IMMEDIATE AND SUBSEQUENT EFFECTS OF RESPONSE-INDEPENDENT FOOD DELIVERY ON PROBLEM BEHAVIOR MAINTAINED BY FOOD

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The immediate and subsequent effects of response-independent food delivery on problem behavior maintained by food were investigated. A functional analysis indicated that the participant’s problem behavior was maintained by tangible (food) reinforcement. In a subsequent analysis, each occurrence of problem behavior produced a bite of wafer in the first and third components of mixed and multiple schedules, while either response-independent food or extinction was presented in the second component. Dense and lean schedules of food delivery were assessed. Results indicated that a very dense schedule of food nearly eliminated problem behavior, a very lean schedule of food and extinction produced substantial decreases in problem behavior, and intermediate schedules did not decrease problem behavior. Response patterns were differentiated across mixed and multiple schedule arrangements, with signaled changes in the schedules (multiple schedule) generally showing more immediate and sustained effects throughout the intervention component. Implications for interpretations of the effects of the intervention are discussed.
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CHAPTER I

INTRODUCTION

Noncontingent reinforcement (NCR) has been experimentally shown to decrease problem behaviors in a substantial body of behavior analytic research. Applications of NCR procedures involve the presentation of a known reinforcing stimulus (typically, the stimulus identified to maintain problem behavior) on a response-independent (i.e., time-based) schedule. NCR has been used to decrease many topographies of problem behaviors, most commonly being self-injury (e.g., Fischer, Iwata & Mazaleski, 1997; Kahng, Iwata, Thompson & Hanley, 2000; Lalli, Casey & Kates, 1997; Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993) and aggression (e.g., Kahng, Iwata, Thompson & Hanley, 2000; Lalli, Casey & Kates, 1997). NCR has been applied across a range of maintaining consequences, although applications to behavior maintained by attention (e.g., Fischer, Iwata & Mazaleski, 1997; Kahng, Iwata, Thompson & Hanley, 2000; Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993) and access to tangible items (e.g., Fischer, Iwata & Mazaleski, 1997; Kahng, Iwata, Thompson & Hanley, 2000; Lalli, Casey & Kates, 1997) are most common in the literature.

Prior to Mace and Lalli’s 1991 early application of NCR to bizarre speech maintained by attention, several basic experimental analyses of response-independent reinforcement had been conducted (e.g., Lattal & Boyer, 1980; Lattal & Bryan, 1976; Zeiler, 1968). For example, Lattal and Bryan (1976) applied response-independent reinforcement to key-pecking behavior maintained by fixed interval deliveries of reinforcement. They found a decrease in responding as the frequency of response
independent reinforcement was increased. Zeiler (1968) used response-independent reinforcement, both at a fixed time (of five minutes) and a variable time (of five minutes on average), to maintain key-pecking responses which were previously trained. The results demonstrated a decrease in key pecking behavior on both the fixed and variable time schedules, when compared to response dependent reinforcement schedules.

In an early application of NCR to severe problem behavior, Vollmer et al. (1993) found NCR to be effective in decreasing frequency of self-injury in adults with developmental disabilities. In comparison with DRO, NCR was found to produce more immediate effects with less evidence of extinction-related side effects for three participants. Subsequent to this publication, a large and growing body of research has been dedicated to investigating NCR and the basic behavioral mechanisms associated with its effects.

Some researchers have been critical of the term NCR, arguing it is an inaccurate descriptor of a time based reinforcement delivery procedure (e.g., Poling & Normand, 1999; Vollmer, 1999). As an alternative to using NCR to describe this procedure, Poling and Normand (1999) suggested referring to the reinforcer deliveries specifically as fixed time schedules and subsequent literature has been consistent with that suggestion (Dozier, Carr, Enloe, Landaburu, Eastridge, & Kellum, 2001; Ringdahl, Vollmer, Borrero, & Connell, 2001; Simmons, Smith & Kliethermes, 2003).

The stimuli used in NCR schedules are typically functionally related to problem behavior, although some studies have evaluated the use of highly preferred items. Most
studies evaluating NCR include a functional analysis to determine the reinforcer maintaining problem behavior (e.g., Fischer, Iwata & Mazaleski, 1997; Kahng, Iwata, Thompson & Hanley, 2000; Lalli, Casey & Kates, 1997; Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993). In addition to a functional analysis, many NCR evaluations have included preference assessment procedures to further narrow the pool of potential reinforcers in the functional class (e.g., Fischer, Iwata & Mazaleski, 1997; Lindberg, Iwata, Kahng, & DeLeon, 1999). In addition, noncontingent arbitrary reinforcement (i.e., presentation of reinforcing stimuli unrelated to those identified to maintain problem behavior) has been shown to effectively decrease problem behavior in some cases, which may be useful if a maintaining reinforcer cannot be identified or easily delivered (e.g., Fischer, Iwata & Mazaleski, 1997).

NCR schedules can be faded over time in order to decrease reinforcer delivery intervals to levels that reduce problematic behaviors but are easier to implement in natural conditions. Most schedule thinning procedures involve incremental increases in intervals between stimulus deliveries based on the occurrence of low levels of problem behavior, as initially described by Vollmer and colleagues (1993) (e.g., Goh, Iwata, & DeLeon, 2000; Kahng, Iwata, DeLeon, & Wallace, 2000; Kahng, Iwata, Thompson & Hanley, 2000; Lalli, Casey, & Kates, 1997). These incremental increases can be based on arbitrary numbers chosen prior to implementing the procedure (e.g. Lalli, Casey, & Kates, 1997; Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993).

Some researchers have used the mean interresponse time (IRT) of problem behavior to calculate initial values and the pace at which fading proceeds. For example,
Kahng, Iwata, DeLeon, and Wallace (2000) compared the effectiveness of fading procedures starting with a fixed time 10 s delivery and an arbitrary interval increase versus an IRT-adjusting method and found both to be effective in reducing problem behavior: however, the IRT-adjusting method achieved the terminal goal in fewer treatment sessions than the arbitrary fixed time delivery.

A substantial amount of research has focused on the basic behavioral mechanisms associated with the effects of NCR. Vollmer, Iwata, Zarcone, Smith, & Mazaleski (1993) suggested that extinction is a key variable contributing to the effects of NCR. Thompson and colleagues found that when NCR was implemented with and without an extinction component, NCR with extinction resulted in more rapid and significant treatment effects (Thompson, Iwata, Hanley, Dozier, & Samaha, 2003).

Although extinction is typically considered to be an important component of NCR, some research outcomes suggest that it may not be necessary to implement extinction in all applications of NCR (e.g., Hagopian, Crockett, van Stone, DeLeon, & Bowman 2000; Lalli, Casey, & Kates, 1997). For example, Lalli et. al. (1997) implemented NCR procedures while continuing to provide reinforcement contingent on problem behavior. Results indicated that NCR without extinction was effective at reducing problem behavior below baseline rates. Hagopian et. al. (2000) compared NCR with and without extinction and compared a thinning of both reinforcement schedules. The results were that NCR with or without extinction was effective in reducing problem behavior, but only NCR with extinction continued to be effective when the NCR schedule was thinned.
In addition to extinction, satiation is thought to be an important factor in the effectiveness of NCR (e.g., Carr, Bailey, Ecott, Lucker, & Weil, 1998; Kahng, Iwata, Thompson & Hanley, 2000). That is, repeated delivery of the stimulus maintaining problem behavior may decrease the reinforcing value of that stimulus and, therefore, function as an abolishing operation (AO) for problem behavior (Smith and Iwata, 1997). For example, DeLeon, Anders, Rodriguez-Catter, and Neidert (2000) showed a decrease in frequency of self-injurious behavior when alternating reinforcers or offering multiple noncontingent reinforcers in a 30-min session. The comparison was made between offering only a single set of reinforcers to the subjects, which resulted in more problem behavior and less engagement with the reinforcers. These results suggest that in this experiment, offering multiple or alternating reinforcers provided less exposure to satiation, as was likely present when only one reinforcer was available. Simmons, Smith, and Kliethermes (2003) used food in an NCR arrangement to treat mouthing maintained by apparent stimulation to the mouth. These researchers found that dense food delivery more completely suppressed mouthing than leaner schedules, and that treatment effects persisted following periods of dense delivery—patterns of responding that are consistent with a satiation or habituation account of NCR effects.

A possible adverse side effect of NCR is adventitious reinforcement of problem behavior. If scheduled stimulus deliveries occur soon after occurrences of problem behavior, it is possible that problem behavior will accidentally, or adventitiously, be reinforced (Skinner, 1953). Vollmer, Ringdahl, Roane, & Marcus (1997) found evidence of extinction bursting between stimulus deliveries on NCR schedules. They also found
that implementing a momentary DRO procedure, in which responses occurring just prior to scheduled deliveries decreased problem behavior significantly.

Although a large body of literature supports the effectiveness of NCR to reduce problem behavior, it has not been shown effective in all cases. Thompson, Iwata, Hanley, Dozier, and Samaha (2003) reported that two of five participants showed no reduction in problem behavior with NCR treatment. Some variability in NCR outcomes has been attributed to schedule effects. For example, Hagopian, Fisher, and Legacy (1994) found that dense schedules of reinforcement were effective in reducing problem behavior, but lean schedules (when presented without fading) did not produce clinically acceptable outcomes. Similarly, Goh, Iwata, and Kahng, (1999) found NCR to be effective at reducing cigarette pica but that treatment effects were lost during attempts to fade from dense to lean schedules. In contrast, Ringdahl, Vollmer, Borrero, and Connell (2001) found dense fixed time schedules of reinforcer delivery to be less effective in reducing behavior, while leaner schedules of fixed time delivery were more effective. Most findings on schedule effects with NCR seem to indicate that dense schedules of stimulus presentation are typically more effective than leaner schedules in suppressing problem behavior.

Roscoe, Iwata, & Goh (1998) compared NCR and extinction and determined that while both procedures were effective at producing decreases in problem behavior, using NCR resulted in a faster and thus a more effective decrease. However, when compared with NCR, some studies have shown extinction to be more effective in reducing problem behavior. Thompson, Iwata, Hanley, Dozier, & Samaha, (2003) found that extinction
was more rapid and complete in producing a reversal than differential reinforcement of other behavior or NCR.

Complex reinforcement schedules have occasionally been used in applied research to evaluate the effects of different contingencies within a session. For example, researchers have used multiple (signaled) and mixed (unsignaled) schedules as components of treatment (e.g., Tiger, Hanley, & Heal, 2006) or to conduct complex evaluations of treatment effects (e.g., Simmons, Smith, & Kliethermes, 2003). Multiple and mixed schedules both involve the sequential presentations of 2 or more simple schedules (e.g., contingent reinforcement and extinction) and differ in that multiple schedules include distinct discriminative stimuli corresponding to specific schedule components (Iverson & Lattal, 1991).

Recent research has shown that the presentation of contingencies in a multiple schedule can be more effective than the nondisclosure of contingencies in a mixed schedule at reducing problem behavior (e.g., Hanley, Iwata and Thompson, 2001; Tiger & Hanley, 2004; Tiger, Hanley, & Heal, 2006). Tiger, Hanley and Heal (2006) found their subjects showed preference for a signaled versus a unsignaled schedule of reinforcement when comparing treatments administered on either of the two schedules. Hanley, Iwata and Thompson (2001) evaluated the several methods for thinning reinforcement schedules following treatment for problem behavior with functional communication training. Their results indicated signaled reinforcement schedules were more effective at decreasing and maintaining low responding of the alternative behavior
and problem behaviors than the mixed schedule of reinforcement evaluated while the reinforcement delivery schedule was thinned.

In addition to being incorporated into treatment procedures, complex reinforcement schedules have been used to evaluate immediate and subsequent effects which may occur as a result of the addition or removal of a signaled contingency (Atcheson, 2006; Simmons, Smith, & Kliethermes, 2003; Tiger & Hanley, 2005). Tiger and Hanley (2005) discovered that when implementing a multiple schedule condition was followed by a mixed schedule condition, their subjects continued to perform as though the multiple schedule were still in effect, even though the signal was removed. Simmons, Smith and Kliethermes (2003) used a three component multiple schedule analysis to determine the immediate and subsequent effects of fixed time food delivery. Once the signaled contingency change occurred, problem behavior decreased in frequency. After the contingency was no longer in effect and the signal was removed, problem behavior was substantially less frequent than before the implementation of the multiple reinforcement schedule. Atcheson (2006) also used a three component multiple schedule analysis to determine the immediate and subsequent effects of response blocking. Once the signaled contingency change occurred, problem behavior decreased in frequency. Once the signal was removed and the contingency was changed, results varied. Some individuals showed an increase in problem behavior following the multiple schedule treatment analysis.

The current study investigated the effects of NCR and extinction contingencies applied within multiple and mixed schedules. First, a series of functional assessments
indicated that the problem behavior of one participant was maintained by positive
reinforcement in the form of the presentation of food. Then, a preference assessment
was conducted to identify preferred food items. Finally, a treatment analysis was
conducted in which intervention periods were alternated with periods of baseline
contingencies within mixed or multiple schedule arrangements. Treatment components
were presented in the middle component of a three-component schedule (e.g.
BL/EXT/BL) within sessions. Treatments were presented in a reversal format across
sessions, and included continuous NCR, NCR fading, a lean schedule of NCR, and
extinction.
CHAPTER II
PRE-TREATMENT ASSESSMENTS

Method

General Procedures

*Participant and setting.* Alexandra was a 29-year-old female with profound mental retardation who exhibited problem behaviors of aggression and self-injury. Self-injury and aggression resulted in tissue damage and scarring to Alexandra and others. Alexandra resided at a large, long term state residential facility for two years prior to the study. An interdisciplinary team referred Alexandra to a specialized program for assessment and treatment of her aggression and self-injury (Behavior Analysis Resource Center [BARC]).

All preference assessment, functional analysis, and treatment analysis sessions were conducted in a clinic room at the BARC facility. The clinic room was 3.7 m by 3.7 m with a two-way mirror for unobtrusive observation and data collection. A therapist, a 1.2 m by 0.8 m table, one stationary chair, one rolling chair, and two magazines (magazines were held by therapist) were present in the room during all sessions. Handheld computers and data collectors were present outside the clinic room during all sessions.

*Response definitions, measurement, and interobserver agreement.* Response definitions for the primary dependent variables were based on Alexandra’s behavior support plan. Aggression was operationally defined as scratching, hitting, pinching, biting, pushing, five-finger contact to another person, or grabbing. Self-injury was
defined as punches to the head with the fist, head banging (on floor, table, or wall), hitting her arms/hand against objects, and biting, pinching, hitting, or scratching herself. Tangible consumption was not defined in Alexandra’s behavior support plan, however was scored when she put the food in her mouth. The independent variables scored were tangible delivery, delivery of demand, demand completion, and attention (see Table 1 for a more detailed definitions of the independent and dependent variables).

All data were recorded by trained observers using handheld computers. Both primary target behaviors (aggression and self-injury), delivery of tangible items by the therapist, delivery of demands by the therapist, and compliance and consumption by the participant were scored using event recording. Attention delivered by the therapist was scored by duration recording.

Interobserver agreement (IOA) was assessed by apportioning session time into 1-s intervals, dividing the number of intervals in which primary and secondary observers agreed on the occurrence or absence of problem behavior by the number of intervals in the session, and multiplying the result by 100. IOA was taken in 60.0% of the functional analysis sessions and averaged 96.4%. For baseline sessions, IOA was taken in 38.5% of the sessions and averaged 92.1%. For treatment sessions, IOA was taken 45.1% of the sessions and averaged 93.1% (see Table 2 for a more detailed breakdown of aggression and self-injury IOA scores). IOA was also recorded for all other target definitions listed in Table 1, and the data are available from the author on request.
Multiple Stimulus without Replacement Preference Assessment

A multiple stimulus without replacement preference assessment (DeLeon & Iwata, 1996) was conducted for edible items. Nine edible items were placed in front of Alexandra, each on an individual paper towel. She was told to pick one. After she selected an item, the corresponding paper towel was removed and the remaining items were rearranged. This was repeated until all nine items were chosen. If Alexandra did not choose an item the preference assessment was stopped, no more assessments were run that day and all items not chosen were ranked lowest for that round. The preference assessment was repeated five times across several days. Results of the preference assessment showed that generic brand vanilla wafers and apples were both ranked first. Pretzels and chips were both ranked second. Generic brand vanilla wafers were chosen to be used during the remainder of the study due to availability and ease of use.

Multiple Stimulus Engagement Preference Assessment

A multiple stimulus engagement preference assessment (Hagopian, Rush, Lewin, & Long, 2001) was conducted for leisure items. Items were placed, one at a time, in front of the participant. The duration of engagement with each item was measured, up to a maximum of 120 s. The assessment was completed twice with a total of nine items. The outcomes of the leisure item preference assessment indicated that the maraca was the most highly preferred stimulus.
Forced Choice Stimulus Preference Assessment

Following both preference assessments completion, a forced choice stimulus preference assessment was conducted to determine whether the highest preferred item was the edible or leisure item (Fisher et al., 1992). The first ranked item from the edible and leisure preference assessments (generic vanilla wafer and maraca) were paired and Alexandra was offered a choice between them five times. Alexandra selected the wafer on each of the 5 trials.

Motivation Assessment Scale

To determine the probable function of Alexandra's problem behaviors of aggression and self-injury, the Motivational Assessment Scale (MAS; Durand & Crimmins, 1988) was administered. MAS administration and analysis procedures were modified as described by Farenholz (2004). The MAS was administered to five of Alexandra's staff who had worked with her for at least six months, and correspondence among the respondents was assessed. Each respondent's outcomes on the MAS identified social positive reinforcement, in the form of access to tangible items, as the likely maintaining contingency for Alexandra's aggression and self-injury (see Table 2 for complete MAS results).

Functional Analysis

A pretreatment functional analysis similar to that described in Iwata, et al, (1994) was conducted. All sessions were 10 min in length and were conducted 1-4
times per day, 3-5 times per week. Sessions were run approximately one hour following Alexandra’s lunch.

*No interaction.* In the no interaction condition, Alexandra was in the room with therapist and with no leisure materials. The therapist did not interact with her and all instances of problem behavior were ignored.

*Attention.* In the attention condition, Alexandra was in the room with therapist. Three magazines were available for her to look through and the therapist had some reading materials as well. At the beginning of the session, the therapist gave Alexandra 5 to 10 s of noncontingent attention and then said nothing else until problem behavior occurred. Every time Alexandra engaged in a predefined target behavior, the therapist delivered attention for 5 to 10 s in the form of disapproval or concern. If she continued to engage in the problem behavior during the attention delivery, attention continued until the problem behavior ceased.

*Tangible.* In the tangible condition, Alexandra and the therapist were in the room together reading material only for the therapist (two magazines). Alexandra was given one tangible item (one quarter of a generic brand vanilla wafer weighing approximately 1 gram) at the beginning of the session. During the condition, the therapist kept the clear container of wafers on her lap, within view of Alexandra. No attention was provided to Alexandra during this condition. Following every occurrence of problem behavior, the therapist removed one quarter of wafer from the container and delivered it to Alexandra.
**Play.** In the play condition, the therapist was in the room with Alexandra. Leisure and recreational materials were present on the table and the therapist sat across the table from Alexandra. Every 30 s and every time Alexandra initiated interaction, the therapist engaged with her, typically using one of the leisure items. All occurrences of problem behavior were ignored and, if problem behavior occurred at the scheduled time of interaction, the interaction was delayed by 10 s.

**Demand.** In the demand condition, the therapist was present in the room with Alexandra. The therapist placed towels on the table and prompted Alexandra to fold the towel every 30 s. If she did not fold the towel within 5 s the therapist provided a modeling prompt. If she did not fold the towel within 5 s following the modeling prompt, the therapist physically guided Alexandra to fold the towel. If at anytime between the initial prompt and completion of the task of towel folding Alexandra engaged in target behavior, the demand was terminated and she was told “You don’t have to” or “Never mind” while the therapist backed away from her. The demand was presented again at the next 30-s interval. If Alexandra engaged in predefined problem behavior at the time the demand was to be delivered, the therapist did not deliver the demand.

Results of the functional analysis are presented in Figure 1. Although problem behavior occurred at least once in all conditions of the functional analysis, the tangible condition resulted in high and differentiated frequencies of problem behavior across sessions. In the no interaction condition, the mean frequency of problem behavior was 6.25, with a range from 0-20. The attention condition produced a mean frequency of 4,
with a range from 0-13. In the tangible condition, the mean frequency of problem behavior was 32.5, with a range from 0-47. The mean frequency of problem behavior during the play condition was 2.5, with a range from 0-7. In the demand condition, the mean frequency of problem behavior was 4.25, with a range from 0-13. The outcomes of the functional analysis of Alexandra’s problem behavior corresponded with the outcomes of her MAS assessment, strongly indicating that her problem behavior was maintained by positive reinforcement in the form of tangible (food) delivery.
CHAPTER III
TREATMENT ANALYSIS

Method

General Procedures

Subject and setting. Based on the result of the series of pretreatment assessments, Alexandra participated in a treatment analysis. All sessions were conducted at the BARC facility in the same room as assessment procedures. Sessions were 30 min in length and divided into three 10-min components. One 30 min session was conducted every day she attended the clinic, and no more than one session was conducted within a single day. All sessions were conducted approximately one hour following Alexandra’s lunch. During the treatment analysis, a clear storage container filled with small pieces of generic brand vanilla wafer was always present on the lap of the therapist. The wafer pieces were approximately 1 g. Each session was designated as either a multiple or mixed schedule session, and that schedule was implemented in all components.

General procedures. Procedures during the first and third 10-min components of each session were identical to those from the tangible condition of the functional analysis. Therefore, only the second component differed across sessions. All sessions were designated as either a mixed or multiple schedule arrangement. Session components were presented sequentially with no breaks or pauses between components. In sessions where a mixed schedule was in effect, there was no programmed stimulus change associated with changes in components (i.e., no
discriminative stimuli were presented when components were switched). In sessions where the multiple schedule was in effect, a red houselight was turned on during component 2. A silver lamp with a red, 100-watt bulb and 12.1 centimeters in diameter, mounted above the two way mirror, was turned on at the beginning of component 2 and the white house lights were simultaneously turned off. At the beginning of component 3, the red light was turned off and the white house lights were simultaneously turned on. The lights were operated by research assistants located outside the laboratory room.

Response definitions, measurement, and interobserver agreement. All definitions, data collection, and IOA procedures were identical to those used during the functional analysis. IOA results are displayed in Table 1.

Baseline. During baseline, procedures identical to the tangible condition of the functional analysis were presented during all 3 components in sessions of either the mixed or multiple schedules. Baseline conditions were conducted 6 times interspersed throughout the treatment evaluation.

Noncontingent reinforcement. When treatment component 2 was NCR, Alexandra and the therapist were seated at the table, as during baseline. However, during NCR, pieces of vanilla wafer were delivered to Alexandra according to response-independent schedules. Initially, wafers were delivered continuously. The therapist placed one wafer on the table in front of Alexandra at the beginning of the session and replaced the wafer as soon as Alexandra picked it up. Subsequently, wafers were delivered according to fixed-time (FT) schedules. A silent timer was present with the therapist in
the room to signal the time for reinforcer delivery. All problem behavior was ignored in this condition. The schedule of wafer delivery was decreased after 3 successive sessions in which less than .5 problem behaviors per min were observed during component 2. The initial fade number was determined by averaging the rate of wafer presentation during the last 3 sessions of the continuous NCR condition. Based on this calculation initial FT value was 8 deliveries per min or a wafer delivery every 7.5 s. The time between deliveries was increased by multiplying the time between wafer deliveries by two. Therefore, the first FT value was 15 s, or 4 reinforcer deliveries per min. If 3 sessions passed without meeting the criterion for decreasing the FT schedule for 3 consecutive sessions, the FT schedule was increased to a value equal to one half of the previous decrease (i.e., the number of deliveries per min decreased to halfway between the current rate of delivery and the previous rate of delivery). If criterion was not met at this value, no further attempt to fade the FT schedule was undertaken.

*Extinction.* When treatment was extinction, all problem behaviors occurring during component 2 were ignored. The container of generic brand vanilla wafers was still present on the therapist's lap, but no wafers were presented either contingently or on a response independent basis during this condition.
CHAPTER IV

RESULTS

The results of Alexandra’s treatment analysis are displayed in Figures 2-8. Figure 2 depicts the frequency of Alexandra’s problem behavior across sessions, with different data symbols and paths corresponding to components of the complex schedules. Open circles represent data values from component 1, closed circles represent data values from component 2, and open triangles represent data values from component 3.

As shown in Figure 2, Alexandra’s problem behavior was highly variable across components during the initial sessions of the first baseline condition (sessions 1-5). Subsequently, an increase in frequency was observed, along with a tighter range across components (sessions 6-9) throughout the remainder of the initial baseline period. No evidence of a general decrease in responding within sessions was observed (as might be expected to result from habituation or satiation).

Following the initial baseline, a mixed schedule analysis of the effects of continuous noncontingent delivery of food (CNCR) was conducted. During this analysis, Alexandra received continuous access to food during component 2 of the schedule, which was not associated with a distinct discriminative stimulus (i.e., the arrangement constituted a mixed schedule). The CNCR intervention produced immediate and dramatic decreases in the frequency of problem behavior during component 2. In addition, component 3 measures tended to fall below those observed during component 1, although overall frequencies in components 1 and 3 were generally within the range
of frequencies observed during the last half of the first baseline condition. Frequencies in component 3 were substantially (i.e., 10 or more responses) less than in component 1 during 5 of 8 sessions (sessions 10, 11, 13, 15 and 17).

Following a brief return to baseline (which produced outcomes similar to the last half of the first baseline), CNCR was implemented again, with similar results. Again, decreases to near-zero levels were observed during component 2, and measures in component 3 tended to fall below those from component 1, with differences of 10 or more responses observed in 2 of 3 sessions (sessions 22 and 23).

After 3 sessions of CNCR, an FT 15 s schedule was implemented during component 2. That is, Alexandra received one piece of wafer every 15 s during component 2. This change from continuous availability of wafers to intermittent delivery of wafers resulted in an immediate increase in problem behavior during component 2 to baseline levels. In addition, measures during component 3 were substantially below those observed during component 1 only for the first session of the FT 15 s treatment. Because adequate treatment effects were not obtained with the FT 15 s treatment, a denser schedule of wafer delivery was evaluated (FT 10 s). Although component 2 values fell consistently below those observed during components 1 and 3, Alexandra continued to emit between 57-72 responses during component 2, well above the criterion for acceptable treatment effects. Based on the failure to effectively decrease the schedule of wafer delivery, a return to CNCR was conducted. Results replicated those from previous implementations of CNCR with substantial decreases in problem behavior in component 2, baseline-level measures in component 1, and lower
levels of problem behavior in component 3 relative to component 1 (substantial differences observed in session 31.)

The results of the initial mixed schedule analysis indicated that the only schedule of food delivery that effectively decreased problem behavior to criterion levels was continuous delivery. Based on these outcomes, a multiple schedule analysis was conducted in which the treatment component (component 2) was associated with a distinctive discriminative stimulus (a red houselight; see Method section). The rationale for this change was that a fade from dense (CNCR) to intermittent (FT) schedules of wafer delivery might be facilitated if a stimulus correlated with treatment (i.e., response-independent delivery of food and extinction for problem behavior), was present during the fading process.

The initial implementation of CNCR within the multiple schedule produced patterns of responding that were similar to those observed during the mixed schedule analysis. Response measures remained high during the first component, at near zero response frequencies during the second component, and at intermediate levels during component 3. Substantial differences between components 1 and 3 were observed during 4 of 5 sessions (38-40 and 42). A brief return to baseline and subsequent reinstatement of CNCR within the multiple schedule replicated the results of previous implementations of these conditions.

Following the CNCR (multiple schedule) analysis, an attempt was made to fade the schedule of wafer delivery to FT 15 s. As with previous attempts to fade the schedule of wafer delivery, this change resulted in an immediate increase in frequencies
of problem behavior during component 2 to levels approximating those observed during baseline. Measures in components 1 and 3 were consistent with previous conditions, with component 3 measures falling substantially below those from component 1 in 2 of 3 sessions (48 and 49) but within previously established ranges. Although a decreasing trend in problem behavior during component 2 was observed, measures remained substantially above criterion levels (range = 46-75). Therefore, the decision was made to implement an extinction condition.

The rationale for implementing extinction was twofold. First, one potential account for the failure to obtain acceptable treatment effects during fading attempts was that wafer deliveries frequently followed problem behavior, resulting in adventitious reinforcement of problem behavior. Therefore, it seemed possible that extinction procedures might facilitate a subsequent reimplementation and fade of response independent delivery of wafers. Second, the failure to effectively fade the wafer delivery schedule called into question whether Alexandra’s problem behavior was, indeed, maintained by the contingent delivery of food. That is, it was possible that Alexandra’s aggression was maintained by another, uncontrolled, contingency, and that the delivery of wafers on a continuous schedule simply competed with the unknown schedule of reinforcement for problem behavior. Placing problem behavior on extinction (food) permitted a more definitive analysis of the effects of food on problem behavior.

The initial implementation of extinction produced a slow decrease in problem behavior across sessions in component 2. High frequencies of responding were
observed during the first 5 sessions of treatment, although a general downward trend was observed (range of response frequencies from component 2 of sessions 51-55 = 45-77). Within the second half of this extinction condition, problem behavior stayed low in the second component (range of response frequencies from component 2 of sessions 56-63 was 6-27). Throughout the extinction condition, there was no consistent difference in response measures between components 1 and 3. Component 3 response frequencies were substantially lower than those observed during component 1 in only 2 of 13 sessions (57 and 60).

Following a return to baseline, which resulted in outcomes similar to previous baselines, extinction was reintroduced. The second implementation of extinction resulted in an immediate decrease in response frequencies during component 2. Responding during components 1 and 3 continued to occur at previous levels; however, responding during component three was substantially lower than during component one in 1 out of 3 sessions (69).

Following the second implementation of extinction, FT 15 s food delivery was again presented within a multiple schedule. This condition was implemented in order to determine if a history with signaled extinction for problem behavior might improve the effectiveness of the FT 15 s schedule when the discriminative stimulus for extinction was present. Response frequencies returned to baseline levels in the second component (range of response frequencies = 71 to 85), replicating the effects of the previous implementation.

Following the FT 15 s, FT 120 s food was presented. This intervention produced
response patterns very similar to those seen during the multiple schedule evaluation of extinction. Although treatment effects were not immediate, the second session data showed a dramatic decrease in responding during component 2, which was sustained across sessions (range of response frequencies = 8-24). Responding was variable during components 1 and 3 and there was no substantial difference in responding between the two components.

In order to evaluate the effects of extinction and FT 120 s food without the presence of a discriminative stimulus, these conditions were repeated within a mixed schedule arrangement. During the mixed schedule analysis of extinction (sessions 83-86), responding in component 2 occurred at significantly lower levels than during baseline (range of response frequencies = 27-42). However, responding continued to occur at levels above those observed in the multiple schedule evaluations of extinction and FT 120 s wafer. Substantial differences in response measures between components 1 and 3 occurred only in 1 of 4 sessions (83).

Following the mixed schedule analysis of extinction, FT 120 s wafer was presented within the mixed schedule arrangement. As in the multiple schedule analysis of extinction, responding in component 2 was significantly lower than baseline levels (range of response frequencies = 18-35). However, response levels were higher than those observed in the multiple schedule analysis of either extinction or FT 120 s wafer. Component three measures were not substantially lower than component one in any of the 5 sessions in this condition.

Following all treatment analyses it was determined that FT 120 s wafer, delivered
within a multiple schedule, was the preferred treatment condition. Therefore, to
conclude the experiment, a replication of FT 120 s wafer was conducted. Responding
immediately decreased to low levels during component 2, and these results persisted
across 4 sessions. In addition, substantial differences in response measures between
components 1 to 3 were observed in 2 of the 4 sessions.

Figures 3-7 depict minute-by-minute means of problem behavior from each
condition. Figure 3 includes data from all implementations of baseline as well as CNCR
in the mixed schedule. As shown in the upper panel, the data paths during baselines
show a great deal of overlap. Responding occurred steadily throughout the 30 min
sessions with no significant trends or changes in level.

The lower panel of Figure 3 shows minute-by-minute means from the three
implementations of CNCR within the mixed schedule. The three data streams show
similar patterning, with high frequencies of responding in components 1 and 3 and very
low to zero occurrences in component 2 (during the continuous delivery wafers).
However, a few small differences are of note. First, the initial implementation of CNCR
(sessions 10-17) resulted in more variability during component 2 than was observed in
the two replications of that condition. In addition, levels of responding in the 1st and 3rd
components in the second replication (sessions 31-33) were slightly lower than prior
administrations of this condition. Finally, a very slight decrease in response frequencies
between components 1 and 3 can be seen in all three administrations of this condition.

Figure 4 displays the minute-by-minute means from the mixed schedule analyses
of FT 15 s wafer (upper panel) and FT 10 s wafer (lower panel). Both FT 15 s wafer
and FT 10 s wafer conditions produced similar response patterns. Each graph shows high frequencies in component 1, a slight initial drop at the transition point from component 1 to 2, and a return to high frequencies in component 3. The data during component 2 of the FT 15 s wafer condition show a slight decreasing trend, whereas a slight increasing trend was observed during component 2 of the FT 10 s wafer analysis. Component 3 measures were slightly lower than those from component 1 for both analyses.

Figure 5 shows the minute-by-minute means of response frequencies from the multiple schedule analyses of CNCR (upper panel) and FT 15 s wafer (lower panel). The two implementations of CNCR within the multiple schedule produced very similar response patterns, with high and stable response frequencies observed during component 1, low-to-zero frequencies during component 2, and high and stable frequencies during component 3 (albeit at slightly lower levels relative to component 1). The two implementations of FT 15 s within a multiple schedule produced similar response patterns. Problem behavior occurred at similarly high levels across all session components, with no decrease observed in component 2. A slight downward trend across sessions is apparent in both graphs.

Figure 6 displays the minute-by-minute means from multiple schedule analyses of extinction and FT 120 s wafer. Both implementations of extinction produced substantial decreases in responding in component 2. However, the first extinction condition (sessions 51-63) showed lower frequencies of problem behavior in components 1 and 3 and higher frequencies in component 2, relative to the second condition.
(replication) implementation of extinction (sessions 67-69). The differences in response levels during component 2 appear to be a function of a slower initial decrease in target behavior, resulting in elevated condition mean values. A single session in which component 2 and 3 response frequencies were substantially above the mean appears to be responsible for higher measures in components 1 and 3 of the second extinction condition.

In the lower panel of Figure 6 displays outcomes of the multiple schedule analyses of FT 120 s wafer. As with extinction, FT 120 s wafer produced high frequencies of problem behavior in components 1 and 3 and low response frequencies in component 2. As was seen with extinction, a more immediate decrease in problem behavior in the second implementation of FT 120 s wafer resulted in substantially fewer occurrences in component 2 relative to the first implementation.

Displayed in Figure 7 are the minute-by-minute means from the mixed schedule analyses of extinction and FT 120 s wafer Mix. Each graph shows similar patterns across session minutes. High frequencies were observed in component 1, a slight initial drop at the transition point from component 1 to 2, low frequencies during the middle of component 2, an increasing trend toward the end of component 2, and a return to high frequencies in component 3.

A comparison of response patterns between multiple and mixed schedule analyses reveals some interesting contrasts. Although CNCR, extinction, and FT 120s wafer all produced substantial decreases in responding during component 2, multiple schedules were associated with more immediate and complete effects in each case.
Whereas CNCR nearly eliminated problem behavior in component 2 when implemented within the multiple schedule, responding persisted at low levels during the mixed schedule analysis. Extinction and FT 120 wafer produced similar decreases in response frequencies when implemented within the multiple schedule, whereas extinction was associated with slightly higher response measures, relative to FT 120 s wafer, when implemented within the mixed schedule.
CHAPTER V

GENERAL DISCUSSION

The outcomes of Alexandra’s pretreatment analyses indicated that her problem behaviors were maintained by positive reinforcement in the form of food. Treatment analyses evaluated the effectiveness of interventions based on the assessment outcomes, including the delivery of food on response independent (continuous and intermittent) schedules and extinction. Results indicated that the effectiveness of interventions varied as a function of the rate of food delivery and the presence or absence of a signal associated with treatment.

An unexpected outcome of this study was that, although continuous wafer delivery decreased problem behavior to near zero levels during component 2, dense FT schedules did not reduce problem behavior. As soon as attempts to fade wafer delivery were initiated (to FT 15 s or FT 10 s), response frequencies in component 2 returned to baseline or near baseline levels (regardless of whether treatment was delivered within mixed or multiple schedules). By contrast, FT 120 s wafer produced substantial decreases in responding, roughly equal to levels observed in extinction conditions but higher than those observed in CNCR. Previous research has indicated that dense schedules of response-independent reinforcement typically produce greater reductions in target responding and that it is often necessary to fade slowly from dense to lean schedules in order to maintain (or obtain) treatment effects (e.g., Hagopian et al., 1994).
The failure to maintain reductions in problem behavior as the schedule of food was changed from continuous availability to FT 15 s or FT 10 s may have been due to adventitious reinforcement, which has been identified as a possible side effect of dense schedules of NCR (Vollmer et al., 1997). During the dense FT schedule conditions, Alexandra emitted problem behavior just prior to the scheduled delivery of food on many occasions; therefore, an adventitious reinforcement account of the maintenance of behavior in these conditions is reasonable.

Inspection of response patterns from components 1 and 3 showed that, in conditions in which food was presented on dense schedules during component 2, response frequencies in component 3 were often (and on average) lower than in component 1. This held true for baseline as well as treatment (CNCR, FT 10 s wafer, FT 15 s wafer) conditions. By contrast, when food was absent from or presented at low levels in component 2 (extinction, FT 120 s wafer), component 3 response levels were roughly equal to or greater than component 1 levels. Interestingly, FT 120 s schedules (both in mixed and multiple schedule arrangements) were most reliably associated with increases in response levels in component 3 (notably, higher response frequencies did not always immediately follow the change in components, as when responding recovered slowly during the mixed schedule analysis and the second implementation within the multiple schedule).

These outcomes suggest that satiation and/or habituation (Murphy et al., 2003) may have begun to occur across the 30-min sessions (e.g., Simmons, Smith, & Kliethermes, 2003). However, the relatively small effects were somewhat surprising, as
Alexandra sometimes consumed as much as 250 g of wafer within a single session. Perhaps the most important implication of these findings was that the lean FT schedule was consistently associated with higher response frequencies in component 3 (if not immediately, then eventually). This outcome, in the context of no increase in response levels in component 3 over component 1 during extinction analyses, suggests that the intermittent delivery of wafers may have resulted in sensitization to the reinforcing effects of wafers. However, the differences between component 1 and 3 response levels were relatively small and sometimes did not follow component changes quickly, and so this account must be considered tentative. Further research might investigate a potential sensitization effect of intermittent stimulus delivery, as the outcomes of such investigations would have significant implications for NCR as treatment.

Extinction was implemented with Alexandra for 2 reasons: First, although CNCR had been shown to be effective in decreasing her problem behavior, it was not considered a practical solution, as it would be impossible to implement outside of the clinical context. Also, the failure to successfully fade the schedule of wafer delivery called into question if food, in fact, did maintain the problem behavior. The initial implementation of extinction (within the multiple schedule) resulted in a slow decrease in response frequencies across sessions. A more rapid decrease was observed during the second implementation, and the final implementation (within the mixed schedule) produced a rapid but less dramatic decrease. These outcomes support the account that Alexandra’s problem behavior was, in fact, maintained by food.

Comparison of response patterns across mixed and multiple schedules suggests
that the presence of a stimulus associated with treatment affected levels and patterns of responding. Across all interventions, response suppression was most complete during multiple schedule analyses. However, this effect was most evident in the second implementation of extinction and FT 120 s wafer treatments in the multiple schedule arrangement. Because neither of these treatments was implemented for a second time within the mixed schedule, it is possible that the differences in response levels across schedules was a function of more extensive previous experience with these interventions in the multiple schedule. CNCR, however, was implemented twice within the multiple schedule and three times within the mixed schedule; therefore, the potential confounding effects of sequence and history are less likely to account for the (small) differences in component 2 response levels in the schedule analyses.

Patterns of responding also were somewhat different between the schedule arrangements. For example, although response suppression was not as complete during mixed schedule analyses, responding recovered somewhat more slowly in the mixed schedule analyses of extinction and FT 120 s wafer. Whereas inspection of the minute-by-minute graphs from the multiple schedule analyses shows immediate recovery of baseline response rates in multiple schedule analyses (with the exception of the second implementation of FT 120 s wafer), response levels slowly recovered to baseline values over the first 3-4 mins of component 3 during mixed schedule analyses.

Comparisons of the effects of FT 120 s wafer and extinction suggest that extinction was sufficient to produce the observed effects and that NCR was not necessary to decrease problem behavior. For example, Alexandra's problem behavior
occurred at response frequencies during FT 120 s wafer conditions that were roughly comparable to frequencies when no food was delivered at (i.e., extinction). Therefore, adding FT wafer deliveries to extinction did not appear to substantially accelerate or enhance treatment effects and, thus, the added value of wafer delivery in decreasing problem behavior was unclear. Combined with slight increases in component 3 values following FT 120 s wafer, these outcomes suggest that, in Alexandra’s case, extinction alone may have been a technically preferred treatment.

As noted previously, whereas CNCR effectively reduced problem behavior, dense FT deliveries of wafer produced no observable treatment effect. As previously suggested, adventitious reinforcement may account for the failure of dense FT schedules to reduce problem behavior; however, this does not explain why CNCR was effective. Extinction seems an unlikely account, as problem behavior rarely occurred and, if it did, should have been even more likely to contact adventitious reinforcement than in dense FT conditions (due to an even higher rate of wafer presentation). Satiation or habituation also do not seem to fully account for the effects of CNCR, based on rapid returns to near-baseline levels of responding immediately following CNCR conditions (in component 3). A more likely account for response decreases produced by CNCR is that the deliveries were so frequent (wafers were delivered immediately after Alexandra picked up the wafer on the table— before that wafer had been consumed) there was no time between deliveries for problem behavior to occur.

Some limitations were of note in the current study. The extent to which the current results are generalizable to other cases is unclear. Some of the response
patterns shown in this study were inconsistent with other research in this area (e.g., absence of substantial evidence of satiation, failure of dense FT schedules), and in the absence of replication across multiple participants, the representativeness of these data is questionable. The current study was very labor intensive, with daily 30 min sessions spanning over ten months, not including the pretreatment analysis. The order of conditions in the experiment also limits interpretations of the results. As previously noted, the effects observed in the replications of multiple schedule analyses of extinction and FT 120 s could very well have been enhanced by the prior use of extinction. Therefore, replications of these conditions within mixed schedules would have improved the design of the study and the ability to interpret observed differences in responding across schedule arrangements.

This study replicates a small body of research showing difficulties in thinning NCR schedules from continuous to intermittent deliveries (Ringdahl, Vollmer, Borrello, & Connell, 2001). Additional research should investigate the conditions under which schedule thinning is and is not effective.

This study extended the previous research by investigating the effects of extinction, continuous availability of food, and dense and lean fixed time food presentation on food-maintained problem behavior. Furthermore, these conditions were evaluated within the contexts of mixed and multiple schedules, permitting evaluations of immediate and subsequent effects, as well as patterns of responding across transitions. Results indicated that the most effective treatment was CNCR; however, this treatment was deemed unrealistic to implement and potentially
detrimental based on dietary concerns. A lean schedule of food presentation and extinction were found to be roughly equally effective when implemented within a multiple schedule. The fixed time delivery of food was determined to be a technically unnecessary component of the final treatment, and slight increases in responding during the 3rd component of the FT 120 s wafer analyses called the logic of the use of lean FT schedules in NCR treatment packages. Future research should clarify the effects of intermittent, response-independent deliveries of stimuli identified to maintain problem behaviors. Outcomes suggesting that, in some cases, such arrangements may produce sensitization and, therefore, subsequent increases in problem behavior, would have implications for the use of lean NCR schedules to treat behavior disorders.

Table 1

Operational Definitions for Motivational Assessment Scales, Functional Analysis, Baseline, Noncontingent Reinforcement and Extinction Sessions

<table>
<thead>
<tr>
<th>Terms</th>
<th>Operational Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggression</td>
<td>Scratching, hitting, pinching, biting, pushing, five finger contact to another person, or grabbing.</td>
</tr>
<tr>
<td>Self-injury</td>
<td>Punches head with fist, head banging (on floor, table or wall), hitting her arms/hand against objects, biting, pinching, hitting or scratching herself.</td>
</tr>
<tr>
<td>Demand</td>
<td>The first prompt in a three prompt demand sequence, which faded from a verbal prompt, to a model prompt, to a physical guidance prompt</td>
</tr>
<tr>
<td>Attention</td>
<td>About five seconds of talking to subject in the form of disapproval</td>
</tr>
<tr>
<td>Compliance</td>
<td>The subject engages in the requested behavior before the third prompt is delivered</td>
</tr>
<tr>
<td>Tangible Delivery</td>
<td>Therapist presents food item to subject</td>
</tr>
<tr>
<td>Tangible Consumption</td>
<td>Subject puts food item into mouth</td>
</tr>
</tbody>
</table>
**Table 2**

*Average Interobserver Agreement Results of Target Behaviors during the Functional Analysis, Baseline, Mixed Schedule, Multiple Schedule and Extinction Sessions*

<table>
<thead>
<tr>
<th></th>
<th>Aggression Mean</th>
<th>Range</th>
<th>Self-injury Mean</th>
<th>Range</th>
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<tbody>
<tr>
<td>FA</td>
<td>96.79%</td>
<td>89.0-99.8%</td>
<td>99.8%</td>
<td>98.8-100%</td>
</tr>
<tr>
<td>Baseline 1</td>
<td>82.4%</td>
<td>77.6-87.1%</td>
<td>99.9%</td>
<td>99.8-100%</td>
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<tr>
<td>FT Mixed 1</td>
<td>91.0%</td>
<td>89.4-92.3%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Baseline 2</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>FT Mixed 2</td>
<td>83.7%</td>
<td>76.6-91.6%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Baseline 3</td>
<td>86.7%</td>
<td>84.7-88.6%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>FT Multiple 1</td>
<td>89.9%</td>
<td>80.2-93.4%</td>
<td>100%</td>
<td>99.8-100%</td>
</tr>
<tr>
<td>Baseline 4</td>
<td>92.3%</td>
<td>92.3%</td>
<td>99.8%</td>
<td>99.8%</td>
</tr>
<tr>
<td>FT Multiple 2</td>
<td>88.3%</td>
<td>78.9-95.9%</td>
<td>100%</td>
<td>99.9-100%</td>
</tr>
<tr>
<td>Extinction Multiple 1</td>
<td>86.9%</td>
<td>79.5-93.5%</td>
<td>99.8%</td>
<td>99.7-100%</td>
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<tr>
<td>Baseline 5</td>
<td>90.3%</td>
<td>87.4-93.1%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Extinction Multiple 2</td>
<td>93.1%</td>
<td>93.1%</td>
<td>99.9%</td>
<td>99.9%</td>
</tr>
<tr>
<td>FT Multiple 3</td>
<td>88.6%</td>
<td>85.7-91.9%</td>
<td>99.9%</td>
<td>99.6-100%</td>
</tr>
<tr>
<td>Baseline 6</td>
<td>91.1%</td>
<td>91.1%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Extinction Mixed 1</td>
<td>93.4%</td>
<td>88.8-96.2%</td>
<td>93.2%</td>
<td>90-95.7%</td>
</tr>
<tr>
<td>FT Mixed 3</td>
<td>91.5%</td>
<td>90.7-92.3%</td>
<td>95.8%</td>
<td>91.9-99.6%</td>
</tr>
<tr>
<td>FT Multiple 4</td>
<td>88.9%</td>
<td>86.6-91.2%</td>
<td>99.8%</td>
<td>99.6-99.9%</td>
</tr>
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</table>

**Table 3**

*Results from Motivational Assessment Scale*

<table>
<thead>
<tr>
<th>SIB</th>
<th>Attention</th>
<th>Tangible</th>
<th>Escape</th>
<th>Sensory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rater 1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Rater 2</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Rater 3</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Rater 4</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Rater 5</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PAO</th>
<th>Attention</th>
<th>Tangible</th>
<th>Escape</th>
<th>Sensory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rater 1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Rater 2</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Rater 3</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Rater 4</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Rater 5</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>
Figure 1. Results of the functional analysis for Alexandra. Data are presented as frequency of problem behavior (both aggression and self-injury) during each session for all conditions.

Figure 2. Comparison of the mixed and multiple schedules results. Data are presented as frequency of problem behavior (both aggression and self-injury) for each component. Component one is represented by open circles, component two is represented by filled circles, and component three is represented by filled triangles.
Figure 3. Results of baseline and CNCR mix in minute-by-minute means. Data are presented as frequency of problem behavior (both aggression and self injury) for each component. Numbers in legends correspond to session numbers in Figure 2.
Figure 4. Results of FT 15 s Mix and FT 10 s Mix in minute-by-minute means. Data are presented as frequency of problem behavior (both aggression and self injury) for each component. Numbers in legends correspond to session numbers in Figure 2.
Figure 5. Results of CNCR Mult and FT 15 s Mult in minute-by-minute means. Data are presented as frequency of problem behavior (both aggression and self injury) for each component. Numbers in legends correspond to session numbers in Figure 2.
Figure 6. Results of Ext Mult and FT 120 s wafer Mult in minute-by-minute means. Data are presented as frequency of problem behavior (both aggression and self injury) for each component. Numbers in legends correspond to session numbers in Figure 2.
Figure 7. Results of Ext Mix and FT 120 s wafer Mix in minute-by-minute means. Data are presented as frequency of problem behavior (both aggression and self injury) for each component. Numbers in legends correspond to session numbers in Figure 2.
REFERENCE LIST


