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Fixed-Time Schedule Effects on Participant Responding: An Evaluation Of Similar vs. Dissimilar Schedule Programs Using a Group Design Approach

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FIXED-TIME SCHEDULE EFFECTS ON PARTICIPANT RESPONDING: AN EVALUATION OF SIMILAR VS. DISSIMILAR SCHEDULE PROGRAMS USING A GROUP DESIGN APPROACH

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Table of Contents

List of Tables

Abstract

We evaluated the effectiveness of fixed-time (FT) schedules of reinforcement at eliminating participant's responding using a between-subjects group design. Participants experienced one of three conditions; a FT leaner schedule, a FT yoked schedule, or a FT denser schedule using a computerized experimental program. Dependent variables of interest are the total number of responses made during the fixed-time reinforcement phase and the latency until the participant met extinction or exit criteria.

Introduction

In Skinner's wildly influential article "Superstition in the Pigeon" (1948), fixed-time schedules of reinforcement were first introduced. Skinner outlined the behavior of pigeons under varying fixed-time (FT) schedules of reinforcement and found a consistent pattern that he termed superstitious behavior. Under the ideal FT 15 s schedule, each pigeon would engage in their own ritual behavior before the next reinforcer was delivered. Even though the reinforcement delivery was determined solely by the passage of time, the pigeon had developed a contingency between their engagement in a specific behavior and reinforcement delivery. Skinner went on to demonstrate that if the time intervals were lengthened enough to which this conditioning pattern could not consistently take place, the behavior would extinguish. It is here in Skinner's writing that noncontingent reinforcement schedules were first experimentally manipulated. However, it would still take decades before researchers systematically began to study noncontingent reinforcement schedule procedures. These early researchers evaluated the procedural properties of noncontingent reinforcement schedules most popularly with animal subjects.

One of the first published studies was conducted by Appel and Hiss (1962), in which the ability of pigeons to discriminate between contingent and noncontingent schedules of reinforcement was investigated. Researchers measured the rate of key pecks made by the pigeons under a FT dependent vs. FT noncontingent schedules of reinforcement. Preferred edible reinforcers were delivered under both schedules. Results showed that pigeons engaged in significantly more responses during the contingent reinforcement condition than the noncontingent reinforcement condition, signaling they could discriminate the reinforcement contingencies. This was also one of the first studies to show that noncontingent reinforcement procedures had a behavior reduction effect. Brinker and Treadway (1975) replicated the results from Appel and Hiss (1962) evaluating the effects of response dependent vs. noncontingent schedules of reinforcement. Brinker and Treadway (1975) reinforced and measured quail peck responses under these differing schedules of reinforcement. Results revealed that across all four quail, response rates were three times greater during response-dependent than during noncontingent reinforcement schedules. Following research investigating behavior under contingent/dependent vs. noncontingent schedules of reinforcement manipulated differing types of noncontingent reinforcement schedules.

One study conducted by Zeiler (1968) extended the literature by investigating variable-time (VT) vs. FT schedules of noncontingent reinforcement with pigeons. Pigeon's key pecking responses were first increased to steady rates of responding under response-dependent reinforcement phase. Following the response-dependent reinforcement phase, pigeons experienced noncontingent schedules of reinforcement that were either VT schedules or FT schedules. Results showed that for all three pigeon's, responding decreased under noncontingent schedules of reinforcement compared to contingent schedules of reinforcement (regardless of whether the reinforcement was delivered on a FT or VT schedule). More interesting however, was that responding was more consistent under the FT schedule of reinforcement compared to the VT schedule of reinforcement. Researchers characterized pigeon responding under the VT schedules of reinforcement as "erratic" and inconsistent across pigeons (Zeiler, 1968).

In another comparison study, Rescorla and Skucy (1969) investigated the effectiveness of extinction and noncontingent reinforcement procedures on reducing a bar pressing response in rats. Rats were placed in chambers in which food pellets were delivered freely on a variable interval (VI) 1 min. schedule and concurrently on an fixed ratio (FR) 1 schedule of reinforcement for bar pressing. Following this baseline phase in which the bar pressing response was strengthened; rats experienced either a continued contingent reinforcement condition, an extinction condition, or a VI noncontingent reinforcement condition. Results revealed that although extinction was more effective at eliminating responding compared to the noncontingent VI schedule, the noncontingent VI schedule did in fact result in significant reductions in responding. This was one of the first experimental demonstrations that VI noncontingent reinforcement schedules could be effective at reducing a behavior previously maintained by reinforcement.

Following the Rescorla and Skucy (1969) study, researchers such as Lachter, Cole, and Schoenfeld (1971) continued to investigate the effectiveness of noncontingent reinforcement procedures at reducing response rates of animals. More specifically, Lachter et al. (1971) compared both dense and lean FT schedules of reinforcement with pigeons to reveal which schedule was most effective at reducing responding. Two pigeons experienced multiple noncontingent reinforcement schedules with inter-reinforcement intervals that ranged from 5-240 s. Results indicated that increasingly dense schedules of noncontingent reinforcement were more effective at reducing the pigeon's responding than the increasingly lean schedules of reinforcement. These results continued to add to the research literature that supported the use of noncontingent reinforcement as an effective behavior reduction procedure. Furthermore, studies such as Alleman and Zeiler, (1974), Calef et al. (1989), Dickinson and Charnock (1985), Edwards, Peek, and Wolfe, (1970), Halliday and Boakes, (1971), Job (1988), and Oakes, Roseblum, and Fox, (1982) all demonstrated the consistent phenomenon that a shift from a response-dependent schedule of reinforcement to a response-independent (i.e. noncontingent) schedule of reinforcement produced a reduction in the previously reinforced response. This led to researchers using noncontingent reinforcement schedules as an alternative control procedure in future research.

Noncontingent reinforcement was first introduced into the field of applied behavior analysis as a control procedure. To evaluate the effects of reinforcement on behavior, reinforcement was delivered independent of the target response to evaluate the effects of reinforcement-based procedures. Prior to the use of noncontingent reinforcement as a control procedure, extinction was commonly used in research designs as the control procedure. As Lachter (1980) discussed, using extinction as a control procedure introduced possible confounds to the analysis because extinction procedures eliminated both the response-reinforcement relationship and the presentation of reinforcement in and of itself. Therefore, noncontingent reinforcement was established as a superior procedure to disrupt the response-reinforcement relationship while keeping the presentation of reinforcement intact. In other words, noncontingent reinforcement procedures allowed researchers to analyze the response-reinforcement relationship while controlling for reinforcement stimulus-presentation effects.

Hart, Reynolds, Baer, Brawley, and Harris (1968) was one of the first published studies to demonstrate the use of noncontingent reinforcement as a control procedure in the evaluation of a response-reinforcement relationship. Hart et al. (1968) evaluated the effects of contingent adult attention vs. noncontingent adult attention on the cooperative play behavior of a 5-year-old girl. There results revealed that cooperative play only increased in the contingent reinforcement condition, suggesting that the causal relationship between the response and reinforcement resulted in the increases in the appropriate target behavior.

A more recent and well-known example of noncontingent reinforcement as a control procedure in applied research is the experimental functional analyses study by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994). Functional analyses typically involve the observation of a target behavior (most commonly problem behavior) under several tightly controlled experimental conditions in the attempt to determine to social consequences maintaining that behavior. Experimental conditions implemented in functional analyses usually consist of (a) contingent attention, (b) contingent escape from demands, (c) contingent tangibles, (d) alone, and (e) free play (the noncontingent control condition). The key components in the noncontingent control condition are noncontingent access to preferred tangible items, noncontingent delivery of attention, and the absence of all demands. Therefore the free play condition can serve as a control for all the other conditions because it controls for attention, presentation of demands, access to tangible items, and the presence of the experimenter. Responding during each of the experimental conditions in the functional analysis is compared singularly to responding during the free play control condition to evaluate potential response-reinforcement contingencies. In addition to research using noncontingent reinforcement as a control condition, one study by Thompson, Iwata, Hanley, Dozier, and Samaha (2003) evaluated multiple control procedures against one another in an evaluation of which procedure was a superior control condition.

Thompson et al. (2003) compared the effects of extinction, noncontingent reinforcement, and differential reinforcement of other behavior as control procedures. Specifically, Thompson et al. (2003) compared the rate and amount of response reduction under each control condition against one another. Participants were 9 adults with developmental disabilities who were all referred for the evaluation of problem behavior. All participants experienced a baseline condition in which task demand materials were present but the target response (i.e. task completion) resulted in no consequences. All participants then experienced a reinforcement condition in which preferred edible reinforcers were delivered contingent on the occurrence of the target response on a FR 1 schedule of reinforcement. Following the reinforcement condition all participants experienced the extinction control condition and either the noncontingent reinforcement control condition or the differential reinforcement of other behavior control condition in a reversal design. During the extinction condition, all task materials were present and the target response resulted in no consequence. During the noncontingent reinforcement condition, the edible reinforcer was delivered according to a FT schedule. Lastly, during the differential reinforcement of other behavior condition, the edible reinforcer was delivered contingent on the absence of the target response during a specified time interval. Results indicated that across participants extinction produced the quickest and largest reduction in the target response compared to both noncontingent reinforcement and differential reinforcement of other behavior procedures. These results would support the continued use of extinction as a control condition in future research, however the authors cautioned against the potential experimental confounds that are associated with extinction procedures. Therefore, the experimenters recommended that researchers continue to weigh practical and methodological advantages of each procedure when selecting which type of control procedure they use. For a review of the advantages and disadvantages of control procedures used in applied research see Thompson and Iwata (2005).

In addition to the implementation of noncontingent reinforcement as a control procedure in applied research, the implementation of noncontingent reinforcement has also been researched as a function-based treatment for aberrant behaviors. However, prior to delving into the treatment literature, it is important to understand the behavior principles underlying the effects of noncontingent reinforcement.

Challenging behavior(s) engaged in by individuals (e.g. aggression, destruction, self-injury) are maintained by one or more types of reinforcement. There are three general classes of reinforcement that have been extensively studied through experimental manipulations (Iwata, Vollmer, & Zarcone, 1990). Positive reinforcement involves the presentation of a stimulus/event contingent upon the occurrence of the challenging behavior that increases the likelihood of that behavior occurring in the future. Negative reinforcement is the removal of an aversive stimulus/event contingent upon the occurrence of the challenging behavior that also increases the likelihood of that behavior occurring in the future. Lastly, automatic reinforcement refers to instances in which the challenging behavior is maintained by some other variable that is not socially mediated. The function of the challenging behavior must be identified through experimental manipulations in order to implement a function-based treatment. Moreover, for a treatment protocol to be function-based it must manipulate the specific reinforcement class that previously maintained the challenging behavior. Therefore, for noncontingent reinforcement to be a function-based treatment the reinforcer being delivered must have been previously shown to be the maintaining variable of the challenging behavior.

To more thoroughly understand the treatment effects of noncontingent reinforcement, the potential underlying behavior mechanisms must also be understood. According to Carr, Coriaty, Wilder, Gaunt, Dozier, Britton, Avina, and Reed (2000), noncontingent reinforcement treatment effects are mediated through two potential behavior mechanisms: (a) reduction in the reinforcer's establishing operation, and (b) elimination of the response-reinforcer relationship. According to Michael (1993) an establishing operations is an environmental stimulus/event that affects the momentary effectiveness of a reinforcer and the likelihood of the occurrence of a behavior that has been reinforced by the manipulated consequence. Therefore, noncontingent reinforcement eliminates an individual's motivation to engage in the specified behavior that has been previously reinforced by that specific consequence, because the individual is already contacting reinforcement. The response-reinforcer relationship mechanism states that during noncontingent reinforcement procedures the delivery of reinforcement is neither predicted nor delayed by the occurrence of the specified behavior. Therefore, the previous behavior-consequence causal relationship is disrupted over time and the behavior is reduced. Theoretically however, it may not always be distinguishable which behavior mechanism is affecting behavior, and it also may be a combination of both behavior mechanisms at the same time. With a more refined understanding of underlying behavior mechanisms of noncontingent reinforcement procedures, the vast literature base of noncontingent reinforcement treatment can be more thoughtfully understood.

Noncontingent reinforcement as a function-based treatment procedure has been demonstrated to be effective at reducing different topographies of challenging behaviors such as, aggressive behaviors (e.g. Baker, Hanley, & Mathews, 2006), disruptive behaviors (e.g. Fischer, Iwata, & Mazaleski, 1997), and self-injurious behaviors (e.g. Kahng, Iwata, DeLeon, & Wallace, 2000), stereotypy (e.g. Lanovaz & Argumedes, 2010), pica (e.g. Piazza, Hanley, & Fisher, 1996), inappropriate speech (e.g. Buchanan & Fisher, 2002), mouthing (e.g. Simmons, Smith & Kliethermes, 2003) and rumination (e.g. Wilder, Draper, Williams, & Higbee, 1997). In addition, noncontingent reinforcement has been shown to be effective at reducing challenging behaviors of differing functions such as, attention-maintained behavior (e.g. Fisher, Ninness, Piazza, & Owen-DeSchryver, 1996), escape-maintained behavior (e.g. Kodak, Miltenberger, & Romaniuk, 2003), tangible-maintained behavior (e.g. Van Camp, Lerman, Kelley, Contrucci, & Vorndran, 2000), and automatic-maintained behavior (e.g. Sprague, Holland, & Thomas, 1997). Lastly, noncontingent reinforcement has been shown to be effective at reducing challenging behaviors across individuals with differing diagnoses such as, autism spectrum disorder (ASD) (e.g. Wilder, Normand, & Atwell, 2005), mental retardation (e.g. Britton, Carr, Landaburu, & Romick, 2002), cerebral palsy (e.g. Fisher, O'Connor, Kurtz, DeLeon, & Gotjen, 2000) and Down syndrome (e.g. Athens, Vollmer, Sloman, & Peter Pipkin, 2008) to name a few. See Table 1 for a more detailed list of noncontingent reinforcement treatment studies.

Table 1
Summary of noncontingent reinforcement treatment studies

Author	**Year**	**Challenging Behavior(s)**	**Function**	**NCR Form**	**Primary Diagnosis**
Athens et al.	2008	Stereotypy	Automatic	Fixed-Time	Down syndrome, ASD
Austin & Soeda	2008	Disruption	Attention	Fixed-Time	None
Baker et al.	2006	Aggression	Escape	Fixed-Time	Dementia
Britton et al.	2000	Aggression, SIB	Attention, Tangible	Fixed-Time	Profound-Severe MR, ASD
Britton et al.	2002	Stereotypy	Automatic	Continuous	Profound-Severe MR, Developmental Delay
Buchanan & Fisher	2002	Inappropriate Vocalizations	Attention, Automatic	Fixed-Time	Dementia
Butler & Luiselli	2007	Aggression, SIB, Disruption	Escape	Fixed-Time	ASD
Carr & Britton	1999	Inappropriate Vocalizations	Attention	Fixed-Time	Moderate MR
Carr et al.	2002	Object mouthing	Automatic	Fixed-Time	ASD
Coleman & Homes	1998	Aggression, Disruption	Escape	Fixed-Time	ASD
DeLeon et al.	2000	SIB	Automatic	Continuous	ASD, Moderate MR
DeLeon et al.	2005	Disruption	Attention	Continuous	Severe MR, seizure disorder
Derby et al.	1996	SIB	Attention	Continuous	Profound MR
Doughty & Anderson	2006	Aggression, SIB, Disruption	Attention	Fixed-Time	Mild-Moderate MR, Developmental Delay

(Table 1 continued)

Author	Year	Challenging Behavior(s)	Function	NCR Form	Primary Diagnosis
Falcomata et al.	2004	Inappropriate Vocalizations	Automatic	Continuous	ASD
Fischer et al.	1997	SIB	Attention, Tangible	Fixed-Time	Profound MR
Fisher et al.	1996	Disruption	Attention	Fixed-Time	ASD
Fisher et al.	1999	Aggression, SIB, Disruption	Attention	Fixed-Time	Mild-Moderate MR, Developmental Delay
Fisher et al.	2000	Disruption	Attention	Fixed-Time	Severe MR, Cerebral palsy
Fisher et al.	2004	Disruption	Attention	Continuous	Mild, Moderate-Severe MR
Goh et al.	1999	Pica	Automatic	Fixed-Time	Severe-Profound MR
Goh et al.	2000	SIB	Attention, Tangible	Fixed-Time	Profound MR
Gouboth et al.	2007	Aggression, Disruption	Attention, Tangible	Fixed-Time	Profound MR, ASD
Hagopian et al.	1994	Aggression, SIB, Disruption	Attention	Fixed-Time	Mild-Severe MR, PDD-NOS
Hagopian et al.	2000(a)	Excessive medical complaints	Attention	Fixed-Time	Moderate MR
Hagopian et al.	2000(b)	Aggression, SIB, Disruption	Attention, Tangible	Fixed-Time	Severe-Profound MR, ASD, Seizure disorder, Cerebral palsy
Hagopian et al.	2001	Aggression, SIB	Escape from Attention, Tangible	Fixed-Time	ASD
Hagopian et al.	2004	Aggression, SIB	Attention, Tangible, Escape	Fixed-Time	Moderate-Severe-Profound MR, Fragile X syndrome, Epilepsy
Hanley et al.	1997(a)	Aggression, SIB, Disruption	Attention	Continuous	Moderate-Severe MR
Hanley et al.	1997(b)	Aggression, Disruption	Attention, Escape	Fixed-Time	Mild MR, Cerebral Palsy

(Table 1 continued)

Author	Year	Challenging Behavior(s)	Function	NCR Form	Primary Diagnosis
Ing et al.	2011	Coprophagia, SIB	Automatic	Fixed-Time	ASD
Ingvarsson et al.	2008	Aggression, SIB, Disruption	Escape, Tangible	Fixed-Ratio	ASD
Jones et al.	2000	Disruption	Attention	Fixed-Time	Attention deficit hyperactivity disorder
Kahng et al.	1997	SIB	Attention	Fixed-Time	Severe-Profound MR
Kahng et al.	2000(a)	SIB	Attention, Tangible	Fixed-Time	Severe-Profound MR
Kahng et al.	2000(b)	Aggression, SIB	Attention, Tangible	Fixed-Time	Severe-Profound MR, Angelman syndrome
Kerth et al.	2009	SIB	Tangible	Continuous	ASD
Kodak et al.	2003(a)	Aggression, Disruption	Attention, Escape	Fixed-Time	Seizure disorder
Kodak et al.	2003(b)	Disruption	Escape	Fixed-Time	ASD
Lalli et al.	1997	Aggression, SIB	Tangible	Fixed-Time	Mild-Severe MR
Lalli et al.	1998	SIB	Attention	Fixed-Time	Severe MR
Lancaster et al.	2004	Inappropriate Vocalizations	Attention, Automatic	Fixed-Time	Moderate-Severe MR, Schizophrenia, Bipolar
Lanovaz & Argumedes	2010	Stereotypy	Automatic	Fixed-time	ASD
Lindberg et al.	2003	SIB	Automatic	Continuous	Moderate-Severe MR
Lomas et al.	2010	Aggression, SIB, Disruption	Escape	Variable-Time	Asperger syndrome, ASD
Luiselli	1994	Stereotypy	Unknown	Continuous	Posttraumatic Neurological Impairment
Mace & Lalli	1991	Inappropriate Vocalizations	Attention	Variable-Time	Moderate MR
Mace et al.	1998	SIB	Escape, Tangible	Fixed-Time	Moderate MR, ASD
Marcus & Vollmer	1996	Aggression, SIB	Tangible	Fixed-Time	Moderate-Profound MR, ASD

(Table 1 continued)

Author	Year	Challenging Behavior(s)	Function	NCR Form	Primary Diagnosis
O'Callaghan et al.	2006	Disruption	Escape	Fixed-Time	Unknown
O'Reilly et al.	1999	Aggression	Attention	Fixed-Time	Mild MR
Persel et al.	1997	Aggression, SIB	Attention	Fixed-Time	Traumatic brain injury
Phillips & Mudford	2011	Aggression	Attention	Fixed-Time	Severe MR
Piazza et al.	1996	Pica	Automatic	Continuous	Severe MR
Piazza et al.	1997	Aggression, Disruption	Attention, Escape	Continuous	Mild MR
Piazza et al.	1998	Pica	Attention, Automatic	Continuous	Moderate-Profound MR, ASD
Rasmussen & O'Neill	2006	Disruption	Attention	Fixed-Time	Bipolar disorder, Anxiety disorder
Ringdahl et al.	2002	Aggression	Attention	Continuous	Mild-Moderate MR, Severe-Profound MR
Ringdahl et al.	2010	Aggression, SIB	Tangible	Fixed-Time	Mild-Moderate MR
Roane et al.	2003	Object mouthing	Automatic	Continuous	Moderate MR, ASD, Cerebral palsy
Rosales et al.	2010	SIB, Disruption	Automatic	Continuous	Severe-Profound MR, ASD, PDD-NOS
Roscoe et al.	1998	SIB	Automatic	Continuous	Moderate-Profound MR
Rush et al.	2001	Aggression, SIB, Disruption	Automatic	Unknown	Moderate-Severe MR, Cerebral palsy, ASD
Schalder et al.	2009	Disruption	Attention, Tangible	Fixed-Time	Severe-Profound MR, PDD-NOS, ASD
Sigafoos & Pennell	1995	SIB	Automatic	Continuous	Severe MR
Simmons et al.	2003	Hand Mouthing	Automatic	Fixed-Time	Unknown
Smith et al.	1996	SIB	Tangible	Continuous	Profound MR
Sprague et al.	1997	SIB, Stereotypy	Automatic	Variable-Time	Severe MR

(Table 1 continued)

Author	Year	Challenging Behavior(s)	Function	NCR Form	Primary Diagnosis
Tarbox et al.	2003	Elopement	Attention, Tangible	Continuous	Severe- Profound MR, ASD
Thelen	1979	Aggression	Unknown	Unknown	None
Van Camp et al.	2000	Aggression, SIB	Tangible	Fixed-Time, Variable-Time	Moderate-Severe MR
Vollmer et al.	1993	SIB	Attention	Fixed-Time	Severe-Profound MR
Vollmer et al.	1995	SIB	Escape	Fixed-Time	Profound MR
Vollmer et al.	1997	Aggression	Tangible	Fixed-Time	Severe MR
Vollmer et al.	1998	Aggression, Disruption	Attention, Escape	Fixed-Time	Moderate-Severe MR
Wallace et al.	2012	Aggression, SIB	Attention, Tangible	Fixed-Time	Profound MR
Waller & Higbee	2010	Disruption	Escape	Fixed-Time	Unknown
Ward et al.	2008	Disruption	Automatic	Fixed-Time	None
Wilder et al.	1997	Rumination	Unknown	Fixed-Time	Profound MR
Wilder et al.	2005	SIB	Escape	Continuous	ASD

There are two predominant ways to program the delivery of reinforcement within noncontingent reinforcement procedures. The first is to deliver reinforcement on a fixed times (FT) schedule (e.g. FT 1 min.). During a FT schedule, reinforcement is always delivered at the designated and equal time interval. To date, FT delivery is the most commonly used programming procedure for noncontingent reinforcement, and has been shown to be effective at reducing challenging behaviors (Carr, et al. 2000). A second way to program reinforcement delivery is to deliver it on a variable time (VT) schedule (e.g. VT 1 min.). During a VT schedule, reinforcement is delivered at a range of different time intervals all varying around a predetermined average length. VT schedules of noncontingent reinforcement have not been as thoroughly studied; however I will highlight two of the prominent studies in the literature.

The first experiment to manipulate VT schedules of noncontingent reinforcement was Mace and Lalli (1991). Mace and Lalli (1991) worked with an adult participant to treat their bizarre speech. First, the authors conducted an experimental functional analysis and results supported attention as the maintaining consequence of the bizarre speech. During the treatment analysis, Mace and Lalli (1991) compared noncontingent attention under three VT schedules (VT 90s, VT 60s, and VT 30s). Results revealed that all three VT schedules of reinforcement were effective at reducing the participant's bizarre speech.

A second experiment evaluating the effectiveness of VT schedules was conducted by Sprague, Holland, and Thomas (1997). Two participants were reinforced with auditory or tactile items previously determined to be competing stimuli for their self-injurious behavior(s). Researchers delivered access to the competing stimuli on a VT 5s schedule. Across both participants, and across both auditory and tactile stimuli, the VT schedule of noncontingent reinforcement was effective at reducing rates of self-injurious behavior(s). Although both of these experimental analyses are in agreement with each other, that VT schedules of noncontingent reinforcement are effective at reducing challenging behaviors, further research should be conducted across behavioral functions, topographies of behavior, and populations.

A second area of research that is lacking in support is research directly comparing FT and VT schedules of noncontingent reinforcement. To date, there are only two studies that directly compare the effectiveness of FT vs. VT schedules of noncontingent reinforcement at reducing behavior. The first study was conducted by Van Camp, Lerman, Kelley, Contrucci, and Vorndran (2000). Participants in this study were two individuals with developmental disabilities that engaged in aggression and self-injury. The authors first conducted an experimental functional analysis to determine the reinforcing consequences of the challenging behavior, and results revealed that for both participants, their challenging behavior was maintained by access to preferred leisure items. Therefore, for the remainder of the study 20s access to preferred items was used as reinforcement. Van Camp et al. (2000) compared FT and VT schedules of noncontingent reinforcement employing a multielement design for participant 1 and a reversal design for participant 2. Reinforcement schedules for both FT and VT procedures ranged from less than 30s to 300s. Time schedules were gradually increased as long as the participant did not engage in any aggression/self-injury between the two previous reinforcement periods. Results from both participants were quite variable; however the authors argue that they do consistently reveal that both VT and FT schedules were effective at reducing the target behaviors below baseline levels. Results for participant 1 were a little clearer, showing that the behavior decreased at equal rates and levels across both schedules. However, authors do admit that the potential for carryover effects were higher for participant 1 due to the multielement design, and therefore these results are only tentative. Results for participant 2 revealed an immediate reduction to near zero levels during the initial continuous VT schedule and then behavior became more variable as the schedule was thinned. Whereas, during the FT schedule phase, behavior was initially more variable and then reduced to consistent near zero levels as the schedule was thinned. In conclusion, this experiment does show preliminary support that VT schedules of noncontingent reinforcement have comparable effects to those seen in the FT schedule literature.

A second study directly comparing the behavior reduction effects of FT and VT schedules was conducted by Carr, Kellum, and Chong (2001). Participants were two adults with mental retardation and the target behaviors for the analysis were individually identified arbitrary responses. Both participants were taught to complete their behavioral response via a training phase in which responding was verbally prompted and reinforced with preferred edible items. Responding for both participants was placed under a FR1 reinforcement phase followed by a VR3 reinforcement phase. The purpose of these two phases was to build up the behavioral response so that subsequent behavioral reduction procedures could be tested. Participant 1 first experienced the comparison of FT and VT schedules within a multielement design phase, and then experienced each schedule in isolation via a reversal design. Participant 2 only experienced the schedules in isolation via a reversal design. Results revealed that during the multielement design for participant 1, the behavior response decreased at almost identical levels for both the FT 20s schedule and the VT 20s schedule. The participant's responding then increased again under a contingent reinforcement phase and then decreased to zero levels during the VT 20s reversal phase. Again, the participant's responding increased under another contingent reinforcement phase and again decreased to zero levels during the FT 20s reversal phase. Taken together, results from participant 1 revealed almost identical behavioral reduction effects during both FT and VT schedules within the multielement phase and reversal design phases. Participant 2 first experienced a FT 5s phase in which the behavioral response decreased from levels seen in the contingent reinforcement phase, however the behavior was still occurring around 10-15 times per minute. Following a brief return to the contingent reinforcement phase, a VT 5s schedule of reinforcement phase was implemented. Behavior under the VT 5s phase decreased to comparable levels as seen in the FT 5s phase, again however, maintaining at around 10-15 responses per minute. Results from participant 2 reveal that although both schedules of reinforcement had almost identical behavior reduction effects, the overall reduction in behavior was minimal. Taken together, the Van Camp et al. (2000) and Carr et al. (2001) studies show preliminary results indicating that FT and VT schedules may be equally effective at reducing behavior. However, it is clear that more research needs to be conducted in this area before a definitive answer is achieved. Future research should focus on analyzing both challenging and arbitrary behaviors, differing functions of behavior, different topographies of challenging behavior, and differing participant populations.

Another central concern when implementing noncontingent reinforcement procedures is the density of the reinforcement schedule. In other words, how often should reinforcement be delivered? The research base for answering this question is mixed, and in some places contradictory. The first argument is that to be effective (i.e. reduce the rate of behavior) the schedule of reinforcement must be highly dense.

In essence, the noncontingent reinforcement schedule must eliminate the motivation to engage in problem behavior by providing more than enough reinforcement to satisfy the individual. In behavior analytic terms, the noncontingent reinforcement schedule must be dense enough to eliminate the establishing operations for engaging in problem behavior (Michael, 1993).

The first study to directly compare differing densities of noncontingent reinforcement schedules was conducted by Hagopian, Fisher, and Legacy (1994). Researchers compared dense and lean schedules of reinforcement using a multiple baseline and multielement design across 5- year old identical quadruplets. Each of the four quadruplets were diagnosed with a pervasive developmental disorder and engaged in destructive behavior(s). Prior to implementing noncontingent reinforcement procedures, Hagopian et al. (1994) conducted functional analyses, as described by Iwata et al. (1982/1994), to determine the maintaining variable of the disruptive behaviors. For all four participants, their destructive behavior was maintained by attention. Following the functional analyses, all participants' disruptive behavior was observed under both dense and lean noncontingent reinforcement schedules using a multielement design. During the dense schedule condition, a therapist delivered attention on a FT 10s schedule. Each time attention was delivered for 10s, making the schedule in essence continuous. During the lean schedule condition, a therapist delivered 10s of attention on an FT 5min schedule. The initial results for the first comparison revealed that the dense schedule was more effective at reducing disruptive behavior than the lean schedule across all participants. These results support the argument that only dense schedules of reinforcement eliminate the establishing operations for engaging in problem behavior, and therefore must be implemented at the outset of a noncontingent reinforcement treatment protocol to be effective.

Following the alternating treatments design, a NCR fading procedure was implemented for all participants in which the initial dense schedule was gradually faded out to the lean schedule. The fading of reinforcement delivery was contingent upon the rate of the participant's destructive behavior. The criterion was a 95% reduction of baseline levels for two participants and a 90% reduction from baseline levels for the other two participants. If the criterion was met for that session, then the schedule of reinforcement would be faded for the next consecutive session. The fading process for each participant consisted of decreasing the number of 10s intervals of reinforcement per minute from 6 per minute to 5, 4, 3, 2, 1, .5, .33, .25, and .2 per minute (Vollmer et al., 1993). During the second analysis, disruptive behavior remained low for all participants as the reinforcement schedule was gradually faded out from the dense to lean schedule. These findings reveal that once problem behavior is reduced under a dense noncontingent reinforcement schedule, noncontingent reinforcement can continue to be an effective treatment as the reinforcement schedule is gradually thinned.

Another experiment with a similar design was conducted by Ingvarsson, Kahng, and Hausman (2008). Ingvarsson et al. (2008) evaluated dense vs. lean schedules of noncontingent reinforcement to reduce an 8-year old girl's challenging behaviors. Similar to Hagopian et al. (1994) a functional analysis, as outlined by (Iwata et al. (1982/1994), of the participant's challenging behavior was conducted to determine the maintaining variable(s) of the behavior. The young girl's challenging behavior was dually maintained by escape from instructions and access to preferred edible items. Subsequent experimental analyses were evaluated using access to preferred edible items as reinforcement. During the high density condition an edible item was given prior to every task demand (FR1 schedule of reinforcement). During the low density condition an edible item was given prior to every forth demand (FR4 schedule of reinforcement). Treatment conditions were alternated using multielement and reversal designs. Results revealed that the participant engaged in comparably low levels of problem behavior during both dense and lean schedules of reinforcement. These results are contradictory to the results from Hagopian et al. (1994). Ingversson et al. (2008) revealed that a lean schedule of noncontingent reinforcement, at the outset of treatment implementation, was effective at reducing levels of challenging behavior in this case.

Additional programming concerns were highlighted in an experiment conducted by Hagopian, Toole, Long, Bowman, and Lieving (2004). Hagopian et al. (2004) evaluated dense and lean schedules of noncontingent reinforcement for one of three participants to reduce challenging behavior. Following a functional analysis the participant's challenging behavior was determined to be maintained by access to preferred tangibles. During the noncontingent reinforcement evaluation, the initial dense schedule was access to video games for 1 min on a FT 15s schedule and the initial lean schedule was access to video games for 1 min on a FT 240s schedule. Following the implementation of the initial dense schedule, the reinforcement schedule was gradually faded until the target goal of FT-240s goal was reached. The fading procedure was to reduce the time that reinforcement was accessed by 1 min at each step. The criterion for progressing to the next step in the fading schedule was the rate of problem behavior had to be below .2 responses per minute for two consecutive sessions. Results revealed two main findings. The first main finding was that there were more sessions with high rates of problem behavior under the lean noncontingent reinforcement condition compared to the dense-to-lean noncontingent reinforcement condition. This would support Hagopian et al. (1994) results that dense noncontingent reinforcement schedules are needed at the outset of treatment to effectively reduce problem behavior. However, the second main finding was that the treatment goal of low rates of challenging behavior under the lean FT-240s schedule was reached faster when the initial schedule was the lean schedule vs. the dense-to-lean schedule. Taken together these results highlight that it may be important to consider what type of behavior you are treating and what your treatment goals are when selecting a noncontingent reinforcement schedule. For instance, if you are treating a harmful or high intensity topography of challenging behavior you may be more interested in reducing the occurrence of the behavior as quickly as possible from the outset of treatment. Therefore you would want to select a dense noncontingent reinforcement schedule and implement fading. In another instance, if you are treating a relatively low intensity topography of challenging behavior and have limited time and resources for treatment analyses, you may want to implement a lean noncontingent reinforcement schedule to get to a manageable treatment package more quickly. Taken together, clinicians may want to take behavioral variables into consideration when programming a noncontingent reinforcement treatment procedure.

A fourth study evaluating dense vs. lean schedules of noncontingent reinforcement was recently published by Wallace, Iwata, Hanley, Thompson, & Roscoe (2012). Researchers in this study evaluated the effectiveness of dense and lean schedules of noncontingent reinforcement at reducing the rates of aggression and/or self-injurious behaviors in three participants. The behavioral function of each participant's challenging behavior was experimentally tested using a functional analysis (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994), and it was determined that all three participant's challenging behaviors were socially maintained by either attention or access to tangible items. Each participant then experienced both dense and lean noncontingent reinforcement treatment sessions lasting 10 minutes using a multielement experimental design. All dense schedule sessions were conducted in a different colored room and by a different therapist than the lean schedule sessions to increase discrimination between the treatment sessions. For all three participants the lean schedule of reinforcement was a FT 5min schedule, and the dense schedule of reinforcement was based off of their baseline rates of behavior and ranged from FT 3s to FT 10s across participants. It should also be noted that the dense schedule of reinforcement was gradually faded to progressively leaner schedules of reinforcement as long as the rate of behavior remained below a set criterion. Results from this analysis indicated that for two of the three participants, rates of behavior under the lean schedule of reinforcement were indistinguishable from rates of behavior under the dense schedule of reinforcement, and that both schedules produced large and consistent reductions in behavior. For the third participant, behavior rates also reduced to near zero levels under both lean and dense schedules of reinforcement, however behavior decreased at a slower rate under the lean schedule of reinforcement. These results indicate that in some circumstances lean schedules of reinforcement can be equally as efficient and effective at reducing undesirable problem behavior when compared to dense schedules of reinforcement at the outset of treatment implementation. However, taken together with the previous three studies discussed, it is apparent that no clear consensus to this question has been revealed.

Taking a slightly different approach, but none the less important, is another highly relevant study conducted by Ringdahl, Vollmer, Borrero, and Connell (2001). Ringdahl et al. (2001) manipulated the degree of similarity of the rate of reinforcement delivery during noncontingent reinforcement to the rate of reinforcement delivery during baseline. They then compared the effectiveness of reducing participant's responding under relatively similar rates of noncontingent reinforcement to baseline and relatively dissimilar rates of noncontingent reinforcement to baseline. I will discuss the methods of this study in more detail, as they are important for understanding the purpose of the current experiment.

Three individuals ranging in age from 4-13 years old participated in this study. Participants Tami and Cathi were diagnosed with mental retardation and Jimmy was diagnosed with Autism. Researchers selected arbitrary responses as the target behavior for each participant (e.g. microswitch pressing and sorting colored blocks), and reinforcement was access to a preferred edible item that was nominated via a free-operant preference assessment (Roane, Vollmer, Ringdahl, & Marcus, 1998) or parental nomination. Each session throughout all conditions were 5-min in duration and began with placing the task materials in front of the participant and saying

"Here is a task to work on; you may do as much as you want, as little as you want, or none at all".

At the end of the 5-min session, the participant was told they were done. Each participant experienced a different experimental design and therefore their procedures and results will be discussed separately.

Tami first experienced a baseline condition in which her responding (i.e. correct sorting of colored blocks) was maintained on an FR1 schedule of reinforcement (i.e. every response was reinforced). Baseline sessions were conducted using varying colored blocks and placements, which would later be paired with the differing reinforcement conditions. Following the baseline phase, Tami experienced a dissimilar and leaner noncontingent reinforcement sessions and extinction sessions using a multielement design. During the dissimilar and leaner noncontingent reinforcement sessions, reinforcement was delivered on a FT 180s schedule (i.e. reinforcement delivered once every 180s). This rate of reinforcement was six times leaner than the rate of reinforcement during baseline. During the extinction sessions, all materials were present but no reinforcement was ever delivered. Following the dissimilar and leaner noncontingent reinforcement and extinction comparison phase, Tami again experienced an identical baseline phase. Following the second baseline phase, Tami experience the second noncontingent reinforcement schedule comparison, in which a similar and denser noncontingent reinforcement schedule was compared to extinction procedures using a multielement design. The rate of reinforcement during similar noncontingent reinforcement sessions (FT 20s) was yoked to the rate of reinforcement during the previous baseline condition. Following this within phase comparison, Tami experienced a third identical baseline phase. Lastly, following the third baseline phase a similar vs.

dissimilar noncontingent reinforcement schedule comparison was conducted using a multielement design. The similar noncontingent reinforcement (FT 20s) was yoked to the rate of reinforcement during the previous baseline condition and the dissimilar noncontingent reinforcement rate was six times leaner (FT 90s) than the rate of reinforcement during the previous baseline condition.

Tami's responding increased as predicted when placed under baseline FR1 reinforcement conditions. Following baseline, a dissimilar and leaner schedule of noncontingent reinforcement effectively eliminated responding, and also did so at comparable levels to extinction procedures. During the second noncontingent reinforcement comparison phase, results revealed that the similar schedule of noncontingent reinforcement was not effective at eliminating responding, whereas extinction procedures were again effective. When responding under each noncontingent reinforcement schedule is compared across phases, the dissimilar and leaner noncontingent reinforcement schedule reduced responding by 76% whereas the similar noncontingent reinforcement schedule only reduced responding by 20%. During the third and last noncontingent reinforcement comparison, Tami's responding was lower during the dissimilar and leaner noncontingent reinforcement schedule when compared to the similar noncontingent reinforcement schedule; however both schedules of noncontingent reinforcement were effective at eliminating Tami's responding. Taking a closer look at responding during only the first five sessions of each noncontingent reinforcement schedule, results reveal that the dissimilar and leaner noncontingent reinforcement schedule reduced responding by 86% whereas the similar noncontingent reinforcement schedule only reduced responding by 39%. In conclusion, Tami's results indicate that a dissimilar and leaner noncontingent reinforcement schedule reduced responding to a greater degree than a noncontingent reinforcement schedule that was similar to baseline rates of reinforcement.

The second participant, Jimmy, experienced an identical baseline setup as Tami, in which his responding was reinforced on an FR1 schedule of reinforcement. However, Jimmy's responding was pressing a colored microswitch and therefore 2 different colored microswitches were used during baseline so that they could later be paired with the differing treatment procedures. Following a baseline phase, Jimmy experienced an extinction phase in which no reinforcement was provided regardless of Jimmy's responding. Following the extinction phase, Jimmy experienced a similar noncontingent reinforcement schedule in which the rate of reinforcement (FT 10s) was yoked to the rate of reinforcement during the previous baseline condition. Using a reversal design, Jimmy then experienced another identical extinction phase followed by another identical similar noncontingent reinforcement schedule phase. This was done to replicate the results of the first comparison. Jimmy then experienced another identical baseline phase (FR1 reinforcement) before experiencing a third similar noncontingent reinforcement schedule phase. To conduct the second noncontingent reinforcement schedule comparison, Jimmy experienced another baseline phase before being exposed to the dissimilar and leaner noncontingent reinforcement phase condition. During the dissimilar and leaner noncontingent reinforcement sessions, reinforcement was delivered on a FT 40s schedule (i.e. reinforcement delivered once every 40s).

This rate of reinforcement was six times leaner than the rate of reinforcement during the previous baseline phase. This comparison was replicated through another baseline phase and a final dissimilar and leaner noncontingent reinforcement phase (FT 40s).

As would be expected, Jimmy's responding increased reliably during the baseline FR1 reinforcement phase and was extinguished during the subsequent extinction phase. During the first implementation of the similar noncontingent reinforcement schedule Jimmy's responding surprisingly increased compared to rates seen under extinction conditions. To try and replicate this pattern of responding Jimmy experienced a reversal back to extinction and then the similar noncontingent reinforcement phase. Jimmy's responding again decreased to zero levels under extinction procedures and again increased significantly when the similar noncontingent reinforcement schedule was implemented. Although Ringdahl et al. (2001) evaluated potential explanations for the drastic increases in responding under the similar noncontingent reinforcement phase, such as adventitious reinforcement, no causal explanation was found. Jimmy continued to respond during the next baseline (FR1) phase prior to experiencing the dissimilar and leaner noncontingent reinforcement phase. During the dissimilar and leaner noncontingent reinforcement phase, Jimmy's responding did decrease from the previous baseline levels, but did not decrease to zero levels of responding. During the last five sessions of the dissimilar and leaner noncontingent reinforcement phase, responding was reduced by 66%. A replication of these results was implemented and responding again increased under baseline conditions. During the final dissimilar and leaner noncontingent reinforcement phase responding was more variable, and during the last five sessions responding had decreased by 53%. Although Ringdahl et al. (2001) argue that Jimmy's results are consistent with Tami's results, in that the dissimilar and leaner schedule of noncontingent reinforcement was more effective at reducing responding than the similar schedule of noncontingent reinforcement, this conclusion is not completely supported by the data. It is apparent that some extraneous variable impacted Jimmy's responding during the similar noncontingent reinforcement schedule phases and therefore these results should be interpreted with caution.

The third and final participant, Cathi, experienced a different type of baseline reinforcement schedule than the previous two participants. Cathi experienced a fixed-interval (FI) schedule of reinforcement compared to a FT schedule of reinforcement. The FI 30s reinforcement schedule programmed reinforcement to be delivered following the first response made following a 30s interval. Following an initial baseline (FI-30s) phase, Cathi experienced a dissimilar and denser noncontingent reinforcement schedule phase in which the rate of reinforcement was six times as dense as during baseline. Therefore, the rate of reinforcement during the dissimilar and denser noncontingent reinforcement schedule was FT 5s. Cathi experienced a replication of both baseline and the dissimilar and denser noncontingent reinforcement phases before moving onto the next comparison. Cathi then experienced a third baseline phase before experiencing the similar noncontingent reinforcement schedule phase. During the similar noncontingent reinforcement phase, reinforcement was delivered on a FT 30s schedule. This schedule was yoked to the rate of reinforcement in the previous baseline phase. Cathi experienced a fourth FI 30s baseline phase before experiencing the final comparison phase in which FT 30s similar schedule of reinforcement was compared to the FT 5s dissimilar and denser schedule of reinforcement using a multielement design.

Cathi's responded at stable levels under baseline conditions before experiencing the first dissimilar and denser noncontingent reinforcement phase. During the first dissimilar and denser noncontingent reinforcement phase, Cathi's responding decreased until levels were low and stable compared to baseline (i.e. 75% reduction in responding during the last five sessions). Cathi's responding then reliably increased again during the second baseline phase and again decreased to stable low levels under the second dissimilar and denser noncontingent reinforcement phase (i.e. 90% reduction in responding during the last five sessions). During the third baseline phase Cathi's responding again increased as expected. During the next phase, the similar noncontingent reinforcement phase, Cathi's responding was highly variable but at lower levels than the previous baseline phase (i.e. 67% decrease in responding during the last five sessions). Cathi's responding again increased during the final baseline phase before the direct comparison on the two noncontingent reinforcement schedules was implemented. During the direct comparison phase, Cathi's responding decreased under both the dissimilar and denser noncontingent reinforcement schedule and the similar noncontingent reinforcement schedule. However, in unison with the previous participants results, responding was reduced to a greater extent under the dissimilar and denser schedule (an 84% decrease during the last five sessions) compared to the similar schedule (a 62% decrease during the last five sessions).

Ringdahl et al. (2001) argued that when one is concerned with the effectiveness of a noncontingent reinforcement schedule at reducing a response, it is the degree of similarity that schedule has to baseline rates of reinforcement that is most important. This argument is one not previously investigated in the literature comparing dense vs. lean noncontingent reinforcement schedules. The authors claim their results support this theory because all three participant's responding decreased to a greater extent under the dissimilar noncontingent reinforcement schedules compared to the similar noncontingent reinforcement schedules, regardless of whether the dissimilar schedule was denser or leaner. Moreover, two of the three participants experienced dissimilar noncontingent reinforcement schedules that were leaner than baseline rates of responding. These results are a direct contradiction of previous research (e.g. Hagopian et al. (1994); Hagopian et al. (2004) revealing that denser noncontingent reinforcement schedules are always more effective at eliminating responding when compared to lean schedules. In addition to understanding how the Ringdahl et al. (2001) experiment fits into the larger body of research literature, it is also necessary to highlight the limitations of this study, and what direction future research should take.

One major limitation in single-subject research design, as used by Ringdahl et al. (2001), is the concern of order effects. Order effects influence single-subject data because although you can counterbalance to order of conditions across participants, you cannot remove the effects of the order of conditions within each participant's data. Therefore, experiencing one condition prior to another, using a reversal design, may cause the participant to respond differently than if the conditions were not in a sequential order. This is especially important when discussing learning effects from exposure to treatment procedures. Once an individual has had experience with a treatment protocol, other similar treatment protocols may be more or less effective during subsequent exposures.

Of the two participants that exhibited lower rates of responding under the leaner schedule of noncontingent reinforcement, Jimmy's data in particular is susceptible to this internal validity threat. Implementing only a reversal design, Jimmy was exposed to the similar noncontingent reinforcement schedule twice before being exposed to the dissimilar and leaner noncontingent reinforcement schedule. Therefore, the possibility that the prior exposure to noncontingent reinforcement procedures caused the later noncontingent reinforcement sessions to be more effective is a viable concern.

Another limitation to the single-subject design used by Ringdahl et al. (2001) is the issue of whether or not Tami had the ability to discriminate between conditions within a multi-element design. During the first test phase in which the multielement design was used, researchers were comparing extinction procedures with a dissimilar and leaner schedule of noncontingent reinforcement (FT 180s). To aid in discrimination of the conditions, researchers used two different colored sets of materials. Although this may have been enough to aid in discrimination between the noncontingent reinforcement and extinction conditions, there was no direct test for discrimination, and therefore it cannot be assumed. Why is it important that Tami be able to discriminate between the extinction sessions and the noncontingent reinforcement schedules? If Tami was not discriminating between the two conditions, then it could be theorized that the reduction in responding seen in the dissimilar and leaner noncontingent reinforcement sessions was actual due to the effects of the prior and subsequent extinction sessions. It should also be noted that with reinforcement only being delivered every 180s during the dissimilar and leaner noncontingent reinforcement schedules, and sessions were only 5 minutes in duration, reinforcement was only delivered once every session during NCR. Consequently, the dissimilar and leaner noncontingent reinforcement schedule procedures were very similar to the extinction procedures in which no reinforcement was delivered.

As previously mentioned, the only way to show the participant clearly was able to discriminate which condition they were in would be to directly test their discrimination. An appropriate test of discrimination in this case would be a choice-preference assessment. It can be assumed that a participant would prefer to be in a condition in which reinforcement was delivered vs. a condition in which no reinforcement is available. To test this preference, both colored materials could be presented to the participant and they could choose which set of materials they would like to work with. After initial exposure to both contingencies, the individual would be expected to select the materials associated with the reinforcement condition over the materials associated with the extinction condition. Once a reliable preference can be shown for materials associated with reinforcement, discrimination can be assumed. Without this discrimination test, or another test of discrimination, an individual's ability to discriminate between two similar procedures cannot be assumed

Taken together, these two design limitations and associated threats to validity, call into question the claims made by Ringdahl et al. (2001). More specifically, the claim that the dissimilar lean schedule of noncontingent reinforcement was equally as effective as the dissimilar dense schedule of noncontingent reinforcement is questionable. Therefore, what final conclusion regarding the programming of noncontingent reinforcement does this leave for future researchers and clinicians? It is clear that no one consensus has been agreed upon as to what parameters of density that are most important for noncontingent reinforcement procedures. It is also clear that future research should take into consideration and correct the limitations made by previous research in order to make more reliable conclusions.

One design approach that would avoid the internal validity threats of single-subject research designs would be a group study analysis. A group design study could evaluate the same research question without being threatened by carryover and order effects. The purpose of this study is to re-evaluate the conclusions of Ringdahl et al. (2001) using a group design study across participants. The current study will evaluate arbitrary responses made by participants via a computerized responding task. The three test conditions will be a six times leaner schedule of noncontingent reinforcement, a yoked (similar) schedule of noncontingent reinforcement, and a six times denser schedule of noncontingent reinforcement. Each participant will experience only one of the three schedules of noncontingent reinforcement. The results of interest will be under which condition do participants engage in the least amount of total responses and separately under which condition do participants meet a designated treatment goal the quickest. These results will either directly confirm or contradict the conclusions made by Ringdahl et al. (2001) regarding dissimilar vs. similar noncontingent reinforcement schedules, and it will also confirm or contradict conclusions made by Hagopian et al. (1994); Ingvarsson et al. (2008); and Hagopian et al. (2004) in regards to the effectiveness of dense vs. lean noncontingent reinforcement schedules.

Method

Design, Participants, Setting, and Apparatus

This research question will be investigated using a between-subjects group design with three conditions. Participants will include 66 undergraduates currently enrolled in an entry level psychology class at Louisiana State University. Participants will receive research credit toward their course contingent upon their participation. Sample size was determined using the computer program G-Power 3.1, which indicated that 66 participants were needed to achieve adequate power. The power level was set at .90 with a modest effect size of 0.4. Each participant will be randomly assigned to one of three conditions. We will conduct the experiment on a computer in an empty office on LSU's campus. All experimental conditions will be run on Superlab® software in which the condition contingencies will be programmed by the experimenter.

Measurement

Superlab® software will record participant's correct responses. A correct response will be defined as the participant pressing the keyboard key that corresponds to the instructions displayed on the computer screen. For example, if the computer instruction says "Press letter K" then the correct response would be pressing the "K" key on the keyboard. Any other keys pressed on the keyboard will not be scored. The correct response will change according to the instructions on the screen. Instructions on the screen will change according to the fixed-time schedule associated with each condition. Reinforcement will consist of delivering a point via the computer program. The participant will be able to view their cumulative points scored in the upper right corner of the computer screen.

Procedures

Instructions. Prior to the experiment beginning the experimenter will read the participant a script of instructions. The script will read as follows:

"You are about to participate in a study interested in how undergraduates respond on a computer program. The computer program will prompt you to press certain keyboard keys. Some of your correct responses will earn you points. You can respond as much, as little, or not at all if you like. You can always see how many points you have earned on the screen. At the end of the study the number of points you have earned will equal the number of times your name will be entered into a drawing for a $100 giftcard to Walkon's restaurant. Therefore, the more points you earn the higher your likelihood is of winning the giftcard. Please do not press the escape key or the CAPS lock key at any point during the experiment. You will begin the experiment in a practice phase. Your cumulative points will reset following the practice phase. The experiment will end automatically. Please put your phone on silent, refrain from looking at your phone, or engaging in any other activities while participating in the study. Once the study has started you may not take a break, so if you need to use the restroom I would recommend doing so now. Do you have any questions?"

The experimenter will also collect demographic data such as date of birth and gender. Each participant will be given a numeric participant number that will identify their data on the program.

Response Training. All participants will experience an identical response training phase. Participants can earn points on a fixed-interval (FI) 30s schedule. Therefore, the first correct response made after the 30s interval has elapsed will result in earning a point. For example, the first screen instruction is "Press letter K". The computer program will record each time the participant presses the letter "K" throughout the entire interval, however only the first “K” press after the 30s interval has passed will result in the delivery of a point. Following a correct response made after the FI 30s interval the screen will immediately change to the next instruction. The next instruction might say “Press letter D”. The computer program will record all the participant’s correct responses (i.e. letter “D” responses), however only the first correct response made following the 30s interval will result in the delivery of a point. All other key responses during this phase will not be recorded and not result in the delivery of any points. The participant will remain in each instructional screen until one correct response is made. The response training phase will end once the participant has earned 10 points (or in other words experienced 10 reinforcement intervals). This procedure will control for reinforcement history across participants. The FI 30s interval was selected because previous pilot data has shown it to result in relatively consistent participant responding. The purpose of this phase is to increase participant’s responding so that a reduction in the response can be later evaluated. Following the response training phase all participants will experience one of three noncontingent reinforcement conditions.

Noncontingent reinforcement. The noncontingent reinforcement phase will immediately begin once the participant has completed response training phase. During noncontingent reinforcement the participant will receive their points on the computer screen on a pre-specified time schedule. In other words, the computer instruction screens and points will change according to the pre-specified interval schedule and will be fully independent from the participant’s responding. For example, during the FT 5s condition the first screen might say “Press letter A” and indicate the participant has 5 points, once 5s have passed the screen will automatically change to the next instruction (e.g. “Press letter G”) and a point will be delivered (i.e. the participant will now have 6 points), once the 5s interval has passed again the instruction will change and another point will be delivered (i.e. the participant will now have 7 points).   Therefore, the participant’s responding will neither predict nor delay the changing of instructions or the delivery of points. Correct responding (i.e. keyboard responding according to the specified instruction) will be recorded and all other keyboard responding will not be recorded. If the participant does not engage in any responding the screen instructions and the delivery of points will continue according to the pre-specified interval schedule. There will be no delay between instructional trials. Each participant will experience only one noncontingent reinforcement condition. Each noncontingent reinforcement schedule will be calibrated using the baseline FI 30 sec. schedule as the anchor schedule. The possible noncontingent reinforcement conditions will be six times leaner than baseline (FT 5s), yoked to baseline (FT 30s), or six times denser than baseline (FT 180s). All participants will remain in the noncontingent reinforcement phase until they meet the extinction criterion of no responding for three consecutive minutes. The purpose of this phase is to analyze the total number of responses made during noncontingent reinforcement and latency to extinction criterion.

Data Analyses. First we will analyze the outcome measure of the total number of responses during the noncontingent reinforcement phase. A one-way analysis of variance (ANOVA) with an $\alpha=0.05$ will be run to detect a main effect of calibration between three levels. If there is a significant main effect, three follow-up pair wise comparisons will be made correcting for multiple t-tests.

We will also analyze the outcome measure of latency to extinction criterion (i.e. duration of time before the participant met extinction criterion). An ANOVA will be run to detect a main effect of calibration. Following a significant main effect, three follow-up pair wise comparisons will be made correcting for multiple t-tests.

Results

To analyze the primary treatment outcome measures (total number of responses during treatment, and the latency until extinction criterion was met) across participants, a one-way analysis of variance (ANOVA) was conducted on each outcome measure separately. Follow-up t-tests were conducted to analyze any statistically significant ANOVA results.

Testing Statistical Assumptions

For each statistical analysis, homogeneity-of-variance was tested. If groups were homogenous, equal variance was assumed; however, if the equality-of-variance assumption was violated, results were reported using the equal variance not assumed procedure.

Treatment Effectiveness

One purpose of this study was to determine the effect of each noncontingent reinforcement schedule on the number of responses made during the treatment phase. It was hypothesized that the 5s reinforcement schedule condition (i.e. the 6x denser schedule) would result in the fewest number of total responses during the treatment phase, because this schedule of reinforcement would decrease the motivating operations to engage in responding. Data was collected on correct responding during the treatment phase in which the noncontingent reinforcement schedule was implemented. Each participant was randomly assigned to experience either the FI 5s (i.e. 6x denser condition), FI 30s (yoked to baseline condition), the FI 180s (or 6x leaner condition). To understand the impact of each treatment condition on the number of correct responses during noncontingent reinforcement, a one-way ANOVA was conducted with 3 treatment condition levels and the dependent variable being the total number of correct responses during noncontingent reinforcement. The means and standard deviations for total correct responses for each condition are presented in Table 1. The results of the one-way ANOVA indicated no statistically significant difference between conditions, F (2, 66) =.730, p= .486.

Table 2
Means and Standard Deviations for Correct Responses during Noncontingent Reinforcement

Treatment Condition	**N**	***M***	***SD***
5s	23	1006.83	1014.26
30s	23	1639.78	4242.29
180s	23	2232.48	4062.72

The second purpose of this study was to determine the effect of each noncontingent reinforcement schedule on the latency to extinction or exit criterion. Extinction criterion was defined as no correct responding for 3 consecutive minutes, and exit criterion was defined as 60 total minutes spent in the noncontingent reinforcement phase. This measure included the time spent in the response training phase, however since the amount of reinforcement earned during the response training phase was held constant across participants, the duration of time spent in the response training phase was not subtracted. Therefore, it would be possible for a participant's outcome measure to be more than 60 minutes. It was hypothesized that the 180s reinforcement schedule condition (i.e. the 6x denser schedule) would result in the shortest latency to extinction criterion because this schedule of reinforcement would have a higher likelihood of eliminating the response-reinforcement contingency. Data was collected on latency (in minutes) to extinction criterion or exit criterion. Each participant was randomly assigned to experience either the FI 5s (i.e. 6x denser condition), FI 30s (yoked to baseline condition), the FI 180s (or 6x leaner condition). To understand the impact of each treatment condition on the latency to extinction or exit criterion, a one-way ANOVA was conducted with 3 treatment condition levels and the dependent variable being latency to extinction or exit criterion. The means and standard deviations for latency (in minutes) to extinction or exit criterion for each condition are presented in Table 2. The results of the one-way ANOVA indicated a statistically significant difference between conditions, F (2, 66) = 4.397 p= .016. Post-hoc comparisons were conducted using Tukey HSD test, which revealed that the latency measure for the 30s condition (M= 50.21, SD= 22.54) was significantly different from the 5s condition (M= 61.82, SD= 14.24), and the 180s condition (M= 62.80, SD= 7.69). No significant differences were reveled between any other conditions.

Table 3
Means and Standard Deviations for Latency to Extinction or Exit Criterion

Treatment Condition	**N**	***M***	***SD***
5s	23	61.82[1]	14.24
30s	23	50.21[1]	22.54
180s	23	62.80[1]	7.69

Note. 1 = significant difference between 5s and 30s, and 30s and 180s $p < .05$ level.

Discussion

The most evident conclusion from this experiment is that none of the conditions were effective at extinguishing participant responding. Results analyzing the first dependent measure, latency to extinction or stop criterion, will be discussed first. To recap, participants had to either meet extinction criterion: no correct responding for three consecutive minutes, or the participants would by default meet the stop criterion of 60 minutes in the noncontingent reinforcement phase. For example, if a participant never met the extinction criterion, then their latency measure would be longer than 60 minutes (i.e. they met the stop criterion). It would be longer than 60 minutes because this measure includes the time spent in the response training phase. The time spent in the response training phase was not subtracted due this phase of the experiment being held constant across participants. These results would indicate that the noncontingent reinforcement schedule was in-effective at extinguishing responding. On the other hand, if the noncontingent reinforcement schedule was very effective at extinguishing responding, then we might expect a participant's latency to extinction criterion to be around, for example, 10 minutes. The current results reveal that the average latency to extinction or exit criteria across all conditions ranged from 50.21-62.80 minutes. Although there was a significant difference found between participants in the 30s condition and both groups of participants in the 5s and 180s conditions, these data indicate that *most* participants did not ever meet the extinction criterion, and instead continued to respond until they met the exit criterion (i.e. 60 min). This outcome measure confirms that all three conditions (i.e. schedules) of noncontingent reinforcement were ineffective at extinguishing participant's responding.

Analysis of the second outcome measure: the total number of correct responses made during the noncontingent reinforcement phase confirms results from the first outcome measure. Again, if a noncontingent reinforcement schedule was effective at extinguishing participant responding, we would expect the total number of correct responses to be relatively low (e.g. 30 responses). If the total numbers of correct responses across participants were high, that would indicate that the noncontingent reinforcement schedules were ineffective at extinguishing participant responding. The current results reveal that participants in the 5s condition averaged 1006.83 responses, participants in the 30s condition averaged 1639.78 responses, and lastly that participants in the 180s condition averaged 2232.48 responses. Therefore, participants continued to respond consistently throughout each of the noncontingent reinforcement conditions. These results confirm the conclusion from the latency measure analysis.

Although there were no significant difference found when analyzing the total number of correct responses made across conditions, this was likely due to participant variability (SD) within conditions. However it is worthwhile to describe the trend and implications of these data. On average, participants in the 180s condition made around twice as many correct responses as participants in the 5s condition. In addition, participants in the 30s condition made around one and half times as many responses as participants in the 5s condition, and one and a half times less as many responses as participants in the 180s condition. This trend suggests that the denser the noncontingent reinforcement schedule was, the fewer number of total responses participants made. These data would align with results from previous research indicating that denser schedules of reinforcement are more effective at extinguishing responding (Hagopian, Fisher, & Legacy, 1994; Hagopian et al., 2004). Moreover, these results can be interpreted within the framework of the behavioral mechanisms discussed by Carr et al. (2000). As previously mentioned, Carr et al. (2000) stated that noncontingent reinforcement treatment effects are mediated through two potential behavior mechanisms: (a) reduction in the reinforcer’s establishing operation, and (b) elimination of the response-reinforcer relationship. These results may suggest that the reduction in the reinforcer’s establishing operations through the increased frequency of reinforcer delivery may be the more salient mechanism at play during noncontingent reinforcement. If it were the second behavior mechanism, the elimination of the response-reinforcer relationship, we might expect the lean schedule of reinforcement to be more effective because of the increased chance of a participant’s response contacting extinction.

Extinction within the lean schedule of reinforcement highlights another potential explanation for the increasing trend in participant’s total responses as the schedules of reinforcement were thinned. It is possible that this trend in the data could be partially explained by an extinction burst in the 180s reinforcement schedule. An extinction burst is when an individual engages in a large increase in the rate or duration of responding when extinction procedures are implemented (Lerman & Iwata, 1995). The increase in responding occurs as a direct result of changing the contingency in which a behavior that previously resulted in reinforcement suddenly does not result in access to that same reinforcer. Although the data were not analyzed in this way, participants may have engaged in higher rats of responding immediately upon the implementation of the lean schedule of reinforcement and slowly decreased their responding as they were exposed to the noncontingent reinforcement schedule. It is also important to keep in mind that extinction was implemented during all three schedules of noncontingent reinforcement; however extinction bursts are more likely to occur when there is no alternative means to contact reinforcement (Lerman & Iwata, 1995). Participants in the 5s and 30s noncontingent reinforcement schedules contacted more or at least equivalent rates of reinforcement as in the response training phase, therefore we may not expect to see an extinction burst when extinction procedures were implemented. However with the 180s noncontingent reinforcement schedule, participants suddenly contacted far less reinforcement than in the response training phase. In fact, those participants experienced three consecutive minutes with no reinforcement compared to contacting reinforcement around every 30s in the response training phase. Therefore an extinction burst would be more likely to occur in this condition. The potential of an extinction burst occurring when extinction procedures are implemented has led to the practice by clinicians and researchers to implement alternative schedules of reinforcement in addition to extinction procedures when treating problem behavior (Lerman & Iwata, 1995). For example, problem behavior is put on extinction (i.e. no longer contacts reinforcement) but reinforcement is still available through a differential reinforcement of alternative (DRA) procedure in which the individual can contact reinforcement by engaging in some other alternative or appropriate behavior.

Contacting reinforcement through engaging in some other more appropriate behavior has led to a decrease in the occurrence of extinction bursts in the treatment literature (Lerman & Iwata, 1995). For the purpose of the current investigation however, these types of attenuating procedures were not implemented, and therefore the occurrence of an extinction burst during the implementation of the 180s lean schedule of reinforcement could potentially account for the increased total number or responses made by participants in that condition.

These explanations however do not address the finding that none of the conditions were effective at eliminating participant responding. This overall lack of results seems to be the core failure of the experimental procedures. As previously mentioned, there is a vast literature on the effectiveness of noncontingent reinforcement at eliminating responding across behaviors, functions of behaviors, and participant characteristics (see Table 1). Moreover, there are landmark studies, all with consistent results that the rate of responding decreases when transitioning from contingent to noncontingent schedules of reinforcement (Appel & Hiss, 1962; Zeiler, 1968; Rescorla & Skucy, 1969; Alleman & Zeiler, 1974; Brinker & Treadway, 1975; Calef et al., 1989; Dickinson & Charnock, 1985; Edwards, Peek, & Wolfe, 1970; Halliday & Boakes, 1971; Job, 1988; and Oakes, Roseblum, & Fox, 1982). To begin to understand why the results of the current study contradict decades of research, a comparison of the current study to the Ringdahl et al. (2001) study is worthwhile. This comparison is important because the current investigation was an extension of the Ringdahl et al. (2001) study, and therefore a comparison of the experimental variables and participants between the two studies is essential.

The Ringdahl et al. (2001) study recruited 3 participants between the ages of 4-13 years old with developmental disabilities. The current investigation recruited 69 undergraduate psychology majors from Louisiana State University. The diagnostic history of the current sample is unknown, but it can be assumed that all the participants passed university entry criteria to attend Louisiana State University. This is the first potential crucial difference with regards to what we know about rule-governed responding.

Rule-governed responding, or rule-governed behavior, is maintained as a consequence of some known rule (Kudadjie-Gyamfi & Rachlin, 2002). This rule may be an explicit verbal prompt, as was provided in the current situation, or there may be some verbal discriminative stimulus in the environment that has be paired with specific antecedents and consequences experienced in the past (Kudadjie-Gyamfi & Rachlin, 2002). Although in the current investigation participants were told they could respond as much, as little, or not at all if they liked, college students in general experience authority figures delivering rules and expectations on a daily basis. In addition, if college students have a history of participating in research studies to earn credit for a class, they also have a history of complying with given rules and procedures. Consequently, even though the experimenter gave them a rule that they could not respond if they wished, they have a history of responding/participating in research studies that may have overrode an anomalous verbal instruction. Moreover, rule-governed behavior may be more likely to exert control on the behavior of adults when compared to children because adults have an extensive history of reinforcement for complying with rules. Lastly, research has shown that when contingencies change without a corresponding explicit rule change (e.g. the change to the noncontingent reinforcement schedule in the middle of the current investigation), rule-governed behavior is slower to change/adjust than contingency-governed behavior (Hayes et al., 1986a, b; Hayes and Ju, 1998; Ninness and Ninness, 1998; Shimoff et al. 1981,1986). Therefore, if participant's responding during the response training phase were under the control of rule-governed behavior and not the FI schedule of reinforcement, then their behavior would be slower to change when the contingency changed to noncontingent reinforcement.

The second important difference between the Ringdahl et al. (2001) study and the current investigation concerns participant's responding during the response training phase. When analyzing Cathi's results (i.e. the one participant who experienced the FI 30s baseline condition), the data indicate that her responding was on average around 5-7 times per 5-minute session. This would indicate that Cathi's responding was under the control of the reinforcement schedule. In contrast, the average number of responses made during the response training phase across all conditions in the current experiment was M= 199.6 responses. If a participant's responding was tightly controlled by the FI 30s reinforcement schedule, then the total number of responses made during the response training phase would be around 10 responses. These results would suggest that for many of the participants, their responding never came under the control of the FI 30s contingency.

Therefore, if the participant's behavior never came under the control of the reinforcement contingencies during the response training phase it is hard to argue that a change from the FI contingency to the noncontingent reinforcement phase was discriminable to the participants. In other words, if a participant's responding never came under the control of the contingent reinforcement phase then we would not predict that the responding would decrease once noncontingent reinforcement was introduced. In addition, if their responding was never maintained by the FI contingency, then this might provide more evidence that participant responding was maintained by rule-governed behavior.

An elegant example of the potential for verbal instructions to influence participant responding under interval schedules of reinforcement was described by Kaufman, Baron, and Knop (1966). Interval schedules of reinforcement can either be implemented as variable-interval (VI) or fixed-interval (FI) schedules of reinforcement. VI schedules of reinforcement are similar to FI schedules of reinforcement in that the first response after a set interval has elapsed is reinforced, however under a VI schedule the duration of the reinforcement interval varies around an average interval time. Therefore, the interval length in VI schedules is usually less discernable to the individual experiencing it because it is somewhat unpredictable. Kaufman and colleagues (1966) gave participants explicit verbal instructions that their responding would be reinforced under a FI schedule of reinforcement. However, participants would in fact be experiencing a VI schedule of reinforcement. Research comparing responding under FI and VI schedules of reinforcement has shown different patterns of responding contingent on the type of schedule (FI vs. VI). Under FI schedules of reinforcement responding typically follows a scalloped pattern in which there is a pause in responding after the reinforcer is delivered, known as a post-reinforcement pause

(PRP), and then the rate of responding gradually increases around the end of the interval (Fester & Skinner, 1957). In contrast, responding under VI schedules of reinforcement is characterized by low and constant rates of responding (Fester & Skinner, 1957). Again, participants were given explicit verbal instructions that their responding would be reinforced by a FI schedule when in fact they would experience a VI schedule. Results from Kaufman, Baron, and Knop (1966) revealed that some of their participant's responding followed a very clear scalloped pattern. This indicated that their behavior was influenced more by the verbal instruction then by the actual schedule of reinforcement. These results provide a clear example of how explicit verbal rules can exert control of participant's responding above and beyond scheduled contingencies. In addition, there is currently no support in the literature that indicates that humans are likely to grossly over respond during FI schedules of reinforcement when the contingencies are discernable. Taken together, these explanations suggest that the current anomalous results of participant responding under FI and noncontingent schedules of reinforcement may have been highly impacted by rule-governed behavior.

One main limitation to the current investigation is the sample population. Future research should assess these behavioral principles with participants that have less extensive histories with rule-governed behavior. To address experimentation regarding the basic behavior principle of noncontingent reinforcement schedules, non-human subjects may have certain advantages. Another limitation of the current study is that the response training phase was potentially insufficient in duration for participant's responding to come under the control of the FI schedule of reinforcement. Future research should address this limitation by increasing the duration of the response training phase. An alternative to increasing the duration of the response training phase would be to implement a reinforcement schedule that is more likely to ensure a participant's behavior comes under control of the schedule of reinforcement, for example by implementing a fixed-ratio (FR) schedule of reinforcement. During a FR schedule of reinforcement, reinforcement is delivered after a set number of responses have been made. Another limitation to the response training phase is that the current study only investigated the effects of noncontingent reinforcement after exposure to an FI schedule of reinforcement. The current results cannot be generalized to address the effects of noncontingent reinforcement after exposure to any other schedule of reinforcement (e.g. FR, VR, VI). The results of the current investigation also cannot be generalized to other schedules of density with regard to the noncontingent reinforcement schedule. The limitation of the current study is that only three schedules of noncontingent reinforcement were investigated. Lastly, a limitation to the current investigation is the response requirement and use of a computerized program. Although this approach allows for the researcher to tightly control independent variables across participants, it is not generalizable to other behaviors or naturalistic environments. A translational study replicating these procedures would need to be conducted to be able to make any statements of how these effects can be generalized to other behaviors, participants, or settings. In particular, these results, or results using a similar methodology, would not be generalizable to the treatment literature on the behavioral treatment of problem behavior.

Future research should continue to investigate manipulations in noncontingent reinforcement schedules and their effectiveness on extinguishing responding/behavior because this is an important principle of behavior to understand for clinical practice. As previously mentioned, future research should approach this investigation by conducting research with diverse groups of research participants (e.g. children, non-human subjects). Research should also investigate the effectiveness of different noncontingent reinforcement schedules by implementing various baseline/response training procedures. Researchers should be very thoughtful of their baseline/response training phase procedures to ensure that participant's responding is maintained by the reinforcement schedule contingency and not extraneous variables. Future research should evaluate the effects of different schedules of reinforcement during the response training phase such as FR, VR, or VI schedules of reinforcement. Future research should also investigate multiple schedules of noncontingent reinforcement. To extend the current study researchers could compare more conditions to extend beyond 6 times denser or leaner than baseline schedules.

For a more applied research approach, researchers should investigate the effects of different densities of noncontingent reinforcement when they are implemented in unison with alternative schedules of reinforcement (e.g. DRA). This line of research would be more applicable to the procedures that are being implemented in the treatment literature (Lerman & Iwata, 1995). A strength in the current study design is how to extend a single-subject study into a group-design study. Future research should continue to investigate these questions using both single-subject design methodology and group-design methodology, as both research designs have strengths and weaknesses in their approach.

References

Alleman, H. D., & Zeiler, M. D. (1974). Patterning with fixed-time schedules of response-independent reinforcement. *Journal of the Experimental Analysis of Behavior, 22,* 135-141.

Appel, J. B., & Hiss, R. H. (1962). The discrimination of contingent from noncontingent reinforcement. *Journal of Comparative and Physiological Psychology, 55,* 37-39.

Athens, E. S., Vollmer T. R., Sloman, K. N., & St. Peter Pipkin, C. (2008). An analysis of vocal stereotypy and therapist fading. *Journal of Applied Behavior Analysis, 41,* 291-297.

Austin, J. L., & Soeda, J. M. (2008). Fixed-time teacher attention to decrease off-task behaviors of typically developing third graders. *Journal of Applied Behavior Analysis, 41,* 279-283.

Baker, J. C., Hanley, G. P., & Mathews, R. M. (2006). Staff-administered functional analysis and treatment of aggression by an elder with dementia. *Journal of Applied Behavior Analysis, 39,* 469-474.

Brinker, R. P. & Treadway, J. T. (1975). Preference and discrimination between response-dependent and response-independent schedules of reinforcement. *Journal of the Experimental Analysis of Behavior, 24,* 73-77.

Britton, L. N., Carr, J. E., Kellum, K. K., Dozier, C. L., & Weil, T. M. (2000). A variation of noncontingent reinforcement in the treatment of aberrant behavior. *Research in Developmental Disabilities, 21,* 425-435.

Britton, L. N., Carr, J. E., Landaburu, H. J., & Romick, K. S. (2002). The efficacy of noncontingent reinforcement as treatment for automatically reinforced stereotypy. *Behavioral Interventions, 17,* 93-103.

Buchanan, J. A., & Fisher, J. E. (2002). Functional Assessment and noncontingent reinforcement in the treatment of disruptive vocalization in elderly dementia patients. *Journal of Applied Behavior Analysis, 35,* 99-103.

Butler, L. R., & Luiselli, J. K. (2007). Escape-maintained problem behavior in a child with autism: Antecedent functional analysis and intervention evaluation of noncontingent escape and instructional fading. *Journal of Positive Behavior Interventions, 9,* 195-202.

Calef, R. S., Choban, M. C., Dickson, M. W., Newman, P. D., Boyle, M., & Baxa, N. D. (1989). The effects of noncontingent reinforcement on the behavior of a previously learned running response. *Bulletin of the Psychonomic Society, 27,* 263-266.

Carr, J. E., & Britton, L. N. (1999). Idiosyncratic effects of noncontingent reinforcement on problematic speech. *Behavioral Interventions, 14,* 37-43.

Carr, J. E., Coriaty, S., Wilder, D. A., Gaunt, B. T., Dozier, C. L., Britton, L. N., Avina, C., & Reed, C. L. (2000). A review of “noncontingent” reinforcement as treatment for the aberrant behavior of individuals with developmental disabilities. *Research in Developmental Disabilities, 21,* 377-391.

Carr, J. E., Dozier, C. L., Patel, M. R., Adams, A. N., & Martin, N. (2002). Treatment of automatically reinforced object mouthing with noncontingent reinforcement and response blocking: experimental analysis and social validation. *Research in Developmental Disabilities, 23,* 37-44.

Carr, J. E., Kellum, K. K., & Chong, I. M. (2001). The reductive effects of noncontingent reinforcement: Fixed-time versus variable-time schedules. *Journal of Applied Behavior Analysis, 34,* 505-509.

Coleman, C. L., & Holmes, P. A. (1998). The use of noncontingent escape to reduce disruptive behaviors in children with speech delays. *Journal of Applied Behavior Analysis, 31,* 687-690.

DeLeon, I. G., Anders, B. M., Rodriguez-Catter, V., & Neidert, P. L. (2000). The effects of noncontingent access to single versus multiple-stimulus sets on self-injurious behavior. *Journal of Applied Behavior Analysis, 33,* 623-626.

DeLeon, I. G., Uy, M. & Gutshall, K. (2005). Noncontingent reinforcement and competing stimuli in the treatment of pseudoseizures and destructive behaviors. *Behavioral Interventions, 20,* 203-217.

Derby, K. M., Fisher, W. W., & Piazza, C. C. (1996). The effects of contingent and noncontingent attention on self-injury and self-restraint. *Journal of Applied Behavior Analysis, 29,* 107-110.

Derby, K. M., Fisher, W. W., Piazza, C. C., Wilke, A. E., Johnson, W. (1998). The effects of noncontingent and contingent attention for self-injury, manding, and collateral responses. *Behavior Modification, 22,* 474-484.

Dickinson, A., & Charnock, D. J. (1985). Contingency effects with maintained instrumental reinforcement. *The Quarterly Journal of Experimental Psychology, 37B,* 397-416.

Doughty, S. S., & Anderson, C. M. (2006). Effects of noncontingent reinforcement and functional communication training on problem behavior and mands. *Education and Treatment of Children, 29,* 23-50.

Edwards, D. D., Peek, V., & Wolfe, F. (1970). Independently delivered food decelerates fixed ratio rates. *Journal of the Experimental Analysis of Behavior, 14,* 301-307.

Falcomata, T. S., Roane, H. S., Hovanetz, A. N., & Kettering, T. L. (2004). An evaluation of response cost in the treatment of inappropriate vocalizations maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 37,* 83-87.

Ferster, C. B., & Skinner, B. F. (1957). *Schedules of reinforcement.* East Norwalk, CT.

Fischer, S. M., Iwata, B. A., & Mazaleski, J. L. (1997). Noncontingent delivery of arbitrary reinforcers as treatment for self-injurious behavior. *Journal of Applied Behavior Analysis, 30,* 239-249.

Fisher, W. W., DeLeon, I. G., Rodriguez-Carter, V., & Keeney, K. M. (2004). Enhancing the effects of extinction on attention-maintained behavior through noncontingent delivery of attention or stimuli identified via a competing stimulus assessment. *Journal of Applied Behavior Analysis, 37,* 171-184.

Fisher, W. W., Ninness, H. A. C., Piazza, C. C., & Owen-DeSchryver, J. S. (1996). On the reinforcing effects of the content of verbal attention. *Journal of Applied Behavior Analysis, 29,* 235-238.

Fisher, W. W., O'Connor, J. T., Kurtz, P. F., DeLeon, I. G., & Gotjen, D. L. (2000). The effects on noncontingent delivery of high- and low- preference stimuli on attention-maintained destructive behavior. *Journal of Applied Behavior Analysis, 33,* 79-83.

Fisher, W. W., Thompson, R. H., DeLeon, I. G., Piazza, C. C., Kuhn, D. E., Rodriguez-Catter, V., & Adelinis, J. D. (1999). Noncontingent reinforcement: Effects of satiation versus choice responding. *Research in Developmental Disabilities, 20,* 411-427.

Goh, H., Iwata, B. A., & DeLeon, I. G. (2000). Competition between noncontingent and contingent reinforcement schedules during response acquisition. *Journal of Applied Behavior Analysis, 33,* 195-205.

Goh, H., Iwata, B. A., & Kahng, S. W. (1999). Multicomponent assessment and treatment of cigarette pica. *Journal of Applied Behavior Analysis, 32,* 297-316.

Gouboth, D., Wilder, D. A., & Booher, J. (2007). The effects of signaling stimulus presentation during noncontingent reinforcement. *Journal of Applied Behavior Analysis, 40,* 725-730.

Hagopian, L. P., Crockett, J. L., van Stone, M., DeLeon, I. G., & Bowman, L. G. (2000) (b). Effects on noncontingent reinforcement on problem behavior and stimulus engagement: The role of satiation, extinction, and alternative reinforcement. *Journal of Applied Behavior Analysis, 33,* 433-449.

Hagopian, L. P., Fisher, W. W., & Legacy, S. M. (1994). Schedule effects of noncontingent reinforcement on attention-maintained destructive behavior in identical quadruplets. *Journal of Applied Behavior Analysis, 27,* 317-325.

Hagopian, L. P., LeBlanc, L. A., & Maglieri, K. A. (2000) (a). Noncontingent attention for the treatment of excessive medical complaints in a medically fragile man with mental retardation. *Research in Developmental Disabilities, 21,* 215-221.

Hagopian, L. P., Toole, L. M., Long, E. S., Bowman, L. G., & Lieving, G. A. (2004). A comparison of dense-to-lean and fixed lean schedules of alternative reinforcement and extinction. *Journal of Applied Behavior Analysis, 37,* 323-337.

Hagopian, L. P., Wilson, D. M., & Wilder, D. A. (2001). Assessment and treatment of problem behavior maintained by escape from attention and access to tangible items. *Journal of Applied Behavior Analysis, 34,* 229-232.

Halliday, M. S., & Boakes, R. A. (1971). Behavioral contrast and response independent reinforcement. *Journal of the Experimental Analysis of Behavior, 16,* 429-434.

Hanley, G. P., Piazza, C. C., & Fisher, W. W. (1997) (a). Noncontingent presentation of attention and alternative stimuli in the treatment of attention-maintained destructive behavior. *Journal of Applied Behavior Analysis, 30,* 229-237.

Hanley, G. P., Piazza, C. C., Fisher, W. W., Contrucci, S. A., & Maglieri, K. A. (1997)(b). Evaluation of client preference for function-based treatment packages. *Journal of Applied Behavior Analysis, 30,* 459-473.

Hart, B. M., Reynolds, N. J., Baer, D. M., Brawley, E. R., & Harris, F. R. (1968). Effects of contingent and noncontingent social reinforcement on the cooperative behavior of a preschool child. *Journal of Applied Behavior Analysis, 1,* 73-76.

Hayes, S. C., Brownstein, A. J., Zettle, R. D., Rosenfarb, I., & Korn, Z., (1986)a. Rule-governed behavior and sensitivity to changing consequences of responding. *Journal of the Experimental Analysis of Behavior, 45,* 237-256.

Hayes, S. C., Brownstein, A. J., Haas, J. R., & Greenway, D. E. (1986) b. Instructions, multiple schedules, and extinction: distinguishing rule-governed from schedule-controlled behavior. *Journal of the Experimental Analysis of Behavior, 46,* 137-147.

Ing. A. D., Roane, H. S., & Veenstra, R. A. (2011). Functional analysis and treatment of coprophagia. *Journal of Applied Behavior Analysis, 44,* 151-155.

Ingvarsson, E. T., Kahng, S. W., & Hausman, N. L. (2008). Some effects of noncontingent positive reinforcement on multiply controlled problem behavior and compliance in a demand context. *Journal of Applied Behavior Analysis, 41,* 435-440.

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27,* 197-209. (Reprinted from Analysis and Intervention in Developmental Disabilities, 2, 3-20, 1982).

Iwata, B. A., Vollmer, T. R., & Zarcone, J. R. (1990). The experimental (functional) analysis of behavior disorders: methodology, applications, and limitations. In A. C. Repp, & N. N. Singh (Eds), *Perspectives on the use of aversive and nonaversive interventions for persons with developmental disabilities* (pp.301-330). Sycamore, IL: Sycamore.

Job, R. F. (1988). Interference and facilitation produced by noncontingent reinforcement in the appetitive situation. *Animal Learning and Behavior, 16,* 451-460.

Jones, K. M., Drew, H. A., & Weber, N. L. (2000). Noncontingent peer attention as treatment for disruptive classroom behavior. *Journal of Applied Behavior Analysis, 33,* 343-346.

Kahng, S. W., Iwata, B. A., DeLeon, I. G., & Wallace, M. D. (2000) (a). A comparison of procedures for programming noncontingent reinforcement schedules. *Journal of Applied Behavior Analysis, 33,* 223-231.

Kahng, S. W., Iwata, B. A., DeLeon, I. G., & Worsdell, A. S. (1997). Evaluation of the “control over reinforcement” component in functional communication training. *Journal of Applied Behavior Analysis, 30,* 267-277.

Kahng, S. W., Iwata, B. A., Thompson, R. H., & Hanley, G. P. (2000)(b). A method for identifying satiation versus extinction effects under noncontingent reinforcement schedules. *Journal of Applied Behavior Analysis, 33,* 419-432.

Kaufman, A., Baron, A, & Knop, R. E., (1966). Some effects of instructions on human operant behavior. *Psychometric Monograph Supplements, 1(11),* 243-250.

Kerth, D. M., Progar, P. R., & Morales, S. (2009). The effects of non-contingent self-restraint on self-injury. *Journal of Applied Research in Intellectual Disabilities, 22,* 187-193.

Kodak, T., Miltenberger, R. G., & Romaniuk, C. (2003). A comparison of differential reinforcement and noncontingent reinforcement for the treatment of child’s multiply controlled problem behavior. *Behavioral Interventions, 18,* 267-278.

Kodak, T., Miltenberger, R. G., & Romaniuk, C. (2003). The effects of differential negative reinforcement of other behavior and noncontingent escape on compliance. *Journal of Applied Behavior Analysis, 36,* 379-382.

Kudadjie-Gyamfi, E. & Rachlin, H. (2002). Rule-governed versus contingency-governed behavior in self-control task: effects of changes in contingencies. *Behavioral Processes, 57,* 29-35.

Lachter, G. D. (1980). A control procedure in operant conditioning. *Perceptual and Motor Skills, 50,* 1257-1258.

Lachter, G. D., Cole, B. K., & Schoenfeld, W. N. (1971). Response rate under varying frequency of non-contingent reinforcement. *Journal of the Experimental Analysis of Behavior, 15,* 233-236.

Lalli, J. S., Casey, S. D., & Kates, K. (1997). Noncontingent reinforcement as treatment for severe problem behavior: Some procedural variations. *Journal of Applied Behavior Analysis, 30,* 127-137.

Lalli, J. S., Mace, F. C., Livezey, K., & Kates, K. (1998). Assessment of stimulus generalization gradients in the treatment of self-injurious behavior. *Journal of Applied Behavior Analysis, 31,* 479-483.

Lancaster, B. M., LeBlanc, L. A., Carr, J. E., Brenske, S., Peet, M. M., & Culver, S. J. (2004). Functional analysis and treatment of the bizarre speech of dually diagnosed adults. *Journal of Applied Behavior Analysis, 37,* 395-399.

Lanovaz, M. J., & Argumedes, M. (2010). Immediate and subsequent effects of differential reinforcement of other behavior and noncontingent matched stimulation on stereotypy. *Behavioral Interventions, 25,* 229-238.

Lerman, D. C., & Iwata, B. A. (1995). Prevalence of the extinction burst and its attenuation during treatment. *Journal of Applied Behavior Analysis, 28,* 93-94.

Lindberg, J. S., Iwata, B. A., Roscoe, E. M., Worsdell, A. S., & Hanley, G. P. (2003). Treatment efficacy of noncontingent reinforcement during brief and extended application. *Journal of Applied Behavior Analysis, 36,* 1-19.

Lomas, J. E., Fisher, W. W., & Kelley, M. E. (2010). The effects of variable-time delivery of food items and praise on problem behavior reinforced by escape. *Journal of Applied Behavior Analysis, 43,* 425-435.

Luiselli, J. K. (1994). Effects of noncontingent sensory reinforcement on stereotypic behaviors in a child with posttraumatic neurological impairment. *Journal of Behavior Therapy & Experimental Psychiatry, 25(4),* 325-330.

Mace, F. C., Borrero, J. C., Connell, J. E., Connelly, M., Delaney, B. A., McLaughlin-Cheng, E., Nocera, R. L., Progar, P. R., Ringdahl, J. E., Sierp, B. J., & Yoon, J. H. (1998). Progress in learning: A review of Catania's 4th edition. *Journal of Applied Behavior Analysis, 31,* 713-716.

Mace, F. C., & Lalli, J. S. (1991). Linking descriptive and experimental analyses in the treatment of bizarre speech. *Journal of Applied Behavior Analysis, 24,* 553-562.

Michael, J. L. (1993). Establishing operations. *The Behavior Analyst, 16,* 191-206.

Marcus, B. A., & Vollmer, T. R. (1996). Combining noncontingent reinforcement and differential reinforcement schedules as treatment for aberrant behavior. *Journal of Applied Behavior Analysis, 29,* 43-51.

Ninness, H. A. C., & Ninness, S. A. (1998). Superstitious math performance: interactions between rules and scheduled contingencies. *The Psychological Record, 48,* 45-62.

O'Callaghan, P. M., Allen, K. D., Powell, S., & Salama, F. (2006). The efficacy of noncontingent escape for decreasing children's disruptive behavior during restorative dental treatment. *Journal of Applied Behavior Analysis, 39,* 161-171.

O'Reilly, M., Lancioni, G., & Taylor, I. (1999). An empirical analysis of two forms of extinction to treat aggression. *Research in Developmental Disabilities, 20(5),* 315-325.

Oakes, W. F., Rosenblum, J. L., & Fox, P. E. (1982). "Manna from heaven": The effect of noncontingent appetitive reinforcers on learning in rats. *Bulletin of the Psychonomic Society, 19,* 123-126.

Persel, C. S., Persel, C. H., Ashley, M. J., & Krych, D. K. (1997). The use of noncontingent reinforcement and contingent restraint to reduce physical aggression and self-injurious behaviour in a traumatically brain injured adult. *Brain Injury, 11(10),* 751-760.

Phillips, K. J. & Mudford, O. C. (2011). Effects of noncontingent reinforcement and choice of activity on aggressive behavior maintained by attention. *Behavioral Interventions, 26,* 147-160.

Piazza, C. C., Contrucci, S. A., Hanley, G. P., & Fisher, W. W. (1997). Nondirective prompting and noncontingent reinforcement in the treatment of destructive behavior during hygiene routines. *Journal of Applied Behavior Analysis, 30,* 705-708.

Piazza, C. C., Fisher, W. W., Haley, G. P., LeBlanc, L. A., Worsdell, A. S., Lindauer, S. E., & Keeney, K. M. (1998). Treatment of pica through multiple analyses of its reinforcing functions. *Journal of Applied Behavior Analysis, 31,* 165-189.

Piazza, C. C., Hanley, G. P., & Fisher, W. W. (1996). Functional analysis and treatment of cigarette pica. *Journal of Applied Behavior Analysis, 29,* 437-450.

Rasmussen, K. & O'Neill, R. E. (2006). The effects of fixed-time reinforcement schedules on problem behavior of children with emotional and behavioral disorders in a day-treatment classroom setting. *Journal of Applied Behavior Analysis, 39,* 453-457.

Rescorla, R. A., & Skucy, J. C. (1969). Effects of response-independent reinforcers during extinction. *Journal of Comparative and Physiological Psychology, 67(3),* 381-389.

Ringdahl, J. E., Call, N. A., Christensen, T., & Boelter, E. W. (2010). Brief report: Signals enhance the suppressive effects of noncontingent reinforcement. *Journal of Autism & Developmental Disorders, 40,* 378-382.

Ringdahl, J. E., Vollmer, T. R., Borrero, J. C., & Connell, J. E. (2001). Fixed-time schedule effects as a function of baseline reinforcement rate. *Journal of Applied Behavior Analysis, 34,* 1-15.

Ringdahl, J. E., Winborn, L. C., Andelman, M. S., & Kitsukawa, K. (2002). The effects of noncontingently available alternative stimuli on functional analysis outcomes. *Journal of Applied Behavior Analysis, (35),* 407-410.

Roane, H. S., Kelly, M. L., & Fisher, W. W. (2003). The effects of noncontingent access to food on the rate of object mouthing across three settings. *Journal of Applied Behavior Analysis, 36,* 579-582.

Roane, H. S., Vollmer, T. R., Ringdahl, J. E., & Marcus, B. A., (1998). Evaluation of a brief stimulus reference assessment. *Journal of Applied Behavior Analysis, 31,* 605-620.

Rosales, R., Worsdell, A., & Trahan, M. (2010). Comparison of methods for varying item presentation during noncontingent reinforcement. *Research in Autism Spectrum Disorders, 4,* 367-376.

Roscoe, E. M., Iwata, B. A., & Goh, H. L. (1998). A comparison of noncontingent reinforcement and sensory extinction as treatments for self-injurious behavior. *Journal of Applied Behavior Analysis, 31,* 635-646.

Rush, K. S., Crockett, J. L. & Hagopian, L. P. (2001). An analysis of the selective effects of NCR with punishment targeting problem behavior associated with positive affect. *Behavioral Interventions, 16,* 127-135.

Schadler Jr, J. J., Wilder, D. A., & Blakely, E. (2009). Signaling stimulus presentation during treatment with noncontingent reinforcement: Visual versus vocal signals. *Behavioral Interventions, 24,* 107-116.

Shimoff, E., Catania, A. C., & Matthews, B. A. (1981). Uninstructed human responding: sensitivity of low-rate performance to schedule contingencies. *Journal of the Experimental Analysis of Behavior, 36,* 207-220.

Shimoff, E., Matthews, B. A., & Catania, A. C. (1986). Human operant: sensitivity and pseudosensitivity to contingencies. *Journal of the Experimental Analysis of Behavior, 46,* 149-157.

Sigafoos, J. & Pennell, D. (1995). Noncontingent application versus contingent removal of tactile stimulation: Effects on self-injury in a young boy with multiple disabilities. *Behavior Change, 12,* 139-143.

Simmons, J. N., Smith, R. G., & Kliethermes, L. (2003). A multiple-schedule evaluation of immediate and subsequent effects of fixed-time food presentation on automatically maintained mouthing. *Journal of Applied Behavior Analysis, 36,* 541-544.

Skinner, B. F. (1948). “Superstition” in the pigeon. *Journal of Experimental Psychology, 38,* 168-172.

Smith, R. G., Lerman, D. C., & Iwata, B. A. (1996). Self-restraint as positive reinforcement for self-injurious behavior. *Journal of Applied Behavior Analysis, 29,* 99-102.

Sprague, J., Holland, K., & Thomas, K. (1997). The effect of noncontingent sensory reinforcement, contingent sensory reinforcement, and response interruption on stereotypical and self-injurious behavior. *Research in Developmental Disabilities, 18(1),* 61-77.

Tarbox, R. S. F., Wallace, M. D., & Williams, L. (2003). Assessment and treatment of elopement: A replication and extension. *Journal of Applied Behavior Analysis, 36,* 239-244.

Thelen, M. H. (1979). Treatment of temper tantrum behavior by means of noncontingent positive attention. *Journal of Clinical Child Psychology,* 140.

Thompson, R. H., & Iwata, B. A. (2005). A review of reinforcement control procedures. *Journal of Applied Behavior Analysis, 38,* 257-278.

Thompson, R. H., Iwata, B. A., Hanley, G. P., Dozier, C. L., & Samaha, A. L. (2003). The effects of extinction, noncontingent reinforcement, and differential reinforcement of other behavior as control procedures. *Journal of Applied Behavior Analysis, 36,* 221-238.

Van Camp, C. M., Lerman, D. C., Kelley, M. E., Contrucci, S. A., & Vorndran, M. (2000). Variable-time reinforcement schedules in the treatment of socially maintained problem behavior. *Journal of Applied Behavior Analysis, 33,* 545-557.

Vollmer, T. R., Iwata, B. A., Zarcone, J. R., Smith, R. G., & Mazaleski, J. L. (1993). The role of attention in the treatment of attention-maintained self-injurious behavior: Noncontingent reinforcement and differential reinforcement of other behavior. *Journal of Applied Behavior Analysis, 26,* 9-21.

Vollmer, T. R., Marcus, B. A., & Ringdahl, J. E. (1995). Noncontingent escape as treatment for self-injurious behavior maintained by negative reinforcement. *Journal of Applied Behavior Analysis, 28,* 15-26.

Vollmer, T. R., Progar, P. R., Lalli, J. S., Van Camp, C. M. Sierp, B. J., Wright, C. S., Nastasi, J., & Eisenschink, K. J. (1998). Fixed-time schedules attenuate extinction-induced phenomena in the treatment of severe aberrant behavior. *Journal of Applied Behavior Analysis, 31,* 529-542.

Vollmer, T. R., Ringdahl, J. E., Roane, H. S., & Marcus, B. A. (1997). Negative side effects of noncontingent reinforcement. *Journal of Applied Behavior Analysis, 30,* 161-164.

Wallace, M. D., Iwata, B. A., Hanley, G. P., Thompson, R. H., & Roscoe, E. M. (2012). Noncontingent reinforcement: A further examination of schedule effects during treatment. *Journal of Applied Behavior Analysis, 45,* 709-719.

Waller, R. D., & Higbee, T. S. (2010). The effects of fixed-time escape on inappropriate and appropriate classroom behavior. *Journal of Applied Behavior Analysis, 43,* 149-153.

Ward, R. D., & Higbee, T. S. (2008). Noncontingent reinforcement as treatment for tub-standing in a toddler. *Education and treatment of children, 31(2),* 213-222.

Wilder, D. A., Draper, R., Williams, W. L., & Higbee, T. S. (1997). A comparison of noncontingent reinforcement, other competing stimulation, and liquid rescheduling for the treatment of rumination. *Behavioral Interventions, 12(2),* 55-64.

Wilder, D. A., Normand, M., & Atwell, J. (2005). Noncontingent reinforcement as treatment for food refusal and associated self-injury. *Journal of Applied Behavior Analysis, 38,* 549-553.

Zeiler, M. D. (1968). Fixed and variable schedules of response-independent reinforcement. *Journal of the Experimental Analysis of Behavior, 11,* 405-414.

Appendix
Institutional Review Board Approval

ACTION ON PROTOCOL APPROVAL REQUEST

LSU
Institutional Review Board
Dr. Robert Mathews, Chair
131 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
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TO: George Noell
Psychology

FROM: Robert C. Mathews
Chair, Institutional Review Board

DATE: August 28, 2013
RE: **IRB#** 3408

TITLE: Fixed-Time Schedule Effects on Participants Responding: An Evaluation of Similar vs. Dissimilar Schedule Programs Using a Group Design Approach

New Protocol/Modification/Continuation: New Protocol

Review type: Full ___ Expedited X **Review date:** 8/29/2013

Risk Factor: Minimal X Uncertain ______ Greater Than Minimal_______

Approved X **Disapproved**__________

Approval Date: 8/29/2013 **Approval Expiration Date:** 8/28/2014

Re-review frequency: (annual unless otherwise stated)

Number of subjects approved: 66

Protocol Matches Scope of Work in Grant proposal: (if applicable)_______

By: Robert C. Mathews, Chairman Robert C Mathews

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING –
Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. SPECIAL NOTE:

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb*

Vita

Jessica Pearl Alvarez is a candidate for the Doctor in Philosophy degree in the department of psychology at Louisiana State University. She graduated with her Bachelor of Science degree in psychology in 2007 from the University of Iowa and received her Masters of Arts degree in 2012 from Louisiana State University. Jessica is currently completing her pre-doctoral internship at The Marcus Autism Center in Atlanta, Georgia and will begin her Postdoctoral Fellowship at Emory University in July 2014. Jessica completed her graduate work under the supervision of George H. Noell, PhD, BCBA.