the reinforcers delivered were the same (i.e., either nickels or tokens were delivered for both alternatives), and (b) unequal-quality reinforcers, during which two stacks of cards were presented on concurrent VI schedules, and high-quality reinforcers (nickels) were delivered on the leaner schedule of reinforcement (i.e., VI 120-s) and low-quality reinforcers (tokens) were delivered on the richer schedule of reinforcement (i.e., VI 30-s). For all participants, time-allocation matching occurred following the introduction of a timer signaling the reinforcement interval. During the equal-quality reinforcers condition, matching was obtained, with the time allocated to each response alternative closely approximating the obtained reinforcement from that alternative. During the unequal quality reinforcers condition, matching was not observed, and responding suggested a preference for one of the two alternatives (i.e., nickels or tokens) for two participants, or responding that maximized the number of reinforcers for that alternative, for one participant.

This study provided support for the applicability of the matching relation to socially significant human behavior, and highlighted some potentially important considerations, such as biased responding, which may occur if the quality of available reinforcers is not equal.

Using the same general procedures described in prior work (i.e., Neef et al., 1992), Neef and colleagues (Mace et al., 1994; Neef, Mace, & Shade, 1993; Neef, Shade, & Miller, 1994) extended the work reported by Neef et al. (1992) and showed that response allocation under concurrent VI schedules was also sensitive to additional reinforcement parameters including reinforcer delay. Because this series of experiments involved academic behavior of individuals with emotional and learning disabilities, the generality of the matching law was extended to socially significant (appropriate) behavior. Overall, research on the matching law indicates that responding on concurrent schedules of reinforcement should match the relative reinforcement available for each response. Manipulations of the rate quality, delay, or duration of reinforcement across response alternatives have been found to result in switches in allocations of responding, and could indicate a treatment for severe problem behavior. More research, however, must be conducted with individuals who engage in severe problem behavior to extend the generality of the findings.

Purpose

Extinction is a highly effective component of the DRA procedure. Unfortunately, problem behavior must sometimes be reinforced to avert danger, and, due to integrity failures, problem behavior is likely to be reinforced on some intermittent schedule in the natural environment. Collectively, previous research suggests that EXT may not always be a necessary component of differential reinforcement treatment packages targeting problem behavior. There were, however, certain limitations inherent in previous investigations. In addition, there is a relative paucity of research in the area of parametric manipulations of reinforcement during DRA without EXT procedures within a concurrent-operants arrangement. The purpose of this dissertation was to examine manipulations that could be considered in the event that EXT either cannot or will not be implemented. These manipulations were assessed with 6 individuals diagnosed with developmental disorders or disabilities who engaged in severe problem behavior.

In Experiment I, functional analyses were conducted for all participants to identify reinforcers for problem behavior. Specifically, conditions were included to evaluate whether problem behavior was sensitive to (a) social positive reinforcement, including adult attention or access to preferred tangible items (e.g., toys, edible items, etc.), (b) social negative reinforcement, including escape from instructional demands or aversive situations (e.g., hygiene tasks, daily living skills, etc.), or (c) automatic reinforcement (e.g., sensory reinforcement, pain alleviation, etc.).

In Experiments II-V, equal concurrent VI schedules of reinforcement were introduced for appropriate behavior and problem behavior (using reinforcers previously identified in Experiment I). Appropriate behavior was identified during descriptive observations of each participant as well as during the functional analysis, and included requests for access to tangible items, attention, escape from demands (e.g., using picture cards, sign language, or vocal requests), and compliance with instructions. For each participant during baseline, appropriate and problem behavior produced reinforcers identical in relation to quality (Experiment II), duration (Experiment III), delay (Experiment IV), and quality, duration, and delay (Experiment V). During parametric manipulations, appropriate behavior produced access to a reinforcer that was parametrically different from the reinforcer produced by problem behavior. During Experiments II-IV, the purpose was to manipulate a single feature of reinforcement such that reinforcement favored appropriate behavior. In Experiment II, appropriate behavior produced a higher quality reinforcer and problem behavior produced a lower quality reinforcer. In Experiment III, appropriate behavior produced a longer duration of access to the reinforcer and problem behavior produced a shorter duration of access to the reinforcer. In Experiment IV, appropriate behavior produced immediate access to the reinforcer and problem behavior produced access to the reinforcer after a delay. In Experiment V, the purpose was to combine several features of reinforcement such that reinforcement favored appropriate behavior. During Experiment V, appropriate behavior produced immediate, longer duration of access to a higher quality reinforcer and problem behavior produced delayed, shorter duration of access to a lower quality reinforcer. In each experiment, parametric manipulations continued until problem behavior was reduced to clinically significant levels and appropriate behavior increased.

CHAPTER 2
EXPERIMENT I: EXPERIMENTAL ANALYSES OF PROBLEM BEHAVIOR

Method

Participants

Six individuals diagnosed with developmental disorders or disabilities who engaged in severe problem behavior participated. These were the first six individuals who engaged in problem behavior sensitive to socially mediated reinforcement and were admitted to an outpatient clinical unit (Justin, Henry, Corey, Kenneth, Lana), or referred for behavioral consultation services at his school (George). Justin was a 7-year-old boy diagnosed with attention deficit and hyperactivity disorder (ADHD). His problem behavior included aggression (hitting, kicking, biting, pinching, scratching, pushing, and head butting other individuals), disruptive behavior (throwing objects or hitting the wall), and inappropriate sexual behavior (touching himself or the therapist in a sexual way). Henry was an 8-year-old male diagnosed with autism. His problem behavior included aggression (hitting and kicking other individuals) and disruptive behavior (throwing objects). Corey was a 9-year-old male diagnosed with autism and ADHD. His problem behavior included aggression (hitting, biting, spitting, and kicking other individuals) and disruptive behavior (throwing, tearing, and otherwise destroying objects). Kenneth was a 6-year-old male diagnosed with autism. His problem behavior was disruption (throwing objects) and aggression (hitting, scratching, and pinching others). Lana was a 5-year-old female diagnosed with autism. Her problem behavior was aggression (hitting, kicking, and scratching others). George was a 10-year-old male diagnosed with autism. His problem behavior was disruption (throwing objects) and aggression (hitting, kicking, and biting other individuals).

Setting

Sessions for Justin, Henry, Corey, Kenneth and Lana were conducted on an outpatient clinical unit to which participants were referred for the assessment and treatment of problem behavior. Session rooms (3 m by 3 m) were equipped with one-way mirrors and sound monitoring equipment. Each room contained materials necessary for a session, which could include toys, paper, and a wastebasket. Sessions for George were conducted in a classroom at his elementary school. The classroom contained materials necessary for a session, and general classroom materials such as posters and tables.

Informed Consent

Prior to beginning each experiment informed consent was obtained for the participants. Participants were considered unable to give informed consent due to their disabilities so parents or legal guardians of the participant gave consent on his or her behalf. Caregivers were asked to read and sign an informed consent which had been approved by an institutional review board and which stated in detail that their child was being asked to participate in a sequence of experiments on treatments for problem behavior.

Procedure

All sessions were conducted by trained clinicians serving as experimenters. Observers were clinicians who received in-vivo training in behavioral observation and had previously demonstrated high interobserver agreement (IOA) scores (> 90%) with trained observers. Observers on the outpatient clinical unit were seated behind a one-way mirror. Observers in school were seated out of the direct line of sight of the child. Observers collected data on desktop or laptop (George) computers that provided real-time data and scored events as either frequency (e.g., aggression, disruption, SIB, and screaming) or duration (e.g., delivery of attention, escape from instructions, etc.). Sessions were conducted four to sixteen times each day, five days per week. Sessions were 10 min in duration and there was a minimum of 5 to 10 min break between each session.

Stimulus preference assessment. For each participant, prior to the functional analysis, paired stimulus preference assessments were conducted using procedures described by Fisher et al. (1992) to identify preferred items to be included in the conditions of the functional analysis. A total of 7-10 leisure items were assessed with each participant (e.g., musical keyboard, drawing toys, ball, etc.). Before beginning the assessment the participant was shown the item and allowed brief (i.e., 2-3 min) contact with the item. The participant was then presented with 2 of the leisure items and told that he or she could briefly (i.e., 20-30 s) play with either of the items. The item the participant selected first was scored. Each leisure item was paired with each other leisure item at least twice. Preferred items were considered to be the three items selected most often.

Functional analysis. Functional analyses were conducted using procedures similar to those described by Iwata et al. (1982), and Day, Rea, Schussler, Larsen and Johnson (1988). Four test conditions were compared: (a) attention, (b) tangible, (c) escape, and (d) ignore, to a control condition (play) using a multielelement design for all participants. Consequences for problem behavior were provided contingent on aggression or disruption (Henry, Corey, Kenneth, Lana, and George), and aggression, disruption, or inappropriate sexual behavior (Justin). During the attention condition the participant was provided with preferred tangible items, no demands were presented, and the therapist diverted her attention to a work task. Contingent on problem behavior brief attention was provided for 30-s and consisted of a reprimand (e.g., “Don’t do that”) followed by the therapist conversing with the participant. This condition was included to determine if problem behavior was reinforced by adult attention. During the tangible condition the participant was provided with adult attention and no demands were present, while the therapist restricted access to preferred tangible items. Access to preferred items was provided for 30-s contingent on problem behavior. This condition was included to determine if problem behavior was reinforced by access to tangible items. During the escape condition the therapist provided instructional demands (e.g., brushing teeth, washing face, combing hair, folding towels) using a three-prompt instructional sequence (Horner & Keilitz, 1975). Contingent on problem behavior, a 30-s break from instructions was provided and the task materials were removed. This condition was included to determine if problem behavior was negatively reinforced by escape from instructional demands. During the ignore condition all preferred tangible items were removed and the participant received no attention from the therapist. There were no programmed consequences for problem behavior. This condition was included to determine if problem behavior persisted in the absence of programmed social consequences. Finally, during the control condition, the participant had continuous access to preferred tangible items, no demands were present, and adult attention was provided at least every 30 s. There were no programmed consequences for problem behavior. This condition was included as a point of comparison (control) to the test conditions.

Interobserver agreement (IOA). Two independent observers collected data on aggression, disruption, and inappropriate sexual behavior for a proportion of functional analyses sessions to assess interobserver agreement (IOA). Observations were divided into 10-s bins and the number of observed responses was scored for each bin. The smaller number of observed responses within each bin was divided by the larger number of observed responses and converted to agreement percentages for frequency measures (Bostow & Bailey, 1969). Agreement on the nonoccurrence of behavior within any given bin was scored as 100% agreement. The bins were then averaged across the session. For duration measures the smaller number of s was divided by the larger number of s for duration measures (and agreement on the nonoccurrence of behavior within any bin was scored as 100% agreement). The bin data were then averaged across the sessions. For Justin, IOA was scored for 43% of functional analysis sessions and averaged 98% for aggression (range, 87% to 100%), 96% for disruption (range, 85% to 100%), and 100% for inappropriate sexual behavior. For Henry, IOA was scored for 49% of functional analysis sessions and averaged 100% for aggression and 99.9% for disruption (range, 99.7% to 100%). For Corey, IOA was scored for 27% of functional analysis sessions and averaged 100% for aggression and disruption. For Kenneth, IOA was scored for 44% of functional analysis sessions, and averaged 98.3% for aggression (range, 94% to 100%) and 98.9% for disruption (range, 97% to 100%). For Lana, IOA was scored for 32% of functional analysis sessions and averaged 99% for aggression (range, 98.7% to 100%). For George, IOA was scored for 30% of functional analysis sessions and averaged 99.5% (range, 98 % to 100%) for aggression and 99 % for disruption (range, 97.9% to 100%). Observer agreement scores throughout 39% of all functional analysis sessions averaged 100% for therapist attention, 99.9% for access to tangible items (range, 99% to 100%), and 100% for escape from instructions.

Results and Discussion

Figure 2-1 shows the results of the functional analyses for Justin, Corey, and Kenneth. Panel A of Figure 2-1 shows responses per min (rpm) of problem behavior for Justin. The highest rates of problem behavior occurred in the escape condition with a mean response rate of 13.72 rpm compared to the attention (*M* = .38 rpm), tangible (*M* = .44 rpm), ignore (*M* = .78 rpm), and control (*M* = .14 rpm) conditions. These results suggested that Justin’s aggression, disruption, and inappropriate sexual behavior were reinforced by escape from instructional demands. Data were collected for aggression, disruption, and inappropriate sexual behavior separately and similar results were obtained, therefore all topographies were combined in this analysis. Although the overall trend in the escape condition appears downward, inspection of the data shows that Justin was becoming more “efficient” in escape behavior by responding only when demands were presented.

Panel B of Figure 2-1 shows the results of Corey’s functional analysis. The highest rates of aggression and disruption were observed during the tangible (*M* = 1.03 rpm) condition when compared to the escape (*M* = .07 rpm), attention (*M* = .07 rpm), ignore (*M* = .07 rpm), and control (*M* = 0 rpm) conditions. These results suggested that Corey’s aggression and disruption were reinforced by access to tangible items. Data were collected for aggression and disruption separately and similar results were obtained, therefore both topographies were combined in this analysis.

Panel C of Figure 2-1 shows the results of Kenneth’s functional analysis. The highest rates of aggression and disruption were observed during the attention (*M* = 2.25 rpm) and escape conditions (*M* = 1.54 rpm) when compared to low rates in tangible (*M* = .16 rpm) and control (*M* = .46 rpm) conditions. These results suggested that Kenneth’s aggression and disruption were reinforced by attention and escape from demands. Data were collected for aggression and disruption separately and similar results were obtained, therefore both topographies were combined in this analysis.

Figure 2-2 shows the results of the functional analyses for Henry, Lana, and George. Panel A of Figure 2-2 shows responses per min (rpm) of aggression and disruption for Henry. The highest rates of aggression and disruption occurred in the escape condition with a mean response rate of 1.75 rpm, as compared to the attention (*M* = 0 rpm), tangible (*M* = 0 rpm), ignore (*M* = .05 rpm), and control (*M* = 0 rpm) conditions. These results suggested that Henry’s aggression and disruption were reinforced by escape from instructional demands. Data were collected for aggression and disruption separately and similar results were obtained, therefore both topographies were combined in this analysis.

Panel B of Figure 2-2 shows the results of Lana's functional analysis. The highest rates of aggression were observed during the tangible (M = 2.65 rpm) condition when compared to the escape (M = .02 rpm), attention (M = 0 rpm), ignore (M = 0 rpm), and control (M = 0 rpm) conditions. These results suggested that Lana's aggression was reinforced by access to tangible items.

Panel C of Figure 2-2 shows the results of George's functional analysis. The highest rates of aggression and disruption were observed during the attention (M = 1.53 rpm) condition when compared to the escape (M = .06 rpm), attention (M = 0 rpm), and control (M = 0 rpm) conditions. These results suggested that George's aggression and disruption were reinforced by social attention. Data were collected for aggression and disruption separately and similar results were obtained, therefore both topographies were combined in this analysis.

In summary, results of Experiment 1 identified the socially mediated reinforcers for the problem behavior exhibited by the five participants. For all but one participant problem behavior was controlled by one form of environmental reinforcer; two individuals engaged in problem behavior reinforced by escape from instructional demands, two engaged in problem behavior reinforced by access to tangible items, and one engaged in problem behavior reinforced by therapist attention. One individual engaged in multiply controlled problem behavior; that is, this individual engaged in problem behavior reinforced by adult attention and by escape from highly aversive instructional demands.

This experiment was a necessary prerequisite to Experiment II-V. The results of Experiment I provided a basis for each subsequent experiment, during which parametric manipulations were made to the reinforcers delivered on concurrent VI schedules of reinforcement following problem and appropriate behavior. Such analyses would not have been possible without identifying the function(s) of problem behavior.

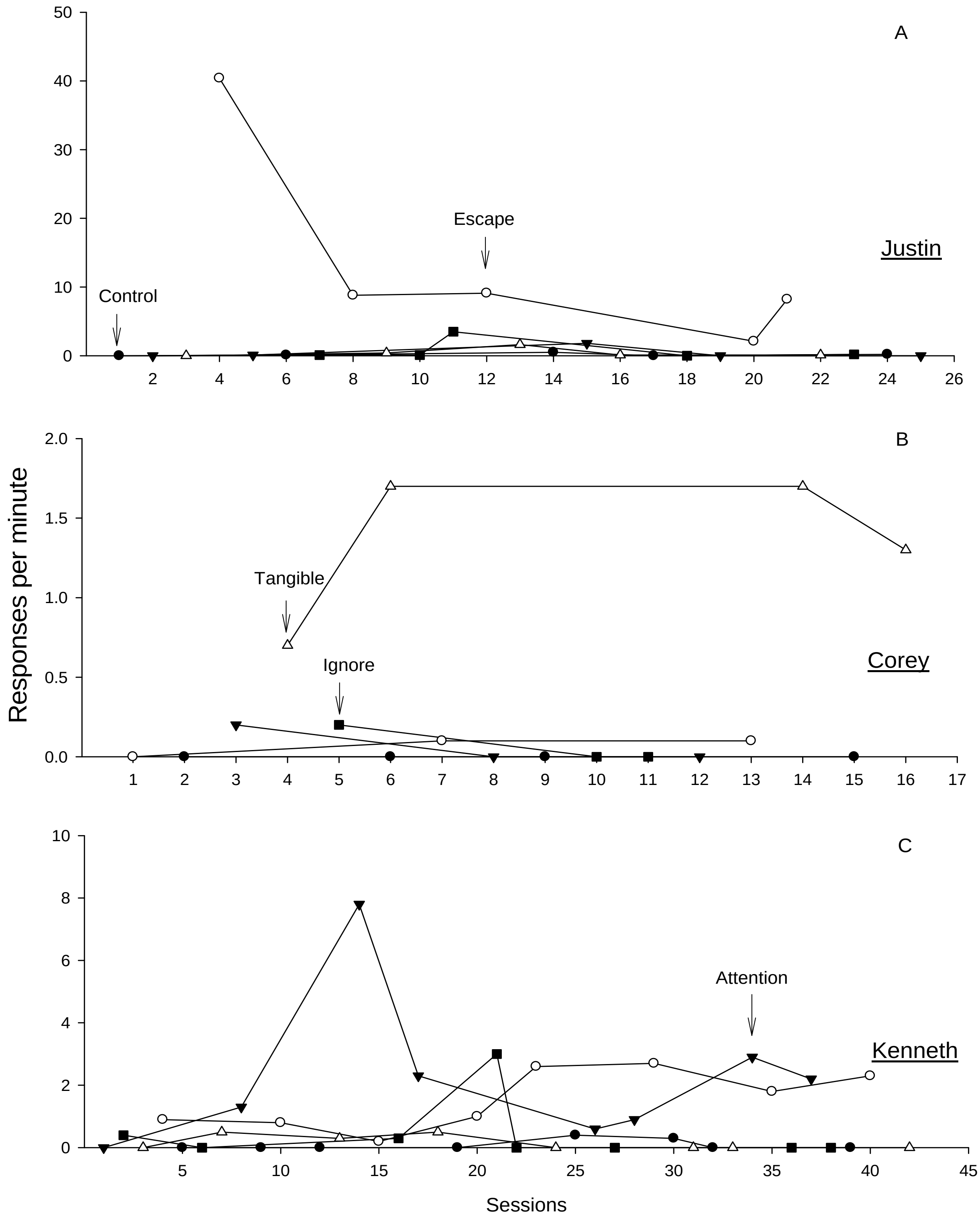

Figure 2-1. Overall response rates during the functional analysis for Justin, Corey, and Kenneth. A) Responses per min of aggression, disruption, and inappropriate sexual behavior for Justin. B) Responses per min of aggression and disruption for Corey. C) Responses per min of disruption and aggression for Kenneth.

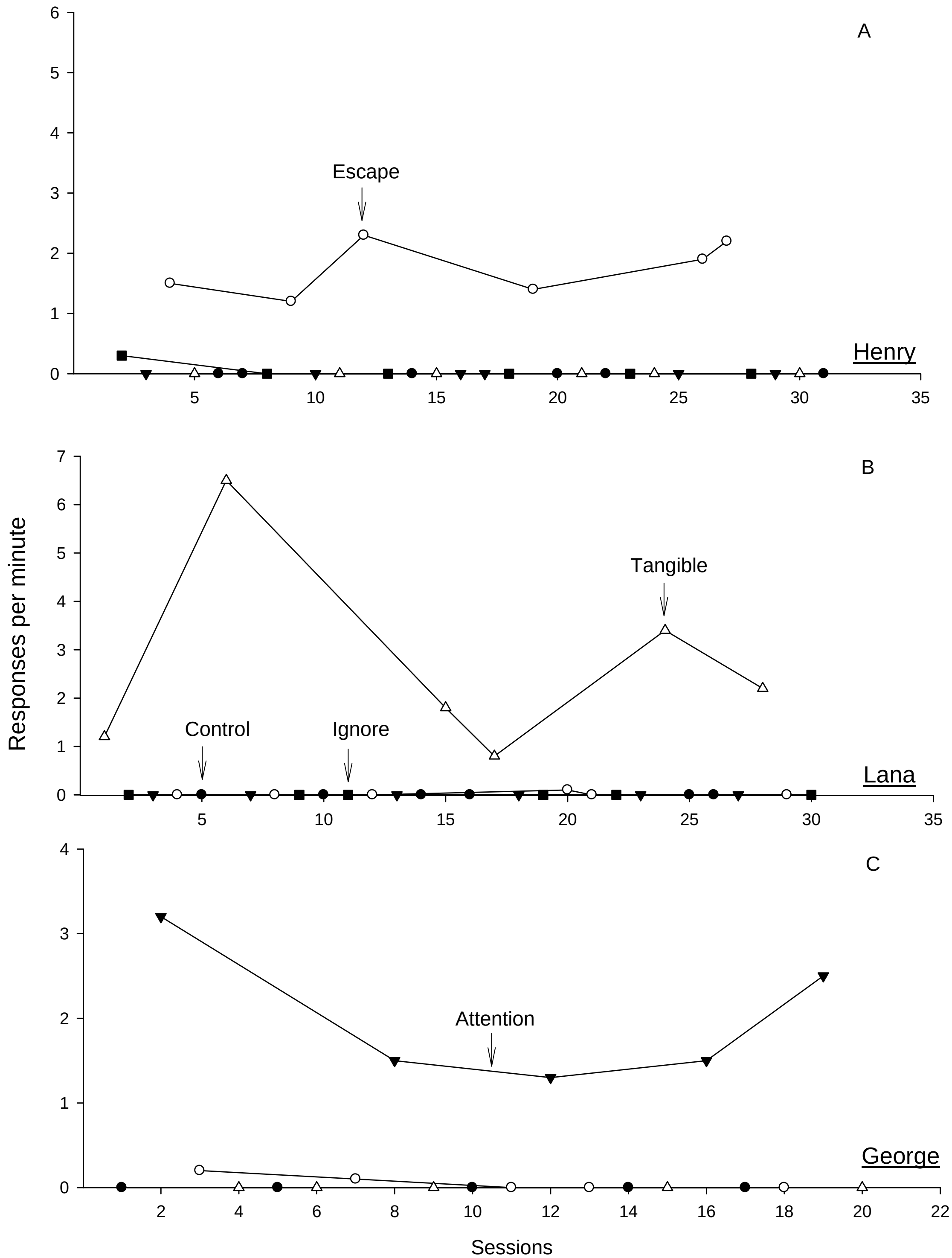

Figure 2-2. Overall response rates for Henry, Lana, and George during the functional analysis. A) Responses per min of aggression and disruption for Henry. B) Responses per min of aggression for Lana. B) Responses per min of aggression for George.

CHAPTER 3
EXPERIMENT II: ANALYSIS OF QUALITY OF REINFORCEMENT

Method

Participants

Participants were two of the individuals, Justin and Kenneth, in Experiment I. Problem behavior was the same for each participant as in Experiment I and appropriate behavior was also evaluated for each participant. Justin's appropriate behavior was compliance with instructional demands (e.g., tidiness training). Kenneth's appropriate behavior was requests (e.g., mands) for attention through the exchange of a picture card. Due to clinical exigencies, Kenneth's escape maintained behavior was addressed outside the context of this research.

Setting

The setting was the same outpatient clinical unit as described for Experiment I. Session rooms (3 m by 3 m) were equipped with one-way mirrors and sound monitoring equipment. Each room contained materials necessary for a session, which could include toys, task materials, a picture card, or some combination of each.

Procedure

A reversal design was used during this and all subsequent analyses. All sessions were conducted by trained clinicians serving as experimenters. Observers were clinicians who received in-vivo training in behavioral observation and had previously demonstrated high interobserver agreement (IOA) scores (> 90%) with trained observers. Observers were seated behind a one-way mirror. Observers collected data on desktop computers that provided real-time data and scored events as either frequency (e.g., aggression, disruption, inappropriate sexual behavior, compliance, and picture card exchange), or duration (e.g., delivery of attention, escape from instructions, etc.). Sessions were conducted four to sixteen times each day five days per week. Sessions were 10 min in duration and there was a minimum of 5 to 10 min break between each session.

Interobserver agreement (IOA). Interobserver agreement was calculated as in Experiment 1. For Justin, IOA was scored for 27% of quality analysis sessions and averaged 98% for aggression (range, 93% to 100%), 98% for disruption (range, 97% to 100%), and 100% for inappropriate sexual behavior. For Justin, agreement on the occurrence of compliance averaged 96% (range, 93% to 100%). For Kenneth, IOA was scored for 32% of quality analysis sessions and averaged 98.7% for aggression (range, 94% to 100%) and 96% for disruption (range, 92% to 100%). For Kenneth, agreement on the occurrence of picture card exchange averaged 98% (range, 96% to 100%).

Stimulus preference assessment. Before the quality analysis with Justin a paired stimulus preference assessment was conducted as in Experiment I. Immediately prior to each session in the quality analysis Justin was also exposed to a multiple stimulus without replacement (MSWO) preference assessment (DeLeon & Iwata, 1996). A total of 4 leisure items were assessed each MSWO. These items were the most preferred items as identified by the previous paired stimulus preference assessment. Before beginning the assessment Justin was shown the item and allowed brief (i.e., 2-3 min) contact with the item. Justin was then presented with all of the leisure items and told that he could play with any of the items; the item he selected first was scored. The most preferred item was considered to be the one selected first. Depending on the condition in effect, the first item selected or the first 3 selected items in the MSWO were included in the upcoming experimental session.

Reinforcer assessment. Before conducting the quality analysis with Kenneth, a reinforcer assessment was conducted using procedures described by Piazza et al. (1999). The reinforcer assessment identified the relative efficacy of two reinforcers in a concurrent operants arrangement. Two sets of toys, identical except for color, were present (i.e. green and orange blocks). The session room was divided in half by blue painters tape; same colored toys were located on opposite sides of the room. During baseline the therapist stood in the middle of the room but provided no social interaction; toy contact and problem behavior resulted in no arranged consequences. Before each contingent attention session, Kenneth was physically guided to interact with toys of each color and provided with the consequence associated with the color. In the first contingent attention phase of the assessment, contact with the green toys resulted in praise (e.g., “Good job, Kenneth”) and contact with the orange toys resulted in reprimands (e.g., “Don’t do that”). Praise was delivered in a high pitched, loud voice with an excited tone. Reprimands were delivered in a deeper pitched loud voice, with a harsh tone. During the second contingent attention phase, the consequences associated with each color of toys were reversed such that green toys were associated with reprimands and orange toys with praise. Continuous reprimands or praise were delivered for the duration of toy contact, and attempts to play with two different-colored toys simultaneously were blocked. Therapists were instructed to remain at a distance of .3 to .5 m from Kenneth and provide no physical contact.

Functional Analysis Baseline. The functional analysis baseline condition was identical to the functional analysis condition associated with problem behavior during Experiment I. These conditions were the escape condition for Justin and the attention condition for Kenneth. During baseline, each instance of problem behavior resulted in delivery of the reinforcer (i.e., escape from instructions for Justin, therapist attention for Kenneth). No programmed consequences were in place for appropriate behavior; that is, instances of appropriate behavior did not result in access to the reinforcer.

Baseline. Equal concurrent VI schedules of reinforcement (VI 20-s VI 20-s) were in place for both problem and appropriate behavior. A random number generator selected intervals between 1 and 39 s, with an average interval length of 20 s. The intervals were timed using a computer generated printout and two timers. The printout indicated the current interval for problem and appropriate behavior, and a therapist controlled the timers to time that interval for each behavior. When reinforcement was available for a response (i.e., the interval elapsed), and the behavior occurred, an observer signaled the therapist discreetly by tapping on the one-way mirror from the observation room. The first instance of behavior following availability of a reinforcer resulted in delivery of the reinforcer (i.e. escape from instructions for Justin, and attention in the form of neutral statements such as “I really like your outfit today,” for Kenneth). After 30 s of reinforcer access, the reinforcer was removed and the timer was reset for that response.

Quality Analysis I. Equal concurrent VI schedules of reinforcement (VI 20-s VI 20-s) were in place for both problem and appropriate behavior. The intervals were timed and the therapist signaled in the same manner as in the baseline analysis. For Justin, problem behavior produced escape with access to one low-preferred tangible item identified via the paired stimulus preference assessment. Appropriate behavior produced escape with access to one high-preferred tangible item, identified in a pre-session MSWO. For Kenneth, problem behavior produced reprimands (e.g., “Don’t do that, I really do not like it and you could end up hurting someone. If I see you keep doing this I will be very disappointed…”), which were indicated by the reinforcer assessment as a less effective form of reinforcement than social praise. Appropriate behavior produced praise (e.g., “Good job handing me the card, I really like it when you hand it to me so nicely….”), a more effective form of reinforcement. For both participants, the reinforcer was removed after 30 s of reinforcer access and the timer was reset for that response.

Quality Analysis II. Equal concurrent VI schedules of reinforcement (VI 20-s VI 20-s) were in place for both problem and appropriate behavior. The intervals were timed and the therapist signaled in the same manner as in the baseline condition. In quality analysis II, the difference in the quality of reinforcement available following appropriate behavior relative to problem behavior was increased. For Justin, problem behavior produced access to one low-preferred tangible item, identified via the paired stimulus preference assessment, and a 30 s break from demands. Appropriate behavior produced access to three high-preferred tangible items, identified in a pre-session MSWO, and a 30-s break from demands. For Kenneth, problem behavior produced reprimands. Appropriate behavior produced praise and physical attention (e.g., “Good job handing me the card;” hugs and tickles). For both participants, after 30 s of reinforcer access, the reinforcer was removed and the timer was reset for that response.

Results and Discussion

Figure 3-1 shows the results for Justin. Responses per min of problem and appropriate behavior are displayed for all phases. There was an initially high rate of appropriate behavior during the functional analysis baseline. The rate of responding decreased after the first session, however, and ultimately Justin engaged in higher rates of problem behavior (*M* = 1.58 rpm) than appropriate behavior (*M* = 1.95 rpm). During the subsequent baseline condition, when problem and appropriate behavior were reinforced on equal concurrent VI schedules, Justin continued to engage in higher rates of problem behavior (*M* = 2.88 rpm) than appropriate behavior (*M* = 1.4 rpm). The quality of reinforcement was then manipulated such that in quality analysis I, one low quality reinforcer was delivered on a VI 20-s schedule for problem behavior, and one high quality reinforcer was delivered on a VI 20-s schedule for appropriate behavior. During this condition, rates of problem behavior (*M* = .94 rpm) decreased and appropriate behavior increased (*M* = 2.21 rpm). The initially therapeutic results were not sustained however. During the last five sessions problem behavior increased and appropriate behavior decreased. Quality analysis II was subsequently conducted. In this analysis, one low quality reinforcer was delivered on a VI 20-s schedule for problem behavior, and three high quality reinforcers were delivered on a VI 20-s schedule for appropriate behavior. During this manipulation, lower rates of problem behavior (*M* = .55 rpm) than appropriate behavior (*M* = 1.39 rpm) were obtained. In the final five sessions of this condition, problem behavior continued to decrease, and appropriate behavior increased to high rates. During the subsequent baseline reversal, we failed to recapture previous rates of problem and appropriate behavior. Instead, problem behavior occurred at a lower rate (1.24 rpm) than appropriate behavior (*M* = 4.56 rpm). Despite the failure to replicate the previous baseline condition with respect to appropriate behavior, problem behavior increased (*M* = 1.24 rpm) relative to what was observed in the immediately preceding quality of reinforcement manipulation (*M* = .55 rpm). Following this, we returned to our second quality of reinforcement manipulation and observed a decrease in problem behavior (*M* = .41 rpm) and sustained high levels of appropriate behavior (*M* = 3.59 rpm). In the final five sessions of this manipulation, problem behavior occurred at low rates (*M* = .08 rpm), and appropriate behavior occurred at high rates (*M* = 3.7 rpm).

Figure 3-2 shows the results for Kenneth. Responses per min of problem and appropriate behavior are displayed for all phases. Kenneth engaged in higher rates of problem behavior (*M* = 9.05 rpm) than appropriate behavior (*M* = .02 rpm) in the functional analysis baseline. In the subsequent baseline condition, Kenneth continued to engage in higher rates of problem behavior (*M* = 4.73 rpm) than appropriate behavior (*M* = .05 rpm). The quality of reinforcement was then manipulated such that in quality analysis I, attention in the form of reprimands (e.g., a low quality reinforcer) was delivered on a VI 20-s schedule for problem behavior and higher quality reinforcement, in the form of social praise, was delivered on a VI 20-s schedule for appropriate behavior. During this condition, rates of problem behavior decreased (M = 2.58 rpm) and appropriate behavior increased (M = .75 rpm) relative to baseline. A closer analysis of the condition shows that by the last five sessions of the analysis, responding was shifting rapidly across response alternatives. Before conducting further analyses, during a replication of baseline, high rates of problem behavior (M = 5.1 rpm), and relatively lower rates of appropriate behavior (M = 1.18 rpm) were obtained. During a subsequent replication of the first quality analysis and obtained slightly higher rates of problem behavior (M = 2.4 rpm) than appropriate behavior (M = 2.22), with responding rapidly shifting across response alternatives. In a replication of baseline, high rates of problem behavior (M = 2.11 rpm) and relatively lower rates of appropriate behavior (M = 1.8 rpm) were obtained. Following this replication, quality analysis II was conducted such that reprimands were delivered on a VI 20-s schedule for problem behavior, and praise as well as physical attention (e.g., hugs, tickles) was delivered on a VI 20-s schedule for appropriate behavior. During this manipulation, problem decreased to rates lower than observed in previous conditions, and appropriate behavior increased to high rates (M = 2.31 rpm). In a reversal to baseline, the findings of the previous baseline condition were replicated. During the baseline reversal, problem behavior occurred at a higher rate (M = 3.52 rpm) than appropriate behavior (M = .83 rpm). Following this, the second quality analysis condition was replicated and a similar decrease in problem behavior (M = 1.72 rpm) and increase in appropriate behavior (M = 1.58 rpm) was obtained. In the final five sessions of this manipulation, problem behavior occurred at low rates (M = .1 rpm), and appropriate behavior at high rates (M = 1.54 rpm). For closer visual inspection of the final five sessions for each condition, refer to Panel B of Figure 3-2.

In summary, results of the quality analysis indicated that, for both participants, the relative rates of both problem behavior and appropriate behavior were sensitive to the quality of reinforcement available for each alternative. This finding replicates the findings of previous investigations on the relative effects of quality of reinforcement on choice responding (Conger & Killeen, 1974; Hoch, McComas, Johnson, Faranda, & Guenther, 2002; Mace, McCurdy, & Quigley, 1990; Martens & Houk, 1989; Neef, Mace, Shea, & Shade, 1992; Peck et al., 1996). In addition, the interventions successfully decreased levels of problem behavior to clinically acceptable levels. Overall, these findings are important in cases where EXT is not an option given the potential for practical constraints or procedural failures that may be associated with EXT procedures.

Several additional findings with each participant require comment. In Experiment 2, quality of reinforcement was assessed using preference assessments (e.g., Justin) and reinforcer assessments (e.g., Kenneth). Previous researchers in this area have also used preference assessments (Hoch et al., 2002) and reinforcer assessments (Piazza et al., 1999) to assess quality of reinforcement. In the current experiment, however, the ultimate identification of a higher quality reinforcer was made based on a shift in response allocation from problem behavior to appropriate behavior. For both Justin and Kenneth, at least two manipulations of quality of reinforcement were required before a shift in response allocation was obtained.

For Justin, a greater number and higher quality of toys delivered contingent on appropriate behavior relative to the reinforcement following problem behavior were required before a consistent shift in response allocation was obtained. In this case, magnitude of reinforcement as well as quality of reinforcement was manipulated. Initially, access to one high quality reinforcer contingent on appropriate behavior and one low quality reinforcer contingent on problem behavior was effective at shifting response allocation toward appropriate behavior. This effect did not maintain, possibly due to satiation. Within session analysis showed that as the session progressed, Justin stopped playing with the toy and showed decreases in compliance. In addition to this observation, we did not have access to potentially higher quality toys Justin requested (e.g., video game systems, etc). Given our limited access to these potentially higher quality single toy items, we increased the number of preferred toys we provided contingent on appropriate behavior as a way of addressing potential satiation with the toys.

For Kenneth, the initial reinforcer assessment indicated praise was a more effective reinforcer than reprimands. This finding was obtained in relation to response allocation across different colored toys. During the functional analysis in Experiment I, however, reprimands functioned as reinforcers for problem behavior. During the first quality analysis, while problem behavior decreased, there were continuous shifts in response allocation across alternatives each session. Based on anecdotal observations between sessions, when Kenneth frequently requested physical attention in the forms of hugs and tickles by guiding the therapist's hands around him or to his stomach, physical attention was added to the social praise available following appropriate behavior. We did not have time to assess this combination of attention in a reinforcer assessment, however after this manipulation a shift in response allocation was observed. Overall, data from both Justin and Kenneth show that preference and reinforcer assessments contributed to the identification of a higher and lower quality reinforcer. These results indicate the need to empirically assess the preference for or quality of reinforcers prior to implementing treatments for problem behavior, and to continue manipulations of the parameters of reinforcement if initial manipulations fail to result in shifts in response allocation.

Another finding from the current experiment was evidence of relatively weak experimental control. With Justin, for example, we were unable to replicate the rates of appropriate behavior observed in previous baseline conditions in our final reversal to baseline. In the final reversal, responding favored appropriate behavior rather than problem behavior. What differed from the first to final baseline conditions was the intervening history where the reinforcement contingencies favored appropriate behavior. It is possible that the effect of reinforcement history influenced the later results. With Kenneth, there was an overall slow change in responding each condition. Without EXT in place, the gradual change should be expected. Responding under intermittent schedules of reinforcement can be more resistant to change (Ferster & Skinner, 1957). The point of comparison for these conditions is to conditions where EXT is not in place (i.e., baseline conditions where problem behavior is reinforced). Given that, these gradual changes are expected, but represent positive results as behavior decreased despite an absence of the EXT component.

With Kenneth, this history with variable reinforcement schedules may have resulted in an initial resistance to the effects of each condition. If weak experimental control was influenced by histories of reinforcement favoring appropriate behavior and intermittency of reinforcement, these effects may have important implications for caregivers. If a treatment can be implemented with sufficient procedural integrity to produce a bias in responding toward appropriate behavior relative to problem behavior, subsequent failures in procedural integrity may have less of an effect on behavior. This finding requires additional, future research.

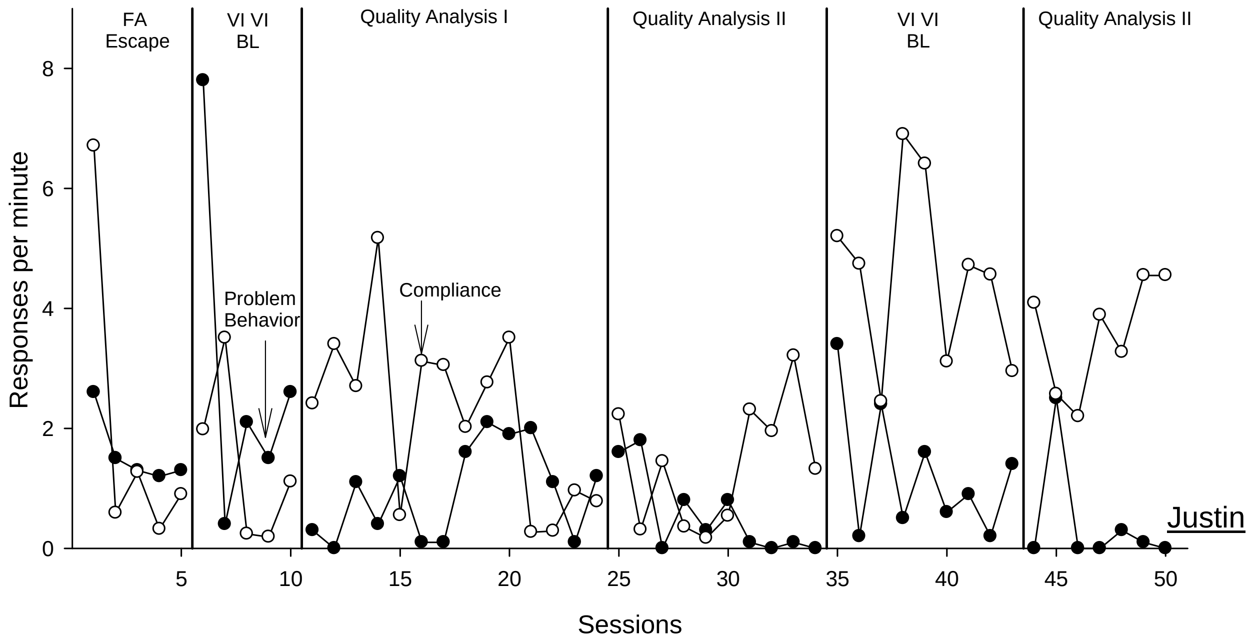

Figure 3-1. Overall response rates for problem and appropriate behavior for Justin.

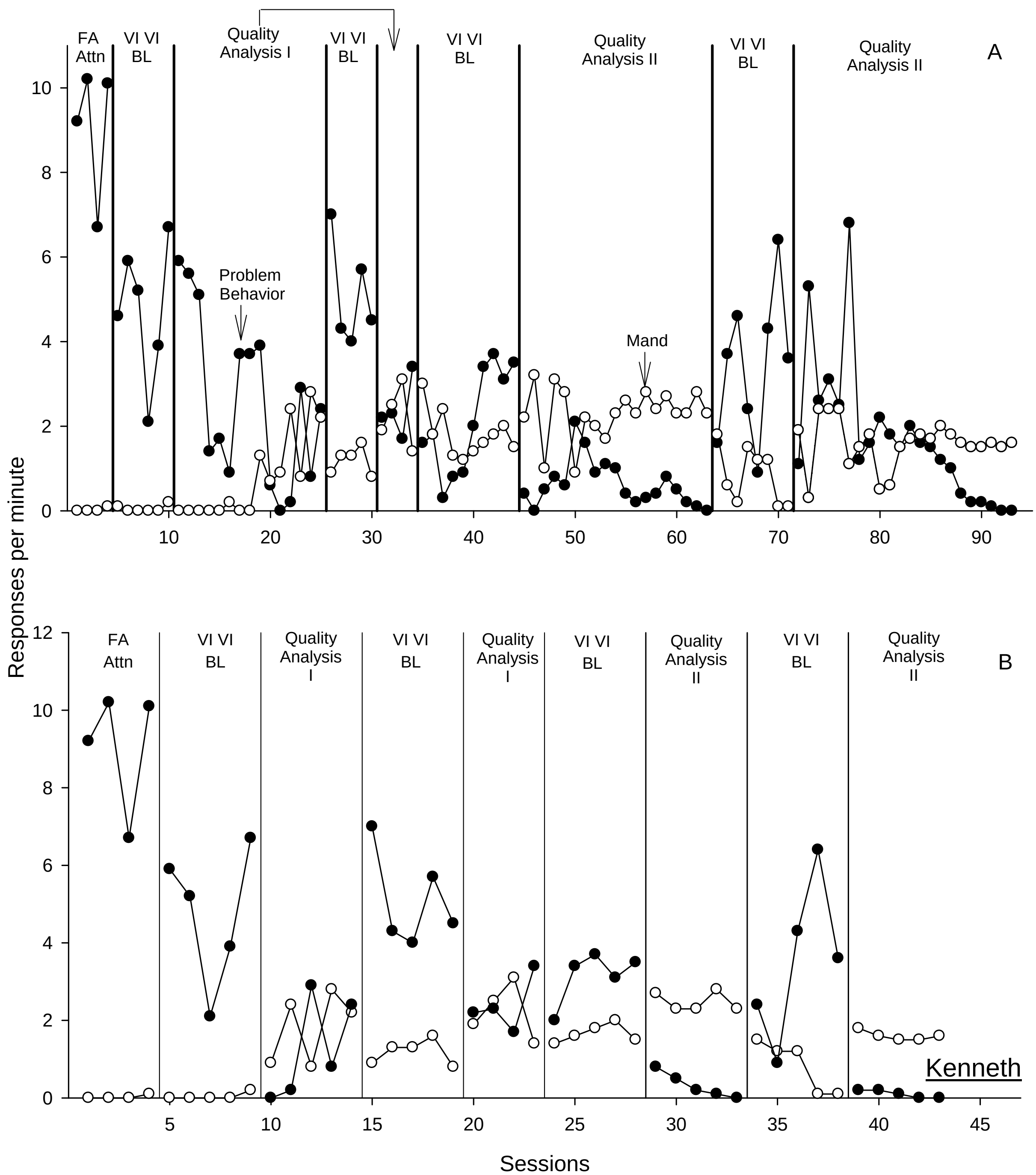

Figure 3-2. Kenneth's overall response rates for problem and appropriate behavior. A) Response per minute of problem and appropriate behavior during all assessment phases for Kenneth. B) Responses per min of problem and appropriate behavior during the final 5 sessions of each condition for Kenneth.

CHAPTER 4
EXPERIMENT III: ANALYSIS OF REINFORCEMENT DURATION

Method

Participants

Participants were two of the individuals, Justin and Lana, in Experiment I. Problem behavior was the same for each participant as in Experiment I, and appropriate behavior was also assessed for each participant. Justin's appropriate behavior was compliance with instructional demands (e.g., tidiness training). Lana's appropriate behavior was requests (i.e., mands) for a toy through the use of the American Sign Language sign for "play."

Setting

The setting was the same outpatient clinical unit as described for Experiment I. Session rooms (3 m by 3 m) were equipped with one-way mirrors and sound monitoring equipment. Rooms contained materials necessary for a session, which could include task materials, a toy, or some combination of each.

Procedure

All sessions were conducted by trained clinicians serving as experimenters. Observers were clinicians who received in-vivo training in behavioral observation and had previously demonstrated high interobserver agreement (IOA) scores (> 90%) with trained observers. Observers were seated behind a one-way mirror. Observers collected data on desktop computers that provided real-time data and scored events as either frequency (e.g., aggression, disruption, inappropriate sexual behavior, compliance, and mands), or duration (e.g., escape from instructions, delivery of toy, etc.). Sessions were conducted four to sixteen times each day, five days per week. Sessions were 10 min in duration, and there was a minimum of 5 to 10 min break between each session.

Interobserver agreement (IOA). Interobserver agreement was calculated as in Experiment 1. For Justin, IOA was scored for 27% of duration analysis sessions, and averaged 97% for aggression (range, 94% to 100%), 99% for disruption (range, 98% to 100%), and 100% for inappropriate sexual behavior. For Justin, agreement on the occurrence of compliance averaged 97% (range, 94% to 100%). For Lana, IOA was scored for 30% of duration analysis sessions, and averaged 99% for aggression (range, 98% to 100%). For Lana, agreement on the occurrence of sign language averaged 98% (range, 95% to 100%).

Stimulus preference assessment. Before the duration analysis, paired stimulus preference assessments were conducted with Lana as was conducted in Experiment 1. Before each duration analysis session, Lana was also exposed to a MSWO preference assessment (DeLeon & Iwata, 1996) as was described in Experiment 2. The item selected first in the MSWO was included in the upcoming experimental session.

Functional analysis baseline. The functional analysis baseline condition was identical to the condition associated with problem behavior during the functional analysis. These conditions varied for each participant, and included the escape condition for Justin and the tangible condition for Lana. During baseline, each instance of problem behavior resulted in delivery of the reinforcer (i.e., escape from instructions for Justin, tangible item for Lana). No programmed consequences were in place for appropriate behavior; that is, instances of appropriate behavior did not result in access to the reinforcer.

Baseline. Equal concurrent VI schedules of reinforcement (VI 20-s VI 20-s) were in place for both problem and appropriate behavior during the baseline analysis. The intervals were selected and timed as described in Experiment 2. The first instance of behavior following availability of a reinforcer resulted in delivery of the reinforcer (i.e. escape from instruction for

Justin, tangible item for Lana) for 30 s. After 30 s of reinforcer access, the reinforcer was removed and the timer was reset for that response.

Duration Analysis I. Equal concurrent VI schedules of reinforcement (VI 20-s VI 20-s) were in place for both problem and appropriate behavior. The intervals were timed and the therapist signaled in the same manner as in the baseline analysis. For Justin, problem behavior produced a 10-s break from instructions. Appropriate behavior produced a 30-s break from instructions. For Lana, problem behavior produced 10 s of access to a top preferred toy. Appropriate behavior produced 30 s of access to the top preferred toy. For both participants, after the interval of reinforcer access was complete, the reinforcer was removed and the timer was reset for that response.

Duration Analysis II. Justin participated in duration analysis II. Equal concurrent VI schedules of reinforcement (VI 20 s VI 20 s) were in place for both problem and appropriate behavior. The intervals were timed and the therapist signaled in the same manner as in the baseline analysis. Problem behavior produced a 5-s break from instructions. Appropriate behavior produced a 45-s break from instructions. After the interval of reinforcer access was complete, the reinforcer was removed and the timer was reset for that response.

Results and Discussion

Figure 4-1 shows the results for Justin. Responses per min of problem and appropriate behavior are displayed for all phases. During the functional analysis baseline, problem behavior occurred at a high rate (M = 13.72 rpm), and appropriate behavior never occurred. In the subsequent baseline condition, problem behavior (M = 2.58 rpm) continued to occur at higher rates than appropriate behavior (M = .28 rpm). In the initial duration analysis condition, there was a further decrease in the rate of problem behavior (M =1.84 rpm). Problem behavior continued to occur, however, at higher rates than appropriate behavior (M = .64 rpm). Following this, reinforcement duration was altered by decreasing the reinforcement for problem from 10 s to 5 s, and increasing the duration for appropriate behavior from 30 s to 45 s. Under these conditions (duration analysis II), problem behavior decreased further (*M* = 1.16rpm), and appropriate behavior increased (*M* = 1.15 rpm). In the last five sessions of this condition, problem behavior decreased to its lowest observed rates. In a reversal to baseline, there was a shift in response allocation such that problem behavior occurred more frequently (*M* = 1.27 rpm) than appropriate behavior (*M* = 1.03 rpm). In the subsequent reversal to the second duration analysis, there was a similar decrease in problem behavior (*M* =.57 rpm) and increase in appropriate behavior (*M* = .85 rpm). Responding stabilized in the last five sessions of this condition, with problem behavior remaining low and appropriate behavior remaining high. In a reversal to baseline, however, there was a failure to replicate previous baseline levels of responding. Instead, low rates of problem behavior (*M* = .22 rpm) and high rates of appropriate behavior (*M* = 1.4 rpm) were observed.

Figure 4-2 shows the results for Lana. Responses per min of problem and appropriate behavior are displayed for all phases. During the functional analysis baseline, problem behavior occurred at high rates (*M* = 2.48 rpm) and appropriate behavior at low rates (*M* = .12 rpm). In the subsequent baseline condition problem behavior (*M* = 1.68 rpm) continued to occur at higher rates than appropriate behavior (*M* = .28 rpm). In the initial duration analysis condition, there was a further decrease in the rate of problem behavior (*M* =.82 rpm), and an increase in appropriate behavior (*M* = 1.46 rpm). In the final four sessions, problem behavior decreased even further (*M* = .04 rpm) and appropriate behavior increased (*M* = 1.95 rpm). Following this, the baseline condition was replicated and there was an observed increase in problem behavior (*M* = 1.8 rpm) and appropriate behavior decreased (*M* = .9 rpm). Lana’s participation was concluded with a return to the initial duration analysis. During this analysis there was a decrease in problem behavior (*M* =.7 rpm) and increase in appropriate behavior (*M* = 1.17 rpm). Problem behavior ceased to occur the final five sessions of this condition, and appropriate behavior remained at relatively higher rates (*M* = 1.8 rpm).

In summary, results of the duration analysis indicate that, for both participants, the relative rates of both problem behavior and appropriate behavior were sensitive to the reinforcement duration available for each alternative. This finding replicates the findings of previous investigations on the effects of reinforcement duration on choice responding (Catania, 1963; Lerman, Kelley, Vorndran, Kuhn, & LaRue, 2002; Ten Eyck, 1970). The interventions also successfully decreased levels of problem behavior to clinically acceptable levels. Problem behavior occurred at zero to near zero rates for both Justin and Lana by the final four sessions of the analysis. Appropriate behavior increased and ultimately remained at a relatively higher rate. Similar to Experiment II, these findings are important in cases where EXT is not an option given the potential for practical constraints or procedural failures that may be associated with EXT procedures.

Similar to Experiment II, there was evidence of lack of experimental control with Justin. With Justin, we were unable to recapture rates of problem and appropriate behavior in our final reversal to baseline. Similar to the previous experiment, this failure to recapture previous rates of responding followed conditions of reinforcement that favored appropriate behavior. These results could indicate a history effect, which, although not the aim of the current study, again has important implications for caregivers. If a treatment can be implemented with sufficient procedural integrity to produce a bias in responding toward appropriate behavior relative to problem behavior, subsequent failures in procedural integrity may have less of a detrimental effect on behavior. Future research into this finding is warranted.

One final result of the analysis requires discussion. For Justin, 10 s of access to reinforcement following problem behavior was sufficient to maintain higher rates of problem behavior. This was not the case for Lana, for whom 10 s of access to reinforcement following behavior resulted in a cessation of problem behavior. This finding highlights the idiosyncratic nature of reinforcement for problem behavior, indicating a need for systematic analysis of the parameters of reinforcement maintaining problem behavior on an individual basis.

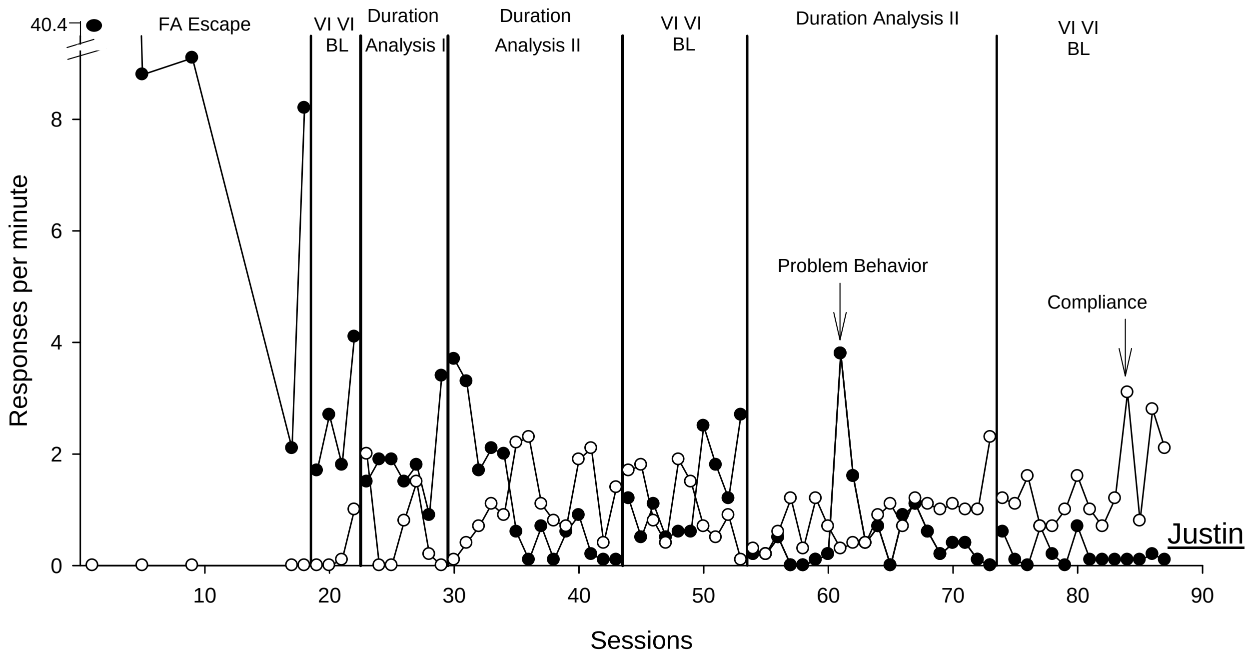

Figure 4-1. Justin's overall response rates for problem and appropriate behavior.

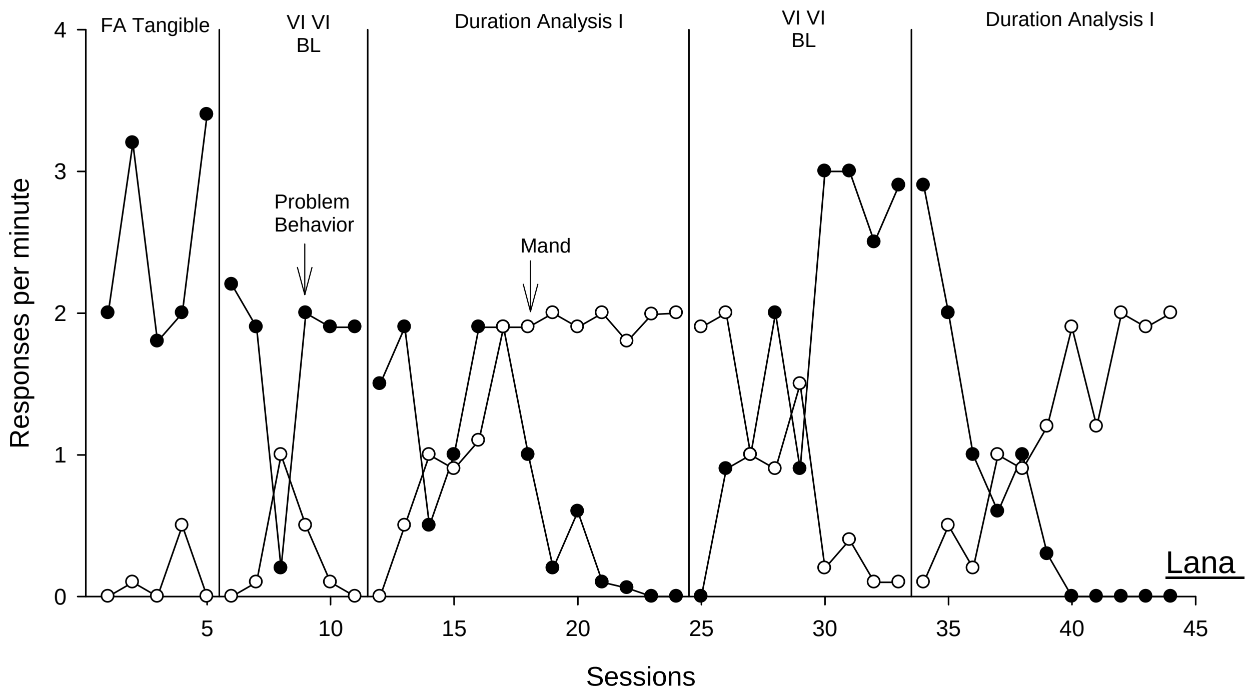

Figure 4-2. Lana’s overall response rates for problem and appropriate behavior.

CHAPTER 5
EXPERIMENT IV: ANALYSIS OF REINFORCEMENT DELAY

Method

Participants

Participants were two of the individuals, Corey and Henry, in Experiment I. Problem behavior was the same for each participant as in Experiment I, and appropriate behavior was also assessed for each participant. Corey's appropriate behavior was a vocal verbal request (mand) for his toy (e.g., "May I have my toy please."). Henry's appropriate behavior was the exchange of a picture card as a request (mand) for a break from instructional demands.

Setting

The setting was the same outpatient clinical unit as described for Experiment I. Session rooms (3 m by 3 m) were equipped with one-way mirrors and sound monitoring equipment. Rooms contained materials necessary for a session, which could include task materials, toys, a picture card, or some combination of each.

Procedure

All sessions were conducted by trained clinicians serving as experimenters. Observers were clinicians who received in-vivo training in behavioral observation and had previously demonstrated high interobserver agreement (IOA) scores (> 90%) with trained observers. Observers were seated behind a one-way mirror. Observers collected data on desktop computers that provided real-time data and scored events as either frequency (e.g., aggression and disruption) or duration (e.g., delivery of toys, escape from instructions, etc.). Sessions were conducted four to sixteen times each day, five days per week. Sessions were 10 min in duration, and there was a minimum of 5 to 10 min break between each session.

Interobserver agreement (IOA). Interobserver agreement was calculated as in Experiment 1. For Corey, IOA was scored for 30% of delay analysis sessions, and averaged 95% for aggression (range, 89% to 100%), and 96% for disruption (range, 95% to 100%). For Corey, agreement on the occurrence of mands averaged 99% (range, 98% to 100%). For Henry, IOA was scored for 31% of delay analysis sessions, and averaged 97% for aggression (range, 94% to 100%), and 92% for disruption (range, 87% to 100%). For Henry, agreement on the occurrence of mands averaged 97% (range, 93% to 100%).

Stimulus Preference Assessment. Before the reinforcement delay analyses, paired stimulus preference assessments were conducted with Corey as was conducted in Experiment 1. Immediately prior to each session in the delay analysis, Corey was also exposed to a MSWO preference assessment (DeLeon & Iwata, 1996) as described in Experiment 2. The item selected first in the MSWO was included in the upcoming experimental session.

Functional analysis baseline. The functional analysis baseline condition was identical to the condition associated with problem behavior during the functional analysis. These conditions were the tangible condition for Corey and the escape condition for Henry. During baseline, each instance of problem behavior resulted in delivery of the reinforcer (i.e., tangible item for Corey, escape from instructions for Henry). No programmed consequences were in place for appropriate behavior; that is, instances of appropriate behavior did not result in access to the reinforcer.

Baseline. Equal concurrent VI schedules of reinforcement (VI 20-s VI 20-s) were in place for both problem and appropriate behavior during the baseline analysis. The intervals were selected and timed as described in Experiment 2. The first instance of behavior following availability of a reinforcer resulted in delivery of the reinforcer (i.e. tangible item for Corey, escape from instruction for Henry) for 30-s. After 30-s of reinforcer access, the reinforcer was removed and the timer was reset for that response.

Delay Analysis I. Equal concurrent VI schedules of reinforcement (VI 20-s VI 20-s) were in place for both problem and appropriate behavior. The intervals were timed and the therapist signaled in the same manner as in the baseline analysis. For Corey, problem behavior produced 30 s of access to a preferred toy after a 30-s unsignaled delay. Appropriate behavior produced 30 s of immediate access to the same preferred toy. For Henry, problem behavior produced a 30-s break from instructions after a 30-s unsignaled delay. Once a delay interval was started, additional instances of problem behavior did not reset the interval. Appropriate behavior produced an immediate 30 s break from instructions. If reinforcement was available for appropriate behavior and the behavior occurred during a delay to reinforcement for problem behavior, the delay interval was stopped and reinforcement was immediately delivered for appropriate behavior. For both participants, after the interval of reinforcer access was complete, the reinforcer was removed and the timer was reset for that response.

Delay Analysis II. Equal concurrent VI schedules of reinforcement (VI 20-s VI 20-s) were in place for both problem and appropriate behavior. The intervals were timed and the therapist signaled in the same manner as in baseline. For Corey, problem behavior produced 30 s of access to a top preferred toy after a 60-s unsignaled delay. Appropriate behavior produced 30 s of immediate access to the top preferred toy. For Henry, problem behavior produced a 30-s break from instructions after a 60-s unsignaled delay. Delay intervals were timed in the same manner described in Delay Analysis I. For both participants, after the interval of reinforcer access was complete, the reinforcer was removed and the timer was reset for that response.

Results and Discussion

Figure 5-1 Panel A shows the results for Corey. Responses per min of problem and appropriate behavior are displayed for all phases. During the functional analysis baseline condition there were high rates of problem behavior (*M* = 3.35 rpm) and low rates of appropriate behavior (*M* = .05 rpm). During the subsequent (VI VI) baseline condition, Corey continued to engage in higher rates of problem behavior (*M* = 3.03 rpm) than appropriate behavior (*M* = 1.63 rpm). A replication of the initial delay analysis was then conducted. During this condition, problem behavior continued to occur at a higher rate (*M* = 2.16 rpm) than appropriate behavior (*M* = 1.98 rpm). Given this, the second delay analysis was implemented. During this condition, a slow decrease in problem behavior (*M* = 1.99) and increase in appropriate behavior (*M* = .91) was observed. By the final five sessions of the second delay analysis condition, problem behavior ceased and appropriate behavior occurred at a high, steady rate (*M* = 1.22 rpm). To further establish control over responding, a baseline reversal was conducted. During this reversal to baseline there was an increase in problem behavior (*M* = 3.45 rpm) and decrease in appropriate behavior (*M* = 1.8 rpm). In the final reversal to the second delay analysis, problem behavior decreased and appropriate behavior increased. In the final five sessions of the condition there was a cessation in problem behavior and high, steady rates of appropriate behavior (*M* = 2.52 rpm). To better show the control over behavior in the final sessions of each phase of the experiment, the last five sessions of each condition with Corey are presented in Figure 5-1 Panel B.

Figure 5-2 shows the results for Henry. Responses per min of problem and appropriate behavior are displayed for all phases. During the functional analysis baseline, Henry engaged in higher rates of problem behavior (*M* = 3.4 rpm) than appropriate behavior (*M* = .05 rpm). During the subsequent (VI VI) baseline condition, Henry continued to engage in higher rates of problem behavior (*M* = 2.2 rpm) than appropriate behavior (*M* = .03 rpm). In the initial delay analysis, despite a slight decrease in problem behavior, Henry continued to engage in a higher rate of problem behavior (*M* = 1.28 rpm) than appropriate behavior (*M* = .91). In a reversal to baseline, there was a slight increase in problem behavior from the previous condition (*M* = 1.75 rpm) and decrease in appropriate behavior (*M* = .55 rpm). Thereafter, the second delay analysis was implemented. During this condition there was a decrease in problem behavior (*M* = 1.6 rpm) to zero rates the last three sessions. There was an increase in appropriate behavior (*M* = 1.6 rpm), to steady rates of 2 per min the last three sessions. To replicate these findings, a reversal to baseline was implemented and increased rates of problem behavior (*M* = 1.5 rpm) and decreased rates of appropriate behavior (*M* = .7 rpm) were observed. In a reversal to the initial delay analysis, there was a decrease in the overall rate of problem behavior (*M* = 1.3 rpm), however this rate was still higher than the rate of appropriate behavior (*M* = .96 rpm). A final reversal to baseline was then conducted, and higher rates of problem behavior (*M* = 2.05 rpm), than appropriate behavior (*M* = .1 rpm) were obtained. Henry's participation in this experiment concluded with exposure to the second delay analysis condition. In this condition, there was a further decrease in problem behavior (*M* = 1.0 rpm) and increase in appropriate behavior (*M* = 1.58 rpm). In the last five sessions of this condition, problem behavior ceased and there was an average of 2 responses per minute of appropriate behavior each session.

In summary, results of the delay analysis indicate that, for both participants, the relative rates of problem behavior and appropriate behavior were sensitive to the delay to reinforcement following each alternative. These results replicate the findings of previous investigations on the relative disruptive effects of unsignaled delay to reinforcement (Sizemore & Lattal, 1978; Williams, 1976; Vollmer, Borrero, Lalli, & Daniel, 1999). The interventions also successfully decreased levels of problem behavior to clinically acceptable levels. Problem behavior decreased to zero rates for both Corey and Henry by the conclusion of the analysis. Appropriate behavior increased and remained at a stable rate. Similar to Experiment II and III, these findings are important in cases where EXT is not an option given the potential for practical constraints or procedural failures that may be associated with EXT procedures.

It is important to note that the delays programmed were not necessarily obtained in the experiment. The occurrence of problem behavior in each delay analysis started a timer that, when elapsed, resulted in delivery of reinforcement. It was therefore possible that problem behavior occurred within the delay interval and resulted in shorter delays to reinforcement. In an examination of the data, this rarely occurred with Henry. With Corey, however, this did occur when problem behavior occurred in bursts or at high rates, and most often occurred at the start of each delay analysis condition. The high rates of responding resulted in some problem behavior being reinforced after delays shorter than the programmed 30 or 60 s. This could explain the weak experimental control observed at the start of each delay analysis condition with Corey. In a close analysis of the data it was found that at least once per session, the interval between instances of problem behavior was sufficient such that the programmed delay to reinforcement was experienced. With this, experimental control was eventually obtained. This control is most easily observed in Figure 5-1 Panel B, which shows the final five sessions of each condition for Corey. Overall this finding highlights a potential limitation to the current method. One way to address this limitation would be to add a differential reinforcement of other behavior component with a resetting reinforcement interval to the procedure. This component would involve the delivery of a reinforcer after a period of time in which no problem behavior occurred. The resetting feature would result in the occurrence of problem behavior within the interval resetting the interval and therefore delaying reinforcement. This component was not added in the current experiment in part because, with high rate problem behavior, it could have resulted in a schedule of reinforcement for problem behavior that resembled EXT.

Another potential limitation to the current experiment was the possibility of adventitious reinforcement of chains of problem behavior and appropriate behavior. For example, when appropriate behavior occurred during the delay interval for problem behavior, and the VI schedule indicated reinforcement was available for that response, there was immediate reinforcement of appropriate behavior. This reinforcement could have strengthened a chain of problem and appropriate behavior. While this did not seem to be a concern in the current experiment, one way to control for this limitation would be to add a changeover delay (COD). A COD allows a response to be reinforced only if a certain interval of time has passed since the last changeover from the other response alternative. The COD could result in longer periods of responding at the alternatives and thus greater control by the relative reinforcement available for those alternatives (Catania, 1966). Each of the potential limitations to the current experiment indicates an avenue of future research on reinforcement delay.

The results of Experiments II-IV have been relatively positive, with each experiment showing the independent effects of isolated parametric manipulations. Although generally positive, the changes in behavior were very gradual. From a treatment standpoint, one might consider combining all the parametric manipulations to stack the deck in favor of appropriate behavior. This possibility was tested in Experiment V.

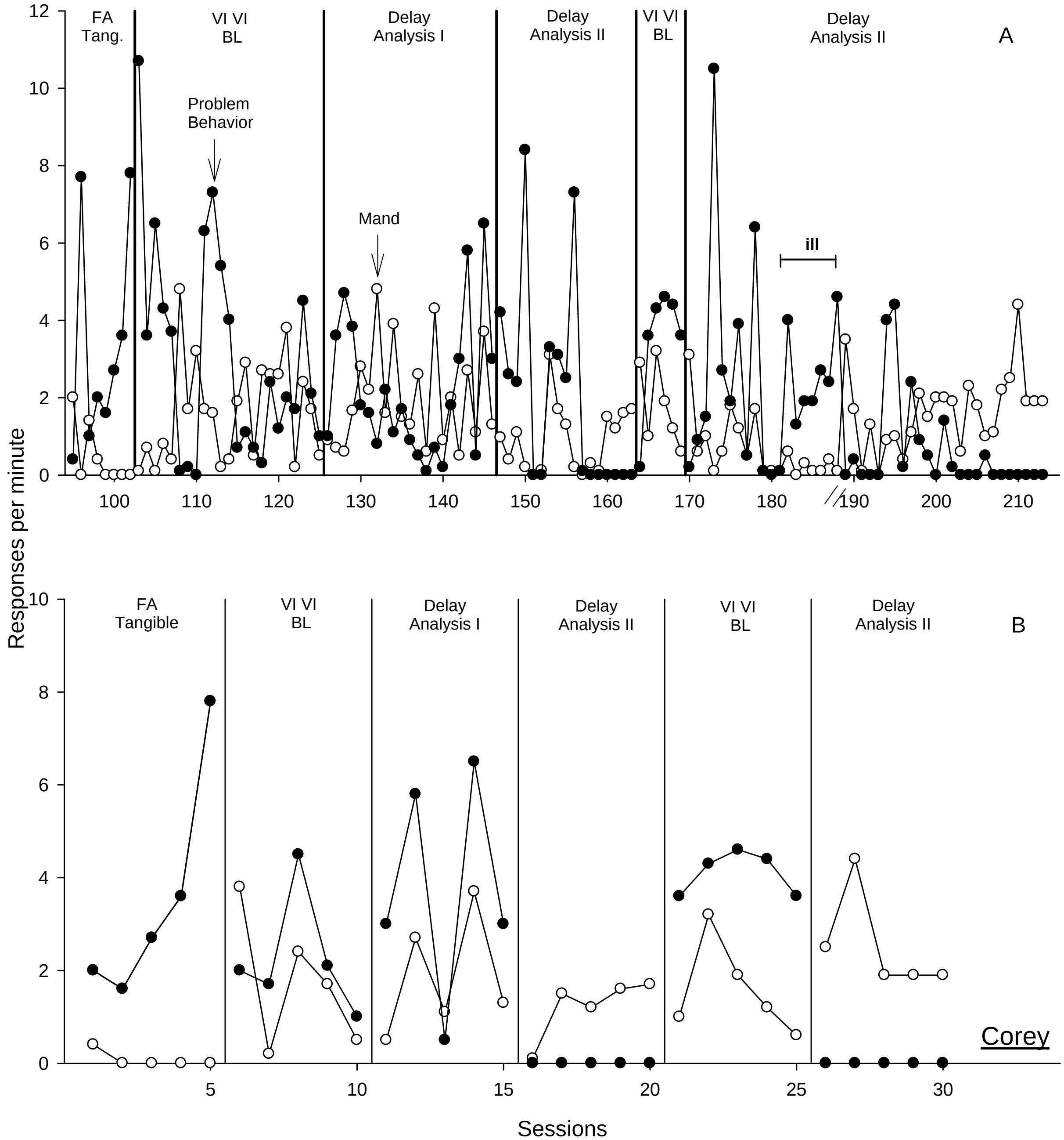

Figure 5-1. Corey's overall response rates for problem and appropriate behavior. A) Responses per minute of problem behavior and appropriate behavior during all assessment phases for Corey. B) Responses per min of problem and appropriate behavior during the final 5 sessions for Corey.

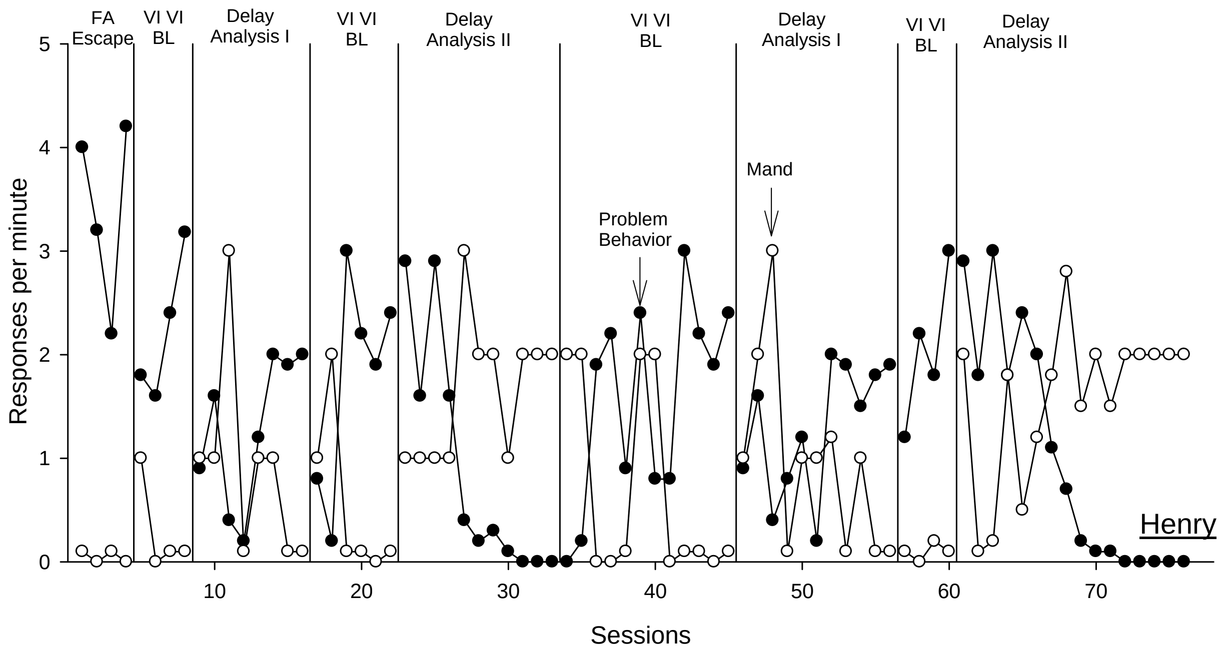

Figure 5-2. Henry's overall responses rates for problem and appropriate behavior for Henry.

CHAPTER 6
EXPERIMENT V: ANALYSIS OF REINFORCEMENT QUALITY, DURATION, AND DELAY

Method

Participant

The participant was one of the individuals, George, in Experiment I. Problem behavior was the same for George as in Experiment I, and appropriate behavior was also assessed. George's appropriate behavior was the exchange of a picture card as a request (mand) for attention.

Setting

The setting was the same elementary school classroom as described for Experiment I. The classroom contained materials necessary for a session, which included a picture card and various classroom materials such as posters and tables.

Procedure

All sessions were conducted by trained clinicians serving as experimenters. Observers were clinicians who received in-vivo training in behavioral observation and had previously demonstrated high interobserver agreement (IOA) scores (> 90%) with trained observers. Observers were seated out of the client's direct line of sight. Observers collected data on laptop computers that provided real-time data and scored events as either frequency (e.g., aggression and disruption), or duration (e.g., delivery of toys, escape from instructions, etc.). Sessions were conducted four to sixteen times each day, five days per week. Sessions were 10 min in duration, and there was a minimum of 5 to 10 min break between each session.

Interobserver agreement (IOA). Interobserver agreement was calculated as in Experiment 1. For George, IOA was scored for 25% of experimental sessions, and averaged 97% for aggression (range, 90% to 100%), and 95% for disruption (range, 89% to 100%).

Reinforcer assessment. Before conducting the experimental analyses with George, a reinforcer assessment was conducted in the same manner as Experiment II using procedures described by Piazza et al. (1999). The reinforcing efficacy of praise (e.g., “Good job, George”) and physical contact (e.g. high fives, pats on the back), was compared with reprimands (e.g., “Don’t do that”) and physical contact (e.g. therapist using his hands to block aggression from George).

Functional analysis baseline. The functional analysis baseline condition was identical to the condition associated with problem behavior during the functional analysis. This condition was the attention condition for George. During baseline, each instance of problem behavior resulted in delivery of attention. No programmed consequences were in place for appropriate behavior; that is, instances of appropriate behavior did not result in access to the reinforcer.

Baseline. Equal concurrent VI schedules of reinforcement (VI 20-s VI 20-s) were in place for both problem and appropriate behavior during the baseline analysis. The intervals were selected and timed as described in Experiment II. The first instance of behavior following availability of a reinforcer resulted in delivery of the reinforcer (i.e. immediate social attention and physical contact) for 30-s. After 30-s of reinforcer access, the reinforcer was removed and the timer was reset for that response.

Parametric Analysis. Equal concurrent VI schedules of reinforcement (VI 20-s VI 20-s) were in place for both problem and appropriate behavior. The intervals were timed and the therapist signaled in the same manner as in the baseline analysis. Problem behavior produced 5 s of low-preferred attention in the form of social disapproval and blocking of aggression after a 10-s unsignaled delay. Appropriate behavior produced 30 s of immediate access to high-preferred attention in the form of social praise and physical attention (e.g., high fives, pats on the back, etc.). Delays to reinforcement were timed in the same manner as described in Experiment IV. After the interval of reinforcer access was complete, reinforcement ceased and the timer was reset for that response.

Results and Discussion

Figure 6-1 shows the results for George. Responses per min of problem and appropriate behavior are displayed for all phases. The initial functional analysis baseline shows sessions for the attention condition. During the functional analysis baseline, George engaged in higher rates of problem behavior (*M* = 2.24 rpm) than appropriate behavior (*M* = .02 rpm). George continued to engage in higher rates of problem behavior (*M* = 3.6 rpm) than appropriate behavior (*M* = .07 rpm) during the VI VI baseline. In the initial parametric analysis there was a decrease in problem behavior (*M* = .07 rpm) and increase in appropriate behavior (*M* = .94 rpm). In a reversal to baseline, there was an increase in problem behavior (*M* = 1.52 rpm) and decrease in appropriate behavior (*M* = .22 rpm). In a reversal to the initial parametric analysis, there was a further decrease in problem behavior (*M* = .1 rpm) and increase in appropriate behavior (*M* = 1.17 rpm). George's participation in this experiment concluded with a one month follow-up to evaluate the maintenance of these effects of the parametric analysis. The last three sessions of this condition were conducted by George's teacher. In this condition, there was a further decrease in problem behavior (*M* = 0 rpm) and increase in appropriate behavior (*M* = 1.64 rpm).

In summary, results of the parametric analysis indicate that the relative rates of problem behavior and appropriate behavior were sensitive to the quality, delay, and duration of reinforcement following each alternative. These results replicate the findings of previous investigations on the relative effects of manipulation of several parameters of reinforcement in a concurrent-operants arrangement (Parrish, Cataldo, Kolko, Neef, & Egel, 1986; Piazza et al., 1997; Russo, Cataldo, & Cushing, 1981). The intervention also successfully decreased levels of problem behavior to clinically acceptable levels. Problem behavior decreased to zero rates for both George by the conclusion of the analysis. Appropriate behavior increased and remained at a stable rate. Similar to Experiments II-IV, these findings are important in cases where EXT is not an option given the potential for practical constraints and integrity failures associated with EXT procedures.

In further comparison to Experiments II-IV, this experiment resulted in clear experimental control; there were rapid changes in response allocation across conditions and consistent replications of responding under previous conditions. The changes in behavior seen in Experiments II-IV were very gradual, but the experiments showed the effects of isolated parametric manipulations. Experiment V showed the effects of combined parametric manipulations. It is possible that the relative insensitivity to change associated with intermittent schedules of reinforcement was reduced with the manipulation of several parameters of reinforcement in combination. This finding requires additional research.

Similar to Experiment IV, it is important to note that the delays programmed were not necessarily obtained in the experiment. The occurrence of problem behavior in each delay analysis started a timer that, when elapsed, resulted in delivery of reinforcement. It was therefore possible that problem behavior occurred within the delay interval and resulted in shorter delays to reinforcement. In an examination of the data, this rarely occurred with George.

Another potential limitation to the current experiment was the possibility of adventitious reinforcement or of chaining problem behavior with appropriate behavior. Appropriate behavior that occurred during the delay interval for problem behavior resulted in immediate reinforcement. This reinforcement could have strengthened a chain of problem and appropriate behavior. In an examination of the data, this rarely occurred with George.

There were several benefits to this investigation. First, sessions were conducted in the environment caregiver's indicated the behavior was most problematic (i.e., most frequent and most severe). Second, both maintenance and generality of the procedures were assessed in a one month follow-up, with George's teacher serving as the therapist in several of the sessions.

George's teacher reported that George had a history of attacking peers, making his behavior too severe for her to consistently ignore. His teacher also indicated that the presence of four other children in the room limited the amount of attention she could deliver following George's appropriate behavior. This was a prime example of a case where EXT of problem behavior and regular attention following appropriate behavior would be a beneficial recommendation, but likely implemented in the natural environment with integrity failures. The current procedure indicated an effective treatment option that did not require EXT of problem behavior or continuous reinforcement of appropriate behavior. Instead, George's teacher briefly delivered a low quality of reinforcement after a short delay from some of George's problem behavior. This attention ensured the safety of those around George. Contingent on some of George's appropriate behavior, however, his teacher immediately delivered high quality attention for a relatively longer duration. Given a choice between these two consequences, George chose to engage in more appropriate behavior than problem behavior. Given there is only one participant in the current analyses, however, additional research must be conducted in order to determine the generality of these results.

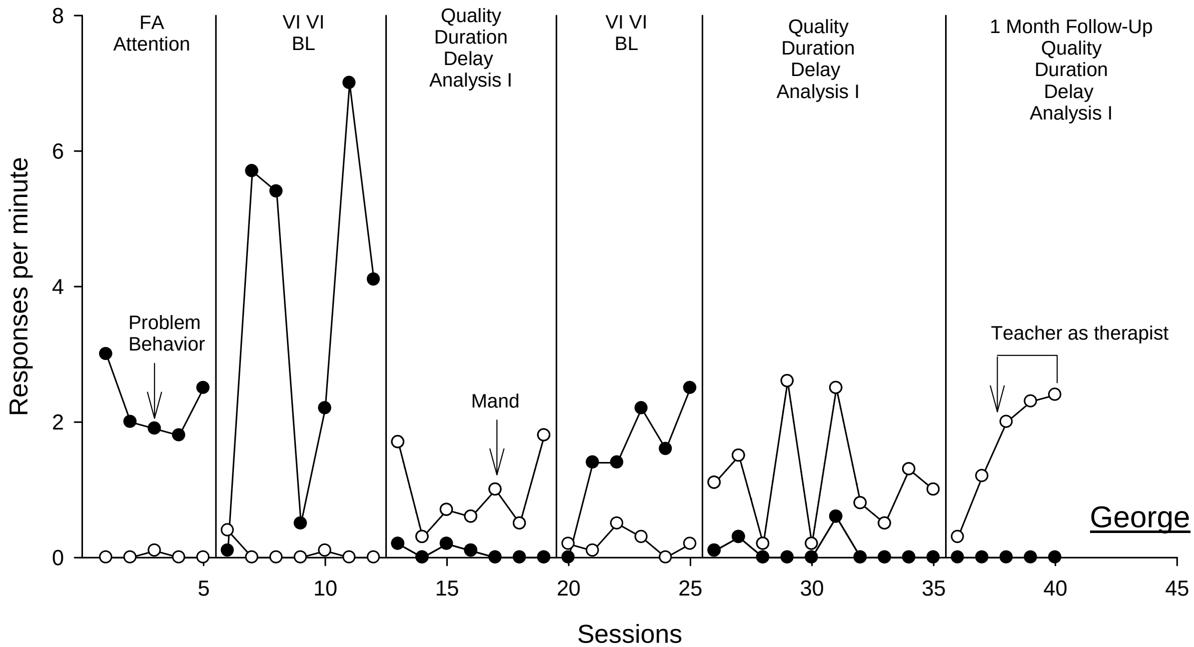

Figure 6-1. George's overall response rates for problem and appropriate behavior.

CHAPTER 7
GENERAL DISCUSSION

The current experiments focused on evaluating several parameters of reinforcement and the effects on problem and appropriate behavior with the purpose of shedding light on manipulations that could be considered in the event EXT either cannot or will not be implemented. The experiments were designed to determine if the manipulation of reinforcement parameters such as the quality, duration, or delay of reinforcement could result in effective treatments for 6 individuals with developmental disorders and/or disabilities who engaged in severe problem behavior.

In Experiment 1, functional analyses were conducted for problem behavior exhibited by five individuals diagnosed with developmental disorders or disabilities to identify reinforcers for problem behavior. For Justin and Henry, problem behavior was reinforced by escape from instructional demands. For Corey and Lana, problem behavior was reinforced by access to tangible items. For George, problem behavior was reinforced by adult attention. For Kenneth, problem behavior was reinforced by adult attention and escape from highly aversive instructional demands. This experiment was a necessary prerequisite to Experiment II-V. The results of Experiment I provided a basis for each subsequent experiment, during which manipulations were made to the reinforcers delivered on concurrent VI schedules of reinforcement following problem and appropriate behavior. Such analyses would not have been possible without identifying the function(s) of problem behavior.

In Experiment II-V, analyses of concurrent reinforcement schedules were conducted with independent reinforcement schedules in place for both problem behavior and appropriate behavior. In Experiment II, we evaluated response allocation under a concurrent schedule of reinforcement when the reinforcement available following appropriate behavior was of a greater quality than that available following problem behavior. Analyses for Justin during the escape conditions and analyses for Kenneth under attention conditions showed the quality manipulations were effective in decreasing problem behavior and increasing appropriate behavior. This finding replicates the findings of previous investigations on the relative effects of quality of reinforcement on choice responding (Conger & Killeen, 1974; Hoch, McComas, Johnson, Faranda, & Guenther, 2002; Mace, McCurdy, & Quigley, 1990; Martens & Houk, 1989; Neef, Mace, Shea, & Shade, 1992; Peck et al., 1996).

In Experiment III, we evaluated the effects of providing longer duration access to the reinforcer/s following appropriate behavior and shorter access following problem behavior. Analyses for Corey during the tangible conditions and analyses for Henry under escape conditions showed the duration manipulations were effective in decreasing problem behavior and increasing appropriate behavior. This finding replicates the findings of previous investigations on the effects of reinforcement duration on choice responding (Catania, 1963; Ten Eyck, 1970).

It is important to note that the manipulation of duration of reinforcement can also be described as a manipulation of magnitude of reinforcement. Magnitude of reinforcement can take the form of intensity, number, or duration. For Justin in Experiment II, magnitude and quality of reinforcement were manipulated by increasing the number of high-quality toys available following appropriate behavior relative to a stable, smaller number of low-quality toys available following problem behavior. In Experiment III, magnitude was manipulated by increasing and decreasing the duration of reinforcement ranged from 5-s to 45-s across responses and participants, with durations favoring appropriate behavior relative to problem behavior. Findings from both investigations supported previous research showing that manipulations of magnitude of reinforcement can produce shifts in response allocation to the response alternative that provides the greater magnitude of reinforcement, relative to that concurrently available for other alternatives (Catania, 1963; Hoch et al., 2002; Lerman et al., 2002).

In Experiment IV, we evaluated the effects of delivering more immediate access to the reinforcer/s following appropriate behavior and delayed access following problem behavior. Analyses for Justin during the escape conditions and analyses for Lana under attention conditions showed the delay manipulations were effective in decreasing problem behavior and increasing appropriate behavior. These results replicate the findings of previous investigations on the relative disruptive effects of unsignaled delay to reinforcement (Sizemore & Lattal, 1978; Williams, 1976; Vollmer, Borrero, Lalli, & Daniel, 1999).

The purpose of Experiments II-IV was to evaluate the effects of manipulating one feature of reinforcement at a time. This leads to the clinical implication that all features could be manipulated in some way to favor appropriate behavior. Given that, in Experiment V we evaluated the effects of delivering more immediate, longer duration access to high quality reinforcement following appropriate behavior and delayed, shorter duration access to lower quality reinforcement following problem behavior. Analyses for George during the attention condition showed these manipulations were effective in decreasing problem behavior and increasing appropriate behavior. In comparison to Experiments II-IV, Experiment V resulted in more rapid changes in responding. Overall, these results replicate the findings of previous investigations on the relative effects of increasing the value of reinforcement along several parameters following appropriate behavior relative to that following problem behavior (Parrish, Cataldo, Kolko, Neef, & Egel, 1986; Piazza et al., 1997; Russo, Cataldo, & Cushing, 1981).

Finally, at the conclusion of each individual's participation in the current investigations, a comprehensive treatment package was developed (not outlined here), and his caregivers were trained in the treatment package as well as given a set of general parenting instructions.

There are several implications of the results of Experiment II-V. As has been noted previously, EXT is a highly effective component of the DRA procedure and increases the efficacy of the DRA procedure as a treatment for problem behavior. Unfortunately, it is not always possible to implement EXT. Of prime concern are cases where treatment integrity failures with EXT may be inevitable. The present studies showed the effectiveness of differential reinforcement of appropriate behavior by providing some combination of more immediate, longer duration, or higher quality of reinforcement for appropriate behavior relative to reinforcement for problem behavior. In cases where EXT is not feasible, the current studies offer a method of decreasing problem behavior and increasing appropriate behavior without the use of EXT. For example, if problem behavior is so severe (e.g., severe aggression, head-banging on hard surfaces, etc.) that it is not possible to withhold reinforcement, it may be possible to manipulate other parameters of reinforcement such as duration or quality or reinforcement to favor appropriate behavior. If problem behavior in the form of severe self-injury is maintained by attention, for example, a caregiver could briefly attend to the self-injury to ensure the safety of the individual. The attention following problem could be of a lower quality than the attention available following appropriate behavior. Problem behavior could result in a short duration of social attention including monotone statements of concern, and brief physical contact to block the self-injury. Appropriate behavior could result in a longer duration of attention in the form of praise, smiles, laughter, and physical attention such as hugs and tickling. Results of the current analyses suggest these types of manipulations could decrease problem behavior and increase appropriate behavior.

Another finding from Experiments II and V implicates the need for future research into history effects. In these experiments there was evidence of carry over from the functional analysis baseline. When concurrent VI schedules were initially equated, response allocation favored problem behavior, presumably as a result of the preceding condition. Also, for both participants in Experiment III, and one in Experiment IV, there was either a failure to replicate the findings from baseline conditions conducted earlier in the experiments or a slower change in responding as the experiment progressed, such that responding began to favor appropriate behavior rather than problem behavior The slower change in responding observed throughout these experiments is expected because EXT was not in place. A proper comparison for parametric manipulations is conditions where EXT is not in place (i.e., baseline conditions where problem behavior is reinforced). In such comparisons, these gradual changes are expected, but represent positive results as problem behavior decreased despite an absence of the EXT component.

It is unclear what caused the failure to replicate baseline conditions. There were, however, differences in the intervening history between each reversal. In these intervening conditions, the reinforcement contingencies favored more appropriate behavior. If history effects were a causal factor in this lack of experimental control, these history effects may have important implications for therapists and caregivers. If a treatment can be implemented with sufficient procedural integrity to produce a bias in responding toward appropriate behavior relative to problem behavior, subsequent failures in procedural integrity may have less of an effect on behavior. This finding requires additional research.

One potential contribution of the current series of experiments was methodological and common to the use of intermittent schedules of reinforcement. The use of intermittent schedules of reinforcement in the treatment of problem behavior had several benefits. For example, these schedules likely mimic to a degree the schedules of reinforcement in effect in the natural environment. It is unlikely that at home or school, for example, each instance of behavior is followed by reinforcement. It is likely, however, that variable amounts of appropriate and problem behavior are reinforced. Further, concurrent VI arrangements allow for comparisons to and translations from experimental work in the matching law.

Variable schedules are also less likely than fixed schedules to force responding toward one response over another. Under fixed schedules, reinforcer delivery is maximized by an individual favoring one response alternative. Under variable schedules, reinforcer delivery is maximized by an individual varying response allocation across alternatives. If responding is observed to favor one response alternative over another under a variable schedule, this would indicate a bias in responding that is independent from the schedule of reinforcement. Of particular interest to the current study, most examinations of responding under concurrent VI schedules show that response rates typically equal the distribution of reinforcements obtained from the schedules of reinforcement (Rider, 1981). This feature of concurrent VI schedules allowed changes in responding in the current experiments to be attributed to changes in the distribution of reinforcement obtained for responding.

Another benefit to the use of intermittent reinforcement is its practicality for caregivers. In the natural environment, caregivers may not always implement EXT procedures accurately. They also may fail to implement reinforcement procedures accurately (Shores et al., 1993). For example, Kenneth’s mom reported that while she could not always ignore problem behavior, she also could not always attend to appropriate behavior. George's teacher gave a similar report. Therefore, it may be important to identify a therapeutic differential reinforcement procedure that does not require constant implementation of EXT or reinforcement for problem or appropriate behavior. The use of concurrent VI schedules in the current experiments allowed for the examination of the effects of failure to ignore every problem behavior and failure to reinforce every appropriate behavior in a highly controlled analogue setting. It also allowed identification of the conditions sufficient to see therapeutic changes in behavior. While it is impractical to expect caregivers to implement VI schedules, these schedules give some information on the general effects of intermittent reinforcement delivery across problem and appropriate behavior.

The current series of experiments also address certain limitations inherent in previous investigations, such as controlling for histories of exposure to EXT and identification of the variables maintaining problem behavior. In addition, there is a relative paucity of research in the area of parametric manipulations of reinforcement during DRA without EXT procedures within a concurrent-operants arrangement.

One limitation of these experiments is the brevity of the conditions. In a basic preparation, it may be possible to conduct conditions until meeting a stability criterion (e.g., a difference of less than 5% between data points), however, in a clinical setting, it was not always possible to bring each condition to stability before exposing behavior to another condition (i.e., Corey and Kenneth). Therefore, the experimental control is not always as strong as would have been ideal. Ideally, for all participants, each condition would have been conducted until meeting stability criteria.

A second potential limitation to the current experiment is the difference in obtained versus programmed schedules of reinforcement. Variable interval schedules of reinforcement involve delivery of a reinforcer for the first response after an average length of time has passed since the last reinforcer. Participants did not always respond immediately after the required length of time elapsed, resulting at times in a less dense reinforcement schedule than what was programmed. The differences in obtained versus programmed reinforcement schedules were neither large nor consistent, however.

Our study suggests several areas for future research. This experiment included concurrent schedules of VI 20 s reinforcement for problem and appropriate behavior. Future research may conduct similar analyses using concurrent schedule arrangements based on naturalistic observations. For example, descriptive analyses (Bijou, Peterson, & Ault, 1968) could be conducted with caregivers and the results could be analyzed using reinforcers identified in a functional analysis (Iwata et al., 1982) with procedures similar to those described by Borrero, Vollmer, Borrero, and Bourret (2005). For example, if descriptive analysis data showed that problem behavior was reinforced on average every 15 s and appropriate behavior was reinforced on average every 30 s, experimental analyses could be designed to mimic these reinforcement rates in an experimental context. The extent to which relative response allocation is similar under descriptive and experimental arrangements may suggest values of reinforcement parameters that may increase both the acceptability and integrity of treatment implementation by caregivers.

Investigations similar to the current experiment could further explore the parameters of quality, duration, and delay more extensively and systematically. Future investigations could also further assess the generality of the matching law in describing response allocation under concurrent VI schedules when the target is problem behavior and parametric manipulations of reinforcement are conducted.

In addition, investigations into the effect of concurrent manipulations of the parameters of reinforcement as treatment for problem behavior could be conducted. For example, it may be that the rate of reinforcement can continue to favor problem behavior if several parameters of reinforcement, such as magnitude, quality, and duration, favor appropriate behavior. The implications for the treatment of severe problem behavior may be significant. This would be the case when problem behavior is so severe (e.g., head-banging on hard surfaces, severe aggression, etc.) that it is not possible to withhold reinforcement (i.e., extinction) for any period of time.

In conclusion, the present experiments focused on evaluating the treatment effects of providing differential reinforcement to appropriate and problem behavior by systematic manipulation of three parameters of reinforcement. It was designed to examine the effects of providing greater quality, longer duration, and more immediate reinforcement contingent on appropriate behavior relative to lower quality, shorter duration, and delayed reinforcement contingent on problem behavior. For 6 individuals with developmental delays or disabilities, an effective intervention was developed that reduced severe problem behavior and increased appropriate behavior to clinically acceptable levels.

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BIOGRAPHICAL SKETCH

Elizabeth Athens has been interested in behavior analysis since volunteering as a research assistant her first year as an undergraduate at the University of Nevada, Reno. She began her graduate studies in behavior analysis at the University of Florida in 2002, under the supervision of Timothy Vollmer. Elizabeth’s research interests center around the development and implementation of interventions for children who have fallen behind academically or exhibit problem behavior. Elizabeth is specifically interested in the variables affecting learning under a discrete trial format, parametric evaluations of common behavioral treatments, and the development of verbal behavior in young or developmentally delayed children.

During her graduate school career, Elizabeth conducted research in several diverse settings, including the laboratory, clinic, schools, and homes. She is currently studying the effects of treatment integrity failures on acquisition of complex discriminations, acquisition of verbal behavior, and methods to increase appropriate behavior while treating problem behavior. Following graduation, Elizabeth will seek a position allowing her to contribute to the field of behavior analysis through research, teaching, and clinical application.