THE INFLUENCE OF A DIFFERENTIAL REINFORCEMENT OF OTHER BEHAVIORS (DRO) PROTOCOL WITH AN EMBEDDED TOKEN ECOMONY TO REDUCE CHALLENGING BEHAVIORS AMONG CHILDREN WITH AUTISM

A dissertation submitted to the
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in partial fulfillment of the requirements for the degree of Doctor of Philosophy

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Recently, there has been an increase on the insistence that evidence-based methods be used when working among children with challenging behaviors and autism (Horner, Carr, Halle, McGee, Odom, & Wolery, 2005; National Research Council, 2001). In addition, the current trends of Positive Behavior Supports (PBS) and Response to Intervention (RtI) advocate for preventative and proactive strategies (Coleman, Buysse, & Neitzel, 2006). The integration of these trends with the principles of Applied Behavior Analysis offer procedural options to improve socially significant behavior among children (Cooper, Heron, & Heward, 1987). Ethical conversations support the need for reinforcement based procedures particularly within applied settings (Lerman, Vorndran, Addison, & Contrucci Kuhn, 2004).

The purpose of this study was to extend the evidence-based literature on reinforcement based protocols when diminishing behaviors. The DRO with an embedded token economy treatment package explored the efficacy of scripted instruction and praise among two school aged participants with autism. A whole interval DRO procedure was
utilized with interresponse times determined on a weekly basis to enhance feasibility for applied practitioners. If a target behavior occurred during the interresponse time, an interval reset application was applied and scripted instruction was verbally administered.

Results found that upon application of the treatment package, target behaviors significantly reduced while the embedded token economy, on a three to one ratio, was found to maintain near zero rates of target behaviors between both participants. The utilization of intermittent praise was thought to support near zero behavior rates as participants worked towards accumulating three tokens. Treatment integrity was monitored throughout the intervention with data supporting the ease in application for applied practitioners. The DRO with an embedded token economy treatment package was found to be efficacious for reducing target behaviors and maintaining near zero rates among children with autism in a special education classroom; holding potential as a simplistic, reinforcement based treatment option.
CHAPTER ONE

Introduction

Autism is a complex developmental disorder first described by Leo Kanner in 1943, resulting from his study of eleven individuals (Corsello, 2005; Volkmar, Klin, & Cohen, 1997). Autism is one of the most widely recognized developmental disorders and is thought to be the best documented disorder in child psychiatry (Jensen & Sinclair, 2002; Volkmar et al.). Originally, Kanner’s work conveyed the rarity of this complex disorder, with his reports noting that out of the 20,000 children with emotional disturbance he had assessed, only 150 of those children had autism (Matson & Minshawi, 2006). While the prevalence was originally thought to be miniscule, present research implies that the rate of autism spectrum disorders has significantly increased over the last decade (Jensen & Sinclair; Matson & Minshawi).

Prevalence

Research suggests that there has been a significant increase since 1990 in the number of individuals diagnosed with autism spectrum disorders or ASD (see Table 1). The Centers for Disease Control and Prevention developed the Autism and Developmental Disabilities Monitoring (ADDM) network, releasing data in 2007 to support the prevalence rate for ASD as 1 in 150 among eight-year-old children in the United States (Centers for Disease Control and Prevention, 2007). The once rare disorder is now reported to be more prevalent than childhood cancer, diabetes, and Down’s syndrome (Geier & Geier, 2006) with the prevalence rate appearing to be unrelated to
socioeconomic or racial status, generally effecting the global population (Spence, Sharifi, & Wiznitzer, 2004).

Table 1

*Prevalence of Autism Spectrum Disorders from 1966 to 2007*

<table>
<thead>
<tr>
<th>Years</th>
<th>ASD prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970’s</td>
<td>Less than 3 per 10,000 children</td>
</tr>
<tr>
<td>1990’s</td>
<td>Greater than 30 per 10,000 children</td>
</tr>
<tr>
<td>2007</td>
<td>1 per every 150 children</td>
</tr>
</tbody>
</table>

The increase in ASD has spurred public debate about the cause for increased prevalence (Kaye, del Mar Melero-Montes, & Jick, 2001). One popular impression is that the increase is a result of expanding diagnostic criteria and public awareness (Fombonne, 2003; Matson & Minshawi, 2006; Spence et al., 2004). Conflicting opinions support the hypothesis of a true autism epidemic (Matson & Minshawi). Further, some believe that environmental factors play a critical role in inducing the onset of ASD among susceptible children (Blaxill, 2004; Geier & Geier, 2006; Spence et al.).

While debate lingers in terms of true causes for heightened ASD prevalence, the evidence supporting the increase in ASD diagnoses is undeniable (United States Government Accountability Office, 2005). The increase has resulted in autism being accepted as a pressing health concern (Blaxill, 2004). Accurate reporting of ASD prevalence is critical to set aside research dollars supporting effective interventions and autism prevention (Centers for Disease Control and Prevention, 2007; Fombonne, 2003).
**Definition of Autism**

Autism is a disorder that affects functioning in social relationships, communication, restricted interests, and repetitive behaviors (Audet, 2004; Rutter, 1978; Spence et al., 2004). Although deficits exist among all of these areas, variations in behaviors and severity of symptoms are individualized for each child with autism (National Research Council, 2001; Spence et al.). Some individuals with autism have profound degrees of intellectual disability while others have intellectual functioning characteristic of the general population (Shea, 2004; Volkmar et al., 1997). Dawson and Osterling (1997) suggest that individuals with milder forms of autism are more likely to be identified, as professionals and parents merge towards an increased understanding of autism.

The two major diagnostic systems, the International Classification of Diseases (World Health Organization, 1993) and the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR; American Psychiatric Association, 2000), have a consensus regarding the diagnostic category for autism and its related features (Volkmar et al., 1997). Table 2 specifies conditions classified in the DSM-IV-TR under autism.
Table 2

*Conditions Classified as Autism in the DSM-IV-TR (2000)*

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autistic Disorder</td>
<td>Qualitative impairments in social interaction, communication, and restricted,</td>
</tr>
<tr>
<td></td>
<td>repetitive, and stereotyped patterns of behavior, interests, and activities,</td>
</tr>
<tr>
<td></td>
<td>evident prior to the age of three years</td>
</tr>
<tr>
<td>Pervasive Developmental Disorder Not</td>
<td>Variability in the autism diagnosis for the age of onset and behavioral criteria</td>
</tr>
<tr>
<td>Otherwise Specified (PDD-NOS)</td>
<td></td>
</tr>
<tr>
<td>Rett Disorder</td>
<td>Females only, more likely to be mute and profoundly mentally retarded (MR),</td>
</tr>
<tr>
<td></td>
<td>hand-washing stereotypies, loss of purposeful hand movement, development of</td>
</tr>
<tr>
<td></td>
<td>various aberrant motor behaviors</td>
</tr>
<tr>
<td>Child Disintegrative Disorder</td>
<td>Apparent late onset of autism or a period of clear deterioration/regression</td>
</tr>
<tr>
<td>Asperger’s Disorder</td>
<td>Qualitative impairments in social interaction and restricted, repetitive, and</td>
</tr>
<tr>
<td></td>
<td>stereotyped patterns of behavior, no delay in language or cognitive development</td>
</tr>
</tbody>
</table>
The DSM-IV-TR (2000) sought to balance the needs of both clinicians and researchers in the field of autism resulting in an explicit and uncomplicated manual (Matson & Minshawi, 2006). Criterion listed in the manual delineates qualitative symptoms typically apparent with ASD. While the updated manual provides a consistent empirical basis for autism diagnoses, the broadening of the definition may contribute to the increase in ASD prevalence (Blaxill, 2004; Fombonne, 2003). Wing and Potter (2002) found that autism spectrum diagnoses were most prevalent when the DSM-IV (1994) or ICD-10 (1993) was utilized in contrast to diagnoses obtained when employing Kanner’s conservative criteria. Revisions in criteria complicate the task of comparing prevalence rates of ASD over time (Blaxill).

Identification of Autism

Professionals and researchers emphasize the importance of early autism identification to promote intervention services during a critical and vulnerable time in human development (Coleman et al., 2006; Johnson & Hastings, 2002; National Research Council, 2001; Sheinkopf & Siegel, 1998; Smith, 1999). Guidelines have recently been developed to establish standard diagnostic practices among Pediatricians (American Academy of Pediatrics, 2001; Johnson, Myers, & the Council on Children with Disabilities, 2007). Developmental screenings are suggested at each well child visit to identify those at risk for atypical development (American Academy of Pediatrics; Corsello, 2005; Johnson et al.). Increased awareness of ASD and the development of reliable diagnostic tools are increasing the potential to diagnose children by the age of three (Jensen & Sinclair, 2002; Spence et al., 2004).
Research suggests that all early intervention autism programs are efficacious in producing developmental gains regardless of educational placements, philosophical approaches, and intervention strategies (Dawson & Osterling, 1997; Gresham & MacMillan, 1998; Smith, Groen, & Wynn, 2000). The prognosis for children with autism is more favorable than originally believed as a result of effective early intervention (Eikeseth, 2001; Lovaas, 1987). Exploring evidence-based intervention practices for this population of young children needs to be further emphasized. The following section discusses the definition for evidence-based practices while considering the recent influence of Response to Intervention (RtI) when working among children with autism.

Evidence-based Practice

The increase in prevalence rates among children with ASD has placed additional pressure on service providers to implement evidence-based interventions for this population (Horner et al., 2005; Odom et al., 2003). The onset of the No Child Left Behind Act required practitioners to utilize services deriving from evidence-based research (Conroy, Dunlap, Clarke, & Alter, 2005; U.S. Department of Education, 2002). The principle theory is that professionals should rely on evidence when making determinations about services and supports for young children (Coleman et al., 2006). Evidence-based practices are obtained from scientific data in collaboration with identified characteristics and preferences of the individual child (Kimball, 2002; Odom et al.). Most previous practices had been reliant on anecdotal testimonials in determining intervention options for children with autism (Jensen & Sinclair, 2002). The trend is currently being replaced with a five-step process adopted from the medical field (Snapshot, 2006). The
specific process recommended for evidence-based decision making is disclosed in Table 3 (Snapshot).

Table 3

<table>
<thead>
<tr>
<th>Process</th>
</tr>
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<tbody>
<tr>
<td>Pose the question</td>
</tr>
<tr>
<td>Seek out the best available research evidence</td>
</tr>
<tr>
<td>Consider the quality and pertinence of the evidence</td>
</tr>
<tr>
<td>Integrate research with professional values and background knowledge</td>
</tr>
<tr>
<td>Evaluate</td>
</tr>
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</table>

*Scientific evidence.* In 2001, the National Research Council proposed two key elements in validating scientific evidence of effectiveness for autism practices (National Research Council, 2001; Odom et al., 2003). First, the committee identified scientific evidence as comprehensive program models and individual intervention techniques specific to the needs of young children with autism. Secondly, the committee emphasized scientific, research based intervention as the causal relationship between the intervention and its effects (Coleman et al., 2006; Kimball, 2002; National Research Council; Odom et al.). Odom et al. and Shavelston and Towne (2002) extended the literature by constituting scientific research as a five component process to guide educators and researchers. The five components of scientific research are offered in Table 4.
Table 4

*Components of Scientific Research*

<table>
<thead>
<tr>
<th>Components</th>
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<tbody>
<tr>
<td>Conduct an empirical investigation</td>
</tr>
<tr>
<td>Link findings to a theory of practice</td>
</tr>
<tr>
<td>Use methods that permit direct investigation</td>
</tr>
<tr>
<td>Provide a coherent chain of reasoning</td>
</tr>
<tr>
<td>Replicate and generalize findings across research</td>
</tr>
</tbody>
</table>

_**Integration of knowledge.**_ Recently, professionals have begun to utilize a novel approach to evidence-based practices by integrating parent and professional wisdom with literature from the field (Buysee, Sparkman, & Wesley, 2003; Coleman et al., 2006; Odom et al., 2003). The process recognizes that evidence can be obtained from a variety of resources (Coleman et al.). Parent and professional wisdom can be defined as a form of knowledge derived from personal experiences and classroom practices (Evidence-based practices, n.d.). Evidence-based practices are thought to create a balance between scientific research and family and professional experience (Coleman et al.; Snapshot, 2006); ensuring socially valid interventions that professionals are comfortable with implementing and maintaining over time. Overall, the process ensures that parents and professionals become active, critical consumers of educational research to make informed intervention decisions (Snapshot). The next section explores the concept of social validity when choosing and implementing interventions for children with disabilities.
Social Validity

The idea of social validity emerged in 1978; resulting from Montrose Wolf’s observations that nonacceptance of interventions could result in severe rejection of behavioral programming (Schwartz & Baer, 1991). Numerous terms such as treatment acceptability, clinical and applied importance, and treatment effectiveness encompass a similar framework and are fairly specific to behavioral interventions for children with developmental disabilities (Cross Calvert & Johnston, 1990; Foster & Mash, 1999). Social validity refers to the social importance and acceptability of treatment goals, procedures, and outcomes (Armstrong, Ehrhardt, Cool, & Poling, 1997; Foster & Mash; Hickey & Rondeau, 2005). Goals of the behavioral treatment and quantity of behavior change are considered in the evaluation process (Elliott, 1988; Foster & Mash). Table 5 summarizes the three critical components of social validity (Elliott; Fawcett, 1991; Miller, Lane, & Wehby, 2005; Schwartz & Baer; Wolf, 1978).

Table 5

<table>
<thead>
<tr>
<th>Components</th>
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<tbody>
<tr>
<td>Are the specific behavioral goals socially significant?</td>
</tr>
<tr>
<td>Are the procedures used socially acceptable to consumers?</td>
</tr>
<tr>
<td>Are consumers satisfied with the outcome, including both predicted behavior change and unpredicted side effects?</td>
</tr>
</tbody>
</table>
Cross, Calvert and Johnston (1990) identified that, as a general understanding, treatments capable of producing rapid results are viewed as more acceptable. Schwartz and Baer (1991) discuss that social validity considers a consumer’s opinion and uses the information to sustain practices when working with intensive behaviors. Social validity seeks to identify treatments that are appropriate while minimizing disruption to the individual’s daily routine (Fawcett, 1991; Foster & Mash, 1999). Further, social validity assessments investigate whether the treatment is appropriate, fair, and reasonable with the understanding that acceptability is a complex construct influenced by several child and practitioner variables (Elliott, 1988). The assessment process is intended to provide information to ensure program survival (Schwartz & Baer). Social validity influences the success of interventions while encompassing a relationship with evidence-based practices and single subject design methodology.

*Single Subject Design and Evidence-based Practices*

Single subject design research is a scientific methodology providing further justification for evidence-based interventions through establishing a causal relationship between an intervention and its effects (Buysee et al., 2003; Horner et al., 2005). A primary benefit of single subject research is that persuasive and practical scientific evidence manifests from an economical and efficient means (Horner et al.). The use of single subject design is a reliable mechanism in contributing to evidence-based practices in the field of early childhood education. The emphasis on establishing experimental control is a significant component of single subject designs, although this control documents just one portion of the overall evidence-based standard (Conroy et al., 2005;
Horner et al.; Kimball, 2002). After experimental control has been established through single subject research, practitioners and parents are then able to contribute insight to the most feasible approach for the individual situation (Buysee et al.). As previously mentioned, assessing the social importance and acceptability of treatment goals and procedures is of critical importance when designing interventions for children (Schwartz & Baer, 1991). Table 6 summarizes the collection of standards necessary when conducting quality single subject research (Horner et al.).

Table 6

*Standards of Single Subject Research When Determining Empirical Evidence*

<table>
<thead>
<tr>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>The intervention is operationally defined.</td>
</tr>
<tr>
<td>The setting of the intervention is defined.</td>
</tr>
<tr>
<td>The practice is implemented with fidelity.</td>
</tr>
<tr>
<td>A functional relationship is established between the intervention and the results.</td>
</tr>
<tr>
<td>The results are replicated across studies, researchers, and participants.</td>
</tr>
</tbody>
</table>

*$Replication to extend evidence-based practices.* Operationally defining the intervention and setting while ensuring fidelity of practices allows for continuity in behavioral research. Intervention and setting conditions must be accurately defined to ensure that it was the protocol, not an extraneous variable, which was responsible for the effects (Flannery-Schroeder, 2005; Gresham, MacMillan, Beebe-Frankenberger, & Bocian, 2000; Peterson, Homer, & Wonderlich, 1982). In regards to replication, Horner
et al. (2005) suggest a minimum of five single subject studies across three different researchers and locations when considering research as evidence-based. Evidence is strengthened when studies are replicated across twenty or more participants (Horner et al.; Odom et al., 2003).

Recent conversation has focused on evidence-based practices and a new era of accountability has been popularized throughout school districts with the introduction of Response to Intervention (RtI). The RtI model is a proactive attempt at addressing academic and behavioral problems, with student outcomes reliant on intervention quality among all levels of instructional practice (Goss, Noltemeyer, & Devore, 2007; Stecker, 2007). Response to Intervention offers a continuum of services ranging from universal interventions to specialized treatments (Fairbanks, Sugai, Guardino, & Lathrop, 2007). Response to Intervention strives to minimize the impact of a disability on student progress by allowing for early and intensive interventions presented through a collaborative approach (Coleman et al., 2006; Stecker). Table 7 addresses RtI components directly related to evidence-based practices for children with disabilities.
Table 7

*Components of the RtI Model*

<table>
<thead>
<tr>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation of treatment integrity</td>
</tr>
<tr>
<td>Utilizing research based practices for classroom instruction</td>
</tr>
<tr>
<td>Continuous monitoring of data</td>
</tr>
<tr>
<td>Evidence-based academic and behavioral interventions</td>
</tr>
</tbody>
</table>


The recent trend in RtI necessitates that practitioners identify evidence-based practices when working among children with disabilities (Poling & Ryan, 1982). Synonymous to this current practice, Positive Behavior Supports (PBS) has become a prominent notion and is constituted as an extension of Applied Behavior Analysis (Filter, 2007). Blending RtI and PBS ensures that consistent, proactive approaches are utilized when servicing students with disabilities (Anderson & Spaulding, 2007). The fidelity of protocol implementation further promotes the efficacy of behavioral interventions. The concept of treatment integrity has become pronounced when working among children with challenging behaviors and is discussed in the following section.
Individuals in the field of special education have verbalized a need for increased treatment integrity among behavioral research for children with disabilities (Gresham et al., 2000; Kazdin, 1997). Treatment integrity is defined as the degree to which an intervention is implemented as designed (Armstrong et al., 1997; Salend, 1984). The independent variable needs to be consistently utilized and assessed to ensure that therapeutic change is attributed to the intervention (Flannery-Schroeder, 2005). Treatment integrity is synonymous with the terms treatment fidelity, intervention integrity, intervention fidelity, and procedural reliability (Goss, Noltemeyer, & Devore, 2007; Gresham et al.; National Research Council, 2001).

Behavioral research, in particular, is vulnerable to violations of treatment integrity (Salend, 1984). Low treatment integrity levels indicate that the treatment being implemented is different or inconsistent from the original intention (Gresham, 2005). Various components of interventions may increase or decrease the accuracy of implementation (Wilkinson, 2006). Noell, Gresham, and Gansle (2002) discuss that identifying effective interventions may be less challenging than assuring precise intervention implementation. Integrity is minimally reported in the literature and is a procedure necessitating further focus in research practice (Goss et al., 2007; Wilkinson). While treatment integrity is a critical element when identifying interventions for children with challenging behaviors, ethical considerations are also an important issue.
Ethical Considerations in Special Education

While recent conversation communicates the importance of evidence-based practices (Buysee et al., 2003; Odom et al., 2003), individuals involved in the field of special education frequently debate best practices from an extensive array of intervention options (Heflin & Simpson, 1998). Practitioners are often concerned about efficacy of treatment interventions and more importantly, the ethical considerations that resonate within the field of special education (Newman, Reeve, Reeve, & Ryan, 2003; Poling & Ryan, 1982). Practitioners have been criticized for utilizing punishment procedures to diminish target behaviors when working among children with disabilities (Matson & Minshawi, 2006; Shea, 2004). Although punishment procedures have been successful in diminishing challenging behaviors, appropriateness has been questioned as the interventions may be interpreted as excessively aversive and intrusive (Poling & Ryan; Reese, Sherman, & Sheldon, 1998).

Ethical considerations have resulted in practitioners initially choosing reinforcement based interventions when programming for challenging behaviors (Anderson & Spaulding, 2007). Further, PBS and functional behavior assessments (FBA) emphasize that educational teams must consider the use of reinforcement based intervention strategies prior to considering punitive procedures (OSEP Center on Positive Behavioral Interventions and Supports et al., 2000). The following paragraph defines reinforcement procedures for consideration when working among children with behavioral challenges.
Reinforcement procedures. Reinforcement procedures, such as differential reinforcement and token economies, are defined as the contingency between a specific behavior and its consequence, resulting in a future increase in the probability of the behavior (Newman et al., 2003). Reinforcement procedures have the inverse intent of a punishment procedure, seeking to increase the behavior in contrast to diminishing the occurrence. Just as punishment procedures can be positive or negative, reinforcement procedures are also categorized in terms of positive and negative types (Newman, Birch, Blausten, & Reinecke, 2005). Cooper et al. (1987) and Newman et al. (2005) discuss the variations in reinforcement procedures and define positive reinforcement as any stimulus delivered after a behavior, resulting in an increase in the behavior. By contrast, negative reinforcement represents the idea that behavior becomes more probable as a result of withdrawing a stimulus whenever the behavior occurs (Miltenberger, 1997; Newman et al., 2005).

The intent of this dissertation is to validate the efficacy of a treatment package including a reinforcement based DRO procedure with an embedded token economy and its effects in reducing target behaviors among children with autism. The remaining segment of the chapter justifies the rationale for this treatment package. Research questions are delineated for the purpose of the study.

Rationale

Current research verifies an increase in autism prevalence (Blaxill, 2004; Matson & Minshawi, 2006), suggesting that higher rates of children with autism are attending public and private facilities. Although research has been conducted on behavioral
interventions, further research is warranted for applied special education settings servicing children with autism (Reed, Osborne, & Corness, 2007).

Response to Intervention and PBS indicate that reinforcement based procedures should be explored as the initial modality when implementing interventions in school facilities. The DRO and token economy treatment package holds promise as a reinforcement based intervention while complimenting the trend of RtI and PBS. The DRO treatment package provides a feasible and efficient protocol with the potential for heightened treatment acceptability and integrity among practitioners.

**Token economy.** Integrating both DRO and token economies into one treatment package results in a protocol that allows instructional momentum to be maintained (e.g., a reinforcer is delivered after three tokens rather than after the exhaustion of each timer interval). Using a DRO intervention alone means that much of the instructional time is spent delivering reinforcers contingent on the absence of target behaviors. Singly employing a DRO intervention results in continuous interruption of academic tasks in the special education classroom setting, particularly when the interresponse time is set to a small interval (e.g., a fifteen second interval would result in delivery of reinforcement every fifteen seconds during instruction).

In contrast, when applying a DRO with an embedded token economy treatment package, minimal disruption occurs during instruction. The treatment package allows for instructional delivery to continue rather than halting tasks to deliver a reinforcer. The use of a DRO with an embedded token economy treatment package was explored for use among school age children with autism. The practicality of utilizing a reinforcement
based treatment package in a special education classroom setting was examined to
determine intervention relevancy by applied practitioners.

Research Questions

The following research questions are explored:

1. Does a whole interval Differential Reinforcement of Other Behaviors (DRO)
   protocol with an embedded token economy reduce target behaviors among school
   age children with autism? The independent variable, a whole interval DRO
   protocol with an embedded token economy, is actively manipulated to verify that
   it is the intervention, not an extraneous variable, which is responsible for the
   behavior change. The independent variable sought to reduce challenging
   behaviors (i.e., the dependent variables) among two school age children with
   autism.

2. Are back-up tokens presented on a three to one ratio potent enough to maintain
   low rates of challenging behavior until the desired reinforcer is delivered?

3. After removal of the intervention, do the effects of the DRO with an embedded
   token economy maintain?
CHAPTER TWO

Literature Review

Chapter two begins with an overview of ethical considerations and differential reinforcement procedures followed by a literature review of the treatment package components, Differential Reinforcement of Other Behaviors (DRO) and token economies. Procedural variations and feasibility are discussed for use among children with autism. Chapter two will validate the efficacy of a reinforcement based treatment package when seeking to minimize challenging behaviors.

Ethical Considerations

When evaluating ethical considerations among behavioral interventions for children with disabilities, the literature strongly suggests that reinforcement based interventions are deemed most acceptable in comparison to punitive procedures (Cross Calvert & Johnston, 1990; Sterling-Turner & Watson, 2002). Although punitive procedures such as response cost may be the most efficacious option for a particular subject (Pfiiffner, O’Leary, Rosen, & Sanderson, 1985), ethical purposes obligate practitioners to initially consider the use of reinforcement based procedures (Anderson & Spaulding, 2007). Differential reinforcement and token economies are scientific, reinforcement based interventions that will be explored throughout this chapter.

Differential Reinforcement

Differential reinforcement procedures are often referred to in the literature as positive reductive procedures with the positive connotation resulting in enhanced appeal
The behavioral procedure is intended to increase the frequency of desired behaviors, while diminishing the occurrence of undesirable behaviors (Miltenberger, 1997). Differential reinforcement procedures reinforce the desired behavior upon each occurrence, simultaneously ensuring that any undesirable behaviors are ignored (Miltenberger). When treatment integrity is employed, Lindberg, Iwata, Kahng, and DeLeon (1999) have found increased efficacy of differential reinforcement procedures resulting from an extinction component in which reinforcement is withheld following occurrence of the problem behavior.

Variations exist in regards to differential reinforcement procedures available for implementation (Bregman & Gerdtz, 1997; Newman et al., 2005; Odom et al., 2003; Reese et al., 1998). Cooper et al. (1987) and Matson and Minshawi (2006) discuss that a positive environment is maintained with differential reinforcement procedures which include Differential Reinforcement of Incompatible Behavior (DRI), Differential Reinforcement of Alternative Behavior (DRA), Differential Reinforcement of Other Behavior (DRO), and Differential Reinforcement of Low Rates of Responding (DRL). Table 8 summarizes definitions of the differential reinforcement procedures to distinguish among the four protocols. The remainder of the chapter focuses specifically on the use of DRO procedures and token economies as well as research accompanying their implementation.
Table 8

*Differential Reinforcement Procedures*

<table>
<thead>
<tr>
<th>Terms</th>
<th>Definitions</th>
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<tbody>
<tr>
<td>DRI</td>
<td>Reinforcement is provided for the occurrence of a behavior that is physically incompatible with the behavior to be reduced.</td>
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<tr>
<td>DRA</td>
<td>Reinforcement is provided for the occurrence of a target behavior that is an alternative to the behavior being reduced.</td>
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<tr>
<td>DRO</td>
<td>Reinforcement occurs for engaging in any response other than the target behavior for a set interval of time.</td>
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<tr>
<td>DRL</td>
<td>Reinforcement occurs for low rates of a target behavior. For DRL to be appropriate, the target behavior must be relatively acceptable, although if occurring frequently or at high levels of intensity, the behavior would be constituted as disruptive.</td>
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</table>


*Differential Reinforcement of Other Behavior (DRO)*

In 1961, George Reynolds coined the term Differential Reinforcement of Other Behavior (DRO) after observing that the key pecking of pigeons decreased to low rates when reinforcement was delivered after a set interval of time a target behavior was absent (Lindberg et al., 1999; Poling & Ryan, 1982). The procedure was unique to behavioral practices because the absence of a behavior was reinforced rather than the occurrence of a
response (Mazaleski, Iwata, Vollmer, Zarcone, & Smith, 1993; Poling & Ryan; Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993). After the introduction of the DRO procedure, popularity soon emerged and DRO quickly became one of the most frequently used treatments for a plethora of behavior problems (Cowdery, Iwata, & Pace, 1990; Lindberg et al.; Mazaleski et al.).

The DRO procedure is the least intrusive of all behavioral interventions, as reinforcers are not removed in this procedure. Rather, reinforcers are withheld when the challenging behavior occurs and are delivered when the behavior does not occur; enhancing intervention appeal (Cowdery et al., 1990). While reinforcement based interventions and punishment procedures both serve as mechanisms in the reduction of target behaviors, DRO has been identified as an alternative to traditional reductive behavior approaches such as punishment and extinction (Goetz, Holmberg, & LeBlanc, 1975; Poling and Ryan, 1982). Although both DRO and punishment are synonymous in terms of outcomes, the legal and ethical acceptability of DRO presents an advantage to the aversive nature of punishment based interventions (Cowdery et al.; Poling & Ryan; Vollmer, Marcus, & Ringdahl, 1995). Researchers contend that reinforcement based procedures are generally best practice when working among children with disabilities (Cowdery et al.).

Cowdery et al. (1990) spoke of the strength of differential reinforcement procedures in maintaining instructional momentum, rather than interrupting activities as would occur with time out. Further, in contrast to punishment procedures, DRO has no
reported side effects (Homer & Peterson, 1980; Poling & Ryan). The ethical foundation inherent in DRO is a persuasive element, convincing users of its acceptability.

Logistics of DRO. To implement DRO, reinforcement is delivered contingent on the absence of target behaviors for a set interval of time (Didden et al., 1997; Lovaas, 2003; Mazaleski et al., 1993; Newman et al., 1997; Repp et al., 1991; Thompson, Iwata, Hanley, Dozier, & Samaha, 2003; Vollmer et al., 1995). Thompson et al. discuss the procedural reliability of DRO as reinforcers are delivered contingent on the absence of a target behavior; suggesting that there is no opportunity for accidental reinforcement. Homer and Peterson (1980) considered the limited training necessary for practitioners to implement DRO and discussed generalization as the protocol is effective across varying populations and behaviors.

Procedural variations. Dependent on individual needs, variations exist when implementing the DRO protocol (Lindberg et al., 1999). The time interval chosen is a significant contributing factor to protocol success and is often referred to as interresponse time or IRT (Thompson et al., 2003; Vollmer et al., 1993). Interresponse time can be found through dividing the number of target behavior occurrences by the duration of time observed. When employing DRO, two options can be used, dependent on practitioner preference. An interval reset may be chosen in which the timer interval may be immediately reset upon target behavior occurrence. The second, more feasible option is continuous interval application in which the subject displays a target behavior and the timer continues until exhausted (e.g., extinction component). No reinforcement is delivered as a result of the behavior. The timer is then set for the new interval.
Vollmer et al. (1995) implemented a DRO procedure with a 4-year-old boy exhibiting self-injurious behavior (SIB). In this study, the child was provided with breaks as a negative reinforcer for maintaining a safe body. If the subject engaged in SIB during an interval, the timer was then reset. Throughout the study, intervals were determined by averaging the interresponse times from the preceding five sessions. By maintaining appropriate intervals in contrast to lengthened intervals, individuals have the opportunity to experience success; resulting in increased reinforcement potential (Vollmer et al.).

In two separate studies, Repp et al. (1983; 1991) explored the influence of interval size on the outcomes of DRO procedures. In the initial study, Repp et al. (1983) discussed the importance of implementing DRO schedules at small intervals with the intent of gradually lengthening the interval size. The second study extensively explored this premise, using a multiple baseline design across subjects for two experiments (Repp et al., 1991). Experiment One executed a DRO intervention among six children with moderate mental retardation, while three subjects in Experiment Two shared similar qualities with the initial participants. The researchers imposed staggered treatment phases in which baseline initially occurred, followed by DRO with an interval value equal to the average interresponse time during baseline, and an additional phase containing a DRO value equal to twice the average baseline interresponse time. Results of this study supported that the initial interval size should be relatively small while matching the response rate (Reese et al., 1998; Repp et al., 1991). The following table provides extended information in regards to DRO as a primary component of early childhood treatment programs.
<table>
<thead>
<tr>
<th>Study</th>
<th>Subjects</th>
<th>Setting</th>
<th>Behavior</th>
<th>DRO consequence</th>
<th>Alternative protocols</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barton, Brulle, &amp; Repp (1986)</td>
<td>Nine elementary school-aged students with Mental Retardation (MR)</td>
<td>Elementary school classroom for students with maladaptive behaviors</td>
<td>Noncompliance, head-weaving, light-gazing, hand-flapping, finger-moving</td>
<td>Primary reinforcers and praise</td>
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<tr>
<td>Conyers et al. (2004)</td>
<td>Twenty-five preschool children</td>
<td>Preschool classroom</td>
<td>Disruptive behavior</td>
<td>Tokens to be exchanged for candy</td>
<td>Response Cost</td>
</tr>
<tr>
<td>Cowdery et al. (1990)</td>
<td>9-year-old boy</td>
<td>Hospital inpatient unit</td>
<td>SIB</td>
<td>Token reinforcement (pennies)</td>
<td>---</td>
</tr>
<tr>
<td>Study</td>
<td>Subjects</td>
<td>Setting</td>
<td>Behavior</td>
<td>DRO consequence</td>
<td>Alternative protocols</td>
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<tr>
<td>Didden, de Moor, &amp; Bruyns (1997)</td>
<td>Five children aged 5 to 6 years with physical disabilities; one child with average intelligence, four children with mild or moderate MR</td>
<td>Rehabilitation center</td>
<td>Inappropriate use of chair, stereotypic mouthing, inappropriate interaction with peers</td>
<td>Tokens</td>
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<tr>
<td>Mahlen O’Neil, White, King, &amp; Carek (1979)</td>
<td>26-month-old girl</td>
<td>Pediatric hospital unit</td>
<td>Rumination</td>
<td>Honey water</td>
<td>Punishment and time out</td>
</tr>
<tr>
<td>Study</td>
<td>Subjects</td>
<td>Setting</td>
<td>Behavior</td>
<td>DRO consequence</td>
<td>Alternative protocols</td>
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<tr>
<td>Newman, Tuntigian, Ryan, &amp; Reinecke (1997)</td>
<td>Three students with autism; male age 12, male age 4, and female age 6</td>
<td>Afterschool program, preschool classroom</td>
<td>Out-of-seat, nail-flicking</td>
<td>Tokens</td>
<td>Self-management</td>
</tr>
<tr>
<td>Repp, Barton, &amp; Brulle (1983)</td>
<td>Three males aged 7-years with MR; 8-year-old male with moderate retardation</td>
<td>Classroom</td>
<td>Disruptive behaviors</td>
<td>Food</td>
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<tr>
<td>Study</td>
<td>Subjects</td>
<td>Setting</td>
<td>Behavior</td>
<td>DRO consequence</td>
<td>Alternative protocols</td>
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<tr>
<td>Repp, Felce, &amp; Barton (1991)</td>
<td>Six students 8-10-years of age with moderate retardation; three children with MR ages 9, 11, and 12</td>
<td>Special education program in segregated facility</td>
<td>Disruptions</td>
<td>Tokens</td>
<td>---</td>
</tr>
<tr>
<td>Taylor, Hoch, &amp; Weissman (2005)</td>
<td>6-year-old girl with autism</td>
<td>Preschool classroom</td>
<td>Vocal stereotypy</td>
<td>Auditory toys and nonauditory toys</td>
<td>Fixed time schedule of reinforcement</td>
</tr>
<tr>
<td>Vollmer et al. (1995)</td>
<td>18-year-old male (MR), 4-year-old male (undiagnosed)</td>
<td>Public school, preschool</td>
<td>SIB</td>
<td>Breaks</td>
<td>Non-contingent escape</td>
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</tbody>
</table>
**Momentary and whole interval DRO.** Another consideration is the use of momentary DRO and whole interval DRO. Barton et al. (1986) deciphered the differences among the two treatment options by defining momentary DRO to be a schedule in which reinforcement is delivered if the target behavior did not occur at the specific moment of observation. The momentary DRO format allows the subject to partake in a challenging behavior throughout an interval as long as the behavior does not occur during the moment that the timer is exhausted. In contrast, whole interval requires the subject to refrain from any occurrence of problem behavior for the whole interval of time to receive reinforcement (Barton et al.).

Repp et al. (1983) conducted a study with four early childhood students with mild mental retardation, examining the benefit of whole interval DRO in comparison to momentary DRO. All students experienced baseline conditions with two participants being exposed to momentary DRO followed by whole interval DRO. A third subject was exposed to an inverse design, defined as whole interval DRO followed by momentary DRO while the fourth participant received a multielement design containing baseline, whole interval DRO, and momentary DRO. The results of the study suggested that whole interval DRO has potent effects on reducing target behaviors while momentary DRO has benefit as a maintenance procedure.

In a later study, Barton et al. (1986) explored the therapeutic effect of both momentary and whole interval DRO with nine elementary school aged students with severe multiple disabilities. To begin, preference assessments were conducted to determine the poignancy of specific reinforcers. Reversal designs were then implemented.
to diminish target behaviors such as noncompliance, head-weaving, light-gazing, hand-flapping, and finger-moving. The results of the study indicated that the whole interval DRO procedure was more effective than momentary DRO schedules at initially reducing challenging behaviors. Further inspection identified momentary DRO as effective in maintaining behaviors originally minimized through whole interval DRO procedures.

Preference assessments. When working with young children, the strength of reinforcers should be considered when implementing reinforcement based interventions. Several researchers have emphasized the need for conducting preference assessments prior to applying intervention procedures (Mazaleski et al., 1993; Repp et al., 1983; 1991; Shabani et al., 2001; Thompson et al., 2003). After determining powerful reinforcers, the DRO intervention has the potential to compete with reinforcers maintaining behavior; enhancing the likelihood that the intervention will be effective (Mazaleski et al.).

In a study conducted by Shabani et al. (2001), an intervention package including DRO and self-monitoring was instituted with a 12-year-old boy with autism, attention deficit hyperactivity disorder, mental retardation, and seizure disorder. Results demonstrated that the treatment package was successful in diminishing rocking behavior, although the design induces confusion in interpretation of the results. The multi-component element of both self-monitoring and DRO complicates the ability to decipher which treatment component was most important to intervention success. The treatment package as a whole could be attributed to the decrease in rocking behavior although further research should be conducted to separate successful treatment package components.
Feasibility and considerations of DRO. Although research suggests that DRO is successful across varying populations and settings, there continues to be resistance for choosing DRO as a primary intervention procedure. Poling and Ryan (1983) and Reese et al. (1998) discussed the intense staff requirement of DRO, emphasizing that overwhelmed practitioners may have difficulty implementing the treatment. Further, Vollmer et al. (1995) note that DRO requires continuous monitoring and recording of data to reset intervals, as a result, treatment settings and practitioner energy should be considered to ensure consistent implementation of DRO.

Despite cautions related to the staff time requirement, other research studies have insisted that the protocol is practical and simplistic to use (Poling & Ryan, 1982). Repp et al. (1983) suggest that if whole interval DRO is excessive, then variations such as momentary DRO are available to increase feasibility. Further research should focus on the implementation of DRO throughout various settings such as general education and special education programs. Components such as individual and whole group DRO should be also explored while focusing on dynamics within settings.

Token Economy

Four decades ago, operant conditioning principles were used to develop the token economy. The behavioral protocol was created to remediate problems among people with mental illness (Liberman, 2000). Since that point in history, the token economy has become more refined and practical while popularity has blossomed among parents, practitioners, and community service providers (Risley, 2005). Token economies can be defined as a system of exchange in which a behavior earns tokens to be traded for
preferred activities or other rewards (Charlop-Christy & Haymes, 1998; DuPaul, 1991; Lazarus, 1990; Newman et al., 2005). Tokens are recognized as easily dispensable and are contingent on behavior meeting specified criteria (DuPaul; Liberman; Tarbox, Ghezzi, & Wilson, 2006). The portability and ease of token delivery enables desirable behaviors to be immediately reinforced (Miltenberger, 1997).

The token economy has been recognized as an effective and powerful intervention with the potential for immediacy in behavior change (de Moor, Didden, & Tolboom, 2005; Higgins, Williams, & McLaughlin, 2001). The reinforcement based intervention is highly structured, thus, increasing the potential that desirable behaviors are reinforced more consistently (Miltenberger, 1997; Sisson & Dixon, 1986; Tarbox et al., 2006). Researchers have emphasized the convenience of the protocol among generalized populations and settings, resulting in increased attractiveness of the intervention (Alberto & Troutman, 1999; Higgins et al.; Kazdin & Geesey, 1980). The following table identifies studies conducted using token economies with children.
Table 10  

**Summary of Token Economy Studies**

<table>
<thead>
<tr>
<th>Study</th>
<th>Subjects</th>
<th>Setting</th>
<th>Behavior</th>
<th>Consequences</th>
<th>Alternative protocols</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carton &amp; Schweitzer (1996)</td>
<td>Ten male hemodialysis patients</td>
<td>Clinic</td>
<td>Noncompliant behavior</td>
<td>Tokens (baseball cards, comic books, small toys)</td>
<td>---</td>
</tr>
<tr>
<td>Charlop-Christy &amp; Haymes (1998)</td>
<td>Three children with autism; aged 9.2, 9, 7.9 years</td>
<td>After school behavior management program</td>
<td>Correct task responses and inappropriate behaviors</td>
<td>Objects of obsession used as tokens</td>
<td>Typical tokens</td>
</tr>
<tr>
<td>de Moor et al. (2005)</td>
<td>4, 5, and 6-year-old girls with severe feeding problems</td>
<td>Therapy room of rehabilitation center</td>
<td>Percentage of food accepted and eating pace</td>
<td>Tokens (sticker, eurocents)</td>
<td>Non-verbal instruction and intermittent contingent attention</td>
</tr>
<tr>
<td>Study</td>
<td>Subjects</td>
<td>Setting</td>
<td>Behavior</td>
<td>Consequences</td>
<td>Alternative protocols</td>
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<tr>
<td>Higgins et al. (2001)</td>
<td>3rd grade student with learning</td>
<td>Integrated elementary</td>
<td>Out of seat, talking out, and poor posture</td>
<td>Check marks</td>
<td>---</td>
</tr>
<tr>
<td>Kazdin &amp; Geesey (1980)</td>
<td>Two students (ages 6 and 7) with mental retardation</td>
<td>Special education classroom</td>
<td>Attentive behavior</td>
<td>Tokens (free time, special recess, toy from treasure, toy from treasure chest, highly preferred toy)</td>
<td>Preselection of back-up reinforcers</td>
</tr>
<tr>
<td>Mottram &amp; Berger-Gross (2004)</td>
<td>Three participants with brain injuries; ages 8.3, 6.7, and 14.1 years</td>
<td>After school program at rehabilitation hospital</td>
<td>Disruptive behaviors</td>
<td>Tokens (mystery motivator)</td>
<td>Response cost</td>
</tr>
<tr>
<td>Study</td>
<td>Subjects</td>
<td>Setting</td>
<td>Behavior</td>
<td>Consequences</td>
<td>Alternative protocols</td>
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<tr>
<td>Musser, Bray, Kehle, &amp; Jenson (2001)</td>
<td>Three school-aged students with social and emotional disorders (ages 8, 9, 10)</td>
<td>Special education services in self-contained room</td>
<td>Disruptive behavior</td>
<td>Tokens (mystery motivator)</td>
<td>Precision requests, response cost, and antecedent strategies</td>
</tr>
<tr>
<td>Sisson &amp; Dixon (1986)</td>
<td>Four children with mental retardation ranging in age from 4 to 15 years</td>
<td>Children’s psychiatric treatment program</td>
<td>Mealtime behaviors (utensil use, napkin use, chewing with mouth closed, good posture)</td>
<td>Tokens (hot chocolate, chocolate milk, tea, juice, soda)</td>
<td>Training sessions</td>
</tr>
<tr>
<td>Study</td>
<td>Subjects</td>
<td>Setting</td>
<td>Behavior</td>
<td>Consequences</td>
<td>Alternative protocols</td>
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<tr>
<td>Tarbox et al. (2006)</td>
<td>5-year-old boy with autism</td>
<td>Day treatment center for children with developmental disabilities</td>
<td>Attending behavior</td>
<td>Tokens (break)</td>
<td>Schedule thinning, no back-up reinforcement, delay to reinforcement</td>
</tr>
</tbody>
</table>
Charlop-Christy and Haymes (1998) explored the idea that using objects of obsession (e.g., alphabet letters, picture of a train) as tokens may serve as primary reinforcement for children with autism. The results found that providing meaningful tokens induced better performance among all children in the study. Further, perseverative behaviors such as self-stimulation and echolalia were experimentally manipulated although access to obsessions (e.g., alphabet letters) continued to be associated with the highest percentage correct on-task behavior. The study concluded that obsessive behaviors appear to be highly potent reinforcers, particularly when working among children with autism spectrum disorders (Charlop-Christy & Haymes).

Using objects of obsession as reinforcers is directly related to the Premack Principle (Cooper et al., 1987). The Premack Principle states that access to high frequency behavior (e.g., playing with objects of obsession) is contingent on the occurrence of low frequency behavior such as completing work tasks (Cooper et al.). Charlop-Christy and Haymes (1998) provided objects of obsession as visual supports to children with autism, allowing children to have a concrete understanding of Premack Principle expectations (e.g., first work, then play with letters).

In a study conducted by Carton and Schweitzer (1996), researchers used a token economy to reduce noncompliant behavior in a ten-year-old boy undergoing hemodialysis. Results signified that the token economy had a considerable effect on reduction of behaviors. The subject was reported to enjoy the token system and
frequently expressed a desire to obtain as many tokens as possible (Carton & Schweitzer).

*Back-up reinforcers.* The success of token economies is attributed to tokens sustaining performance over time until the delayed or back-up reinforcer is provided (Alberto & Troutman, 1999; Tarbox et al., 2006). Kazdin and Geesey (1980) discussed the efficacy of token economies in improving attentive behavior while exploring variations in intervention delivery among two male subjects with mental retardation. The results found that allowing children to preselect their back-up reinforcer prior to earning tokens was more salient than allowing children to choose back-up reinforcers after receiving tokens. The authors hypothesized that preselecting back-up reinforcers may serve as a prompting function during the intervention; therefore, accelerating behavioral performance (Kazdin & Geesey).

Three different studies examined the use of mystery motivators (e.g., a sealed envelope with a question mark written on it containing a prize) as back-up reinforcers during token economy interventions (Mottram & Berger-Gross, 2004; Musser et al., 2001; Rhode, Jenson, & Reavis, 1992). Musser et al. employed a multicomponent intervention among three school-aged students with social and emotional disorders. Findings suggest that the intervention was successful in reducing levels of disruptive behavior for all students, although the combination of behavioral protocols complicates the determination of which component influenced the positive results. Mottram and Berger-Gross implemented a similar treatment package among three male patients with
disruptive behaviors at a rehabilitation hospital. The study reinforced the utility of mystery motivators as back-up reinforcers during token economy protocols.

**Blending Reinforcement Based Procedures**

The versatility of Differential Reinforcement of Other Behavior (DRO) protocols and token economies signify their strength (Kazdin & Geesey, 1980; Lazarus, 1990), as the protocols may be modified as individual programs or used in conjunction with other procedures to collectively design a treatment package (DuPaul, 1991; Kazdin & Geesey; Musser et al., 2001). Research findings lend support for a blended model of behavioral protocols when working among children with disabilities (Carlson, Mann, & Alexander, 2000; DuPaul). Including DRO in a treatment package with other behavior procedures often results in more efficient behavior change (Cooper, Heron, & Heward, 2007). Further research is warranted to determine which treatment package is most effective for implementation with children.

**Future research.** Experimental research with behavioral strategies has been minimally published among the early childhood population, suggesting that research needs to be extended to verify and refine behavioral procedures. Research should be conducted in realistic settings to ensure feasibility for minimal levels of staffing (Sisson & Dixon, 1986). Designing economical and simplistic treatment interventions would enhance protocol access for practitioners with diverse educational backgrounds (Mottram et al., 2004; Musser et al., 2001).

Behavioral strategies such as DRO and token economies share procedural characteristics and produce similar outcomes (Mottram et al., 2004). Research should be
conducted to support the behavioral needs of children with disabilities such as autism. When implementing behavior protocols, the multiple baseline design may be used to validate intervention effectiveness. The following portion will present information about the use of the multiple baseline design when seeking to establish experimental effects during behavioral treatment.

**Multiple Baseline Design**

In the multiple baseline design, the effects of interventions on particular behaviors, subjects, and settings are explored through different baseline phases (Cooper et al., 1987; Kazdin, 1982; Kubina, 2004). For example, when looking specifically at behaviors, three target behaviors of a single participant are usually measured (Horner et al., 2005). Stability of the initial behavior during baseline phase predicts that continuation of the baseline phase will result in constant behavior levels (Cooper et al.). In other words, one would expect the behavior to remain the same without intervention.

Upon introduction of the intervention for the first behavior, other targeted behaviors remain in the baseline phase. A functional relationship is said to exist once the first behavior changes after intervention and other behaviors remain the same (Kazdin, 1982; Leitenberg, 1973). Application of the intervention to the second behavior should produce similar results; affirming the initial success of the intervention (Kazdin; Kendall, 1981). During application of the intervention for behaviors one and two, the remaining target behavior remains untouched in the baseline phase. After demonstrating that behavior change occurs after intervention application for behaviors one and two, the third behavior is then exposed to the intervention (e.g., independent variable).
The multiple baseline design attempts to show that behavior changes only upon introduction of the independent variable (Baer, Wolf, & Risley, 1968; Cooper et al., 1987; Kazdin, 1982; Kubina, 2004). Multiple baseline designs first begin with implementation of an intervention on one behavior prior to extending treatment to other behaviors; providing preliminary information about the efficacy of the treatment protocol (Kazdin).

**Advantages of the multiple baseline design.** An advantage to the multiple baseline design is that repeated alteration in behavior upon treatment application provides assurance that the intervention was indeed responsible for the change (Kazdin, 1982; Kubina, 2004). The multiple baseline design does not require removal of the intervention to establish experimental effects (Alberto & Troutman, 1999; Cooper et al., 1987; Kazdin; Kubina). Ethical considerations among self-injurious and aggressive behaviors highlight this feature of the multiple baseline design (Kazdin) as it would be unethical to withdraw successful treatments.

The applicability of multiple baseline designs in practical settings offers enhanced appeal to practitioners seeking to assist multiple students with multiple skills in multiple settings (Cooper et al., 1987; Kazdin, 1982; Kubina, 2004). Further, the integration of two or more behaviors, subjects, or settings into one design allows for the assessment of generalization (Cooper et al.). Multiple baseline designs are regarded as relatively easy for conceptualization, resulting in increased acceptance from staff typically resistant to behavioral intervention methodology (Cooper et al.; Kazdin).
Conclusion

The multiple baseline design provides a feasible mechanism for evaluating the effectiveness of the treatment package, a whole interval DRO procedure with an embedded token economy. Within chapter three, methods are discussed for use when seeking to reduce challenging behaviors among children with autism. Intricacies of the study are specified to allow for future replications of the protocol.
CHAPTER THREE

Methods

As previously discussed, research is identifying an increase in autism spectrum disorder prevalence (Blaxill, 2004; Matson & Minshawi, 2006); suggesting that higher rates of children with autism are attending public and private facilities. Extended research is necessary for special education classrooms supporting children with autism (Reed et al., 2007). Positive Behavior Supports (PBS) desire the usage of reinforcement based procedures when instituting interventions in school facilities (OSEP Center on Positive Behavioral Interventions and Supports et al., 2000). Both DRO and token economies are reinforcement based protocols that hold promise when seeking to reduce challenging behaviors among children with autism (Cooper et al., 1987). Further, the emphasis on Response to Intervention (RtI) among school age children necessitates that research based interventions be utilized to diminish the occurrence of challenging behaviors (Coleman et al., 2006).

The literature review presented evidence supporting the use of a treatment package containing both DRO and token economy. Differential Reinforcement of Other Behaviors (DRO) and token economy interventions are distinguished as evidence-based, resulting from guidelines specifying replication for a minimum of five studies across three different researchers and locations to include a total of at least twenty participants (Horner et al., 2005). As a result of scientific, evidence-based studies reported in the literature review, the following research questions may be explored:
1. Does a whole interval Differential Reinforcement of Other Behaviors (DRO) protocol with an embedded token economy reduce target behaviors among school age children with autism to include vocalizations, scratching surfaces, hair touching to self, breathing behavior, and perseverative hand movements?

2. Are back-up tokens on a three to one ratio potent enough to maintain low rates of challenging behaviors until the desired reinforcer is distributed to subjects if effective preference assessments and analyses have been conducted?

3. Do the effects of the DRO with an embedded token economy maintain after removal of the intervention?

The purpose of the study was to investigate the relationship between a DRO and token economy treatment package and the rate of target behaviors for school age children with autism. It was hypothesized that school aged children with autism receiving the DRO and token economy treatment package would have reduced target behaviors after onset of the intervention.

Setting

To begin, two students with an autism diagnosis were identified from a sample of students in a multiple disabilities public school classroom. The school is located in an upper socioeconomic community in northeast Ohio. Services are delivered in an intensive one-on-one format by the intervention specialist and three educational assistants. Four students between kindergarten and third grade are housed in the classroom. The multiple disabilities classroom provides services five full days per week to students with a variety of individualized needs. The educational environment primarily utilizes Applied

The increase in autism prevalence over time has prompted an evolution in treatment programs specific to behavioral, developmental, and cognitive needs of children with autism (Corsello, 2005). While many children receive an eclectic combination of treatment modalities, most are implemented with the intent of improving their overall functioning (Gresham & MacMillan, 1998; Sheinkopf & Siegel, 1998). Researchers have explored Applied Behavior Analysis and TEACCH and have found commonalties between both programs, communicating the efficacy of a multi-methodological approach (Dawson & Osterling, 1997; Jennett, Harris, & Mesibov, 2003; Ozonoff & Cathcart, 1998; Smith, 1999).

Participant Criteria

After obtaining approval from Kent State University’s Institutional Review Board (IRB), participants were identified according to the following criteria; (a) a professional diagnosis of autism based upon a version of the Diagnostic and Statistical Manual of Mental Disorders (American Psychological Association, 2000), (b) current attendance in the multiple disabilities classroom, (c) a current age between eight and nine, (d) and who exhibit target behaviors that disrupt or halt the learning process for themselves or others in the classroom environment. After identifying two participants that met criteria for the study, consent forms were sent to parents of the children invited for participation in the DRO with an embedded token economy protocol. The consent allowed for video
recording of the participants for purposes of interobserver agreement, treatment integrity, and a private blog site. Phone contact with parents was attempted to further explain the intent of the study and to enhance clarity of the protocol. Additionally, written consent was distributed to classroom staff to ensure their willingness to partake in the intervention. The study stringently abided by the rules and regulations established by the IRB at Kent State University. All information was kept confidential. Parents and classroom staff had the right to cease the intervention at any time during the study.

Design

Independent Variables

A multiple baseline design across behaviors was utilized while investigating the efficacy of the DRO with an embedded token economy in one-on-one settings. The treatment package sought to reduce challenging behaviors among children with autism to maximize participation in the special education classroom and inclusion settings. Table 11 summarizes the substantive components of the whole interval DRO with an embedded token economy protocol.

Dependent Variables

After obtaining consent from parents of participants and from classroom staff, the dependent variables were defined and measured. To ensure rigorous application of single subject methodology, the dependent variables were operationally defined to enhance assessment validity (Horner et al., 2005). The dependent variables (e.g., target behaviors) are explained in Table 12 to enhance clarity for purposes of data collection.
Table 11

**Intervention Components**

<table>
<thead>
<tr>
<th>Design</th>
<th>Participants</th>
<th>Setting</th>
<th>Token economy</th>
<th>DRO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple baseline design</td>
<td>Eight-year-old female with autism, nine-year-old male with autism</td>
<td>Public school multiple disabilities classroom, table tasks area</td>
<td>Tokens exchanged on a three to one ratio for backup reinforcers. IRT determined</td>
<td>Whole interval reset, weekly from averaging data from past week</td>
</tr>
</tbody>
</table>

Introduction of the independent variable at different points in time (Horner et al., 2005)

Table 12

**Dependent Variables**

<table>
<thead>
<tr>
<th>Participant one</th>
<th>Participant two</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocalizations to include throat, screaming, whining, and guttural sounds. Each time a sound is made, this accounts as one occurrence. When there is a brief pause</td>
<td>Perseverative hand movements occur each time her hand moves up in front of her body (e.g., from stomach to head range) and is accompanied with up and down, side</td>
</tr>
</tbody>
</table>
(breath) and the sound resumes, this would be considered as a second occurrence and so on. If the vocalization is prolonged to include numerous sounds strung together or one single sound, then a tally is made for one occurrence, a count of thousand one, thousand two, thousand three, a second tally is made, a count of thousand one, and so on. Attempts at initial consonant sound imitation and humming are excluded for this category.

<table>
<thead>
<tr>
<th>Participant one</th>
<th>Participant two</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hair touching to self is tallied each time fingers touch hair (even for a brief moment), this would be considered one occurrence of hair touching behavior. If the fingers linger in hair, then a tally is made for one occurrence, a count of thousand one, thousand two, thousand three, a second tally is made, a count of thousand one, and so on. However, when the hand is side, cupped, or whole hand movement.</td>
<td>Scratching is tallied as one occurrence when the subject sweeps her fingers across a surface (e.g., table or toy) with whole hand movement. Scratching is further defined as the hand being open with palm facing upwards. Each time the fingers sweep across a surface with the palm facing upwards, hand is lifted and then returns to the surface, this is considered as one occurrence of hand movement. When the hand is placed down or when she places the hand down to be raised again with hand or finger movement, this would be considered a second occurrence. If the hand movement is prolonged, then a tally is made for one occurrence, a count of thousand one, thousand two, thousand three, a second tally is made, a count of thousand one, and so on.</td>
</tr>
</tbody>
</table>
Participant one | Participant two
--- | ---
removed from the hair and then returns, | one occurrence of scratching behavior.
this would be considered as a second occurrence. |  
Breathing behavior may be tallied each | Vocalizations include throat, whistling, and
time the subject blows from mouth up into guttural sounds. Each time a sound is
nose and breathing into a cupped hand. made, this accounts as one occurrence.
Each time the subject takes a breath while When there is a brief pause (breath) and the
cupping hand or breathes from mouth up sound resumes, this would be considered as
into nose, and then exhales, this would be a second occurrence and so on. Does not
considered as one occurrence of breathing pertain to screaming or loud breathing
behavior. The next breath in and exhalation behavior. If the vocalization is prolonged,
would be considered as a second then a tally is made for one occurrence, a
occurrence. count of thousand one, thousand two,
 | thousand three, a second tally is made, a
 | count of thousand one, and so on.

Procedures

Assessing Social Validity

After operationally defining target behaviors, classroom staff and participants’ parents were given a social validity measure to investigate the social importance and acceptability of the dependent variable, procedures, and outcomes at the onset and upon
closure of the study (Armstrong, Ehrhardt, Cool, & Poling, 1997; Foster & Mash, 1999; Hickey & Rondeau, 2005). The goals of the behavioral treatment and the quantity of behavior change were considered in the process (Elliott, 1988; Foster & Mash). Research suggests that pretreatment acceptability directly influences the integrity of behavioral interventions for children with disabilities (Cross Calvert & Johnston, 1990; Elliott; Gresham, 2005; Sterling-Turner & Watson, 2002). See Appendix A for the complete social validity questionnaire used in the protocol.

Functional Behavior Assessments

Prior to implementing the DRO with an embedded token economy study, classroom staff and research assistants utilized the online version of the Motivation Assessment Scale (MAS) to verify the function of target behaviors for both participants (Durand & Crimmins, n.d.). The MAS presents sixteen questions that seek to establish whether the behavior is sensory, escape, attention, or tangible (Durand & Crimmins). After completing the MAS, classroom staff set up situations to analyze and validate assessment results for each participant. The timeline sequence for the study is presented in Table 13.
Table 13

*Study Timeline*

<table>
<thead>
<tr>
<th>Event</th>
<th>Principal investigator and research assistant</th>
<th>Classroom staff</th>
<th>Parents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional Review Board approval</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introductory explanation of protocol to parents and staff</td>
<td>Consent form</td>
<td>Consent form</td>
<td></td>
</tr>
<tr>
<td>Preference assessment, social validity questionnaire</td>
<td>Preference assessment, social validity questionnaire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff training</td>
<td>Attendance at training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Functional Behavior</td>
<td>Functional Behavior</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessment and Analysis</td>
<td>Assessment and Analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly reevaluation of preference assessment</td>
<td>Monthly reevaluation of preference assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interobserver agreement</td>
<td>Video recording during baseline and intervention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>completion on a basic rotation schedule from video review; treatment integrity checklist</td>
<td>phases, in vivo data</td>
<td>collection</td>
<td></td>
</tr>
<tr>
<td>completed through video review on an opposing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principal investigator and research assistant</td>
<td>Classroom staff</td>
<td>Parents</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>----------------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>rotation schedule from that of IOA after onset of the intervention.</td>
<td>Performance Feedback on weekly basis for integrity throughout entirety of intervention</td>
<td>Performance Feedback on weekly basis for integrity throughout entirety of intervention</td>
<td></td>
</tr>
<tr>
<td>Maintenance data and video review until conclusion of academic school year (May 2008)</td>
<td>Social validity form</td>
<td>Social validity form</td>
<td></td>
</tr>
</tbody>
</table>

**Functional Analyses**

After completing the MAS, functional analyses were conducted to further clarify behavior functions for both participants. To begin, twelve table task sessions were video recorded during mornings and afternoons over the course of two weeks. All sessions were video recorded at the table tasks area to maintain setting consistency. Four experimental conditions were alternated throughout the analyses. The sequence of conditions varied across each of the twelve sessions and was determined by randomly pulling conditions.
from a jar. The conditions included free play, contingent escape, contingent tangible, and contingent attention. Conditions are described in the following paragraphs.

*Free play.* The free play condition began with the research assistant sitting across from the participant at the table. During the condition, participants were allowed to play with preferred toys for a five-minute duration of time. The research assistant simultaneously played with toys while sitting in close proximity to participants. The research assistant made remarks to each participant about the toys, but no demands were placed at this time. If a target behavior was displayed during the free play condition, the research assistant ignored the behavior and continued to play next to the participant. The free play condition was intended to serve as a control in comparison to the remaining functional analysis conditions.

*Contingent escape.* For this condition, participants sat at the table for five minutes while being asked to complete a challenging task. The task presented was the Edmark reading program with functional sight words that were novel to each participant. The research assistant gave firm prompts for the participant to identify sight words from a choice of three. If the participant displayed a target behavior during this task, the activity was immediately removed and the verbiage, “You’re telling me you don’t want to work right now. You don’t have to work if you don’t want to” was stated. Once the target behavior had ceased for a three second duration of time, the task was again presented and a new prompt was given. The contingent escape condition was intended to evaluate whether participants engaged in target behaviors to escape work tasks.
Contingent attention. In this condition, each participant was presented with an array of their favorite toys (e.g., beads, water toy, squish balls, noodles). While participants played with toys, the research assistant sat at the table with her body faced away from participants. The research assistant spent the time writing in student communication notebooks or reading a book. If the participant displayed a target behavior, the research assistant would turn towards the participant and would state what the behavior was paired with a replacement suggestion (e.g., “Oh, I heard you make a noise. Stay quiet when you play.”) The research assistant would continue to interact with the participant if a target behavior was being displayed. Once the participant ceased the behavior, the research assistant would resume writing in the communication notebook or reading a book. The contingent attention condition was implemented to determine if participants engaged in a target behavior to receive adult attention.

Contingent tangible. During the five minute condition at table tasks, the participant was given a non-preferred object (e.g., piece of paper) while the research assistant played with the participant’s favorite toys (e.g., squish ball, noodles, water toy). When a target behavior was displayed by the participant, the research assistant would give the desired toy to them. Once the target behavior had ceased for a three second duration of time, the toy was removed from the participant and the piece of paper was again presented. The research assistant would continue to play with the preferred toy until the participant displayed a target behavior. The contingent tangible condition was intended to test whether participants engaged in the target behavior to gain access to preferred toys and activities.
Data

Data for graphing. After completing the initial social validity questionnaire, functional behavior assessment, and the functional analyses, classroom staff was trained by the principal investigator on the data collection sheet for use throughout the study (see Appendixes C and D). Baseline began with in vivo data collection for a ten-minute duration among all behaviors at the table task setting. For example, classroom staff tallied all occurrences of vocalizations, hair touching, and breathing behavior for participant one during a ten-minute duration. A timer was set and the interval began when the participant and staff member sat at the work table. While staff collected data in vivo, video recording occurred simultaneously for purposes of interobserver agreement (IOA) and treatment integrity. Video review data collected by the principal investigator was used for graphing behavior frequency throughout the study.

Interobserver agreement (IOA). When conducting single subject research, the dependent variable should be continuously monitored for IOA to ensure consistency throughout the study (Horner et al., 2005). Cooper et al. (1987) recommend reporting IOA for a minimum of twenty percent of the observation sessions. Interobserver agreement refers to the extent that two or more observers report the same number of behavior occurrences after measuring the same video sample (Cooper et al., 2007). The usual practice in behavioral research is to obtain a mean of no less than 80% agreement when assessing observational recording (Cooper et al., 2007). The closer agreement levels are to 100%, the more trustworthy the data.
Two trained staff members independently reviewed the video to determine simple agreement (e.g.: small number of occurrences ÷ large number of occurrences × 100 = %) throughout baseline, intervention, and maintenance phases. Practitioners paired the word “go” with a timer to begin the observation interval. Once the timer was exhausted (e.g., auditory beeping), the observation period was concluded. The timer system produced strict accuracy to the ten-minute observation interval.

Video recordings were reviewed on a basic rotation schedule (e.g., Monday, Wednesday, Friday, Tuesday, and so on) to signify various days of the treatment protocol. The private blog site was utilized for IOA at this time. The principal investigator posted ten-minute video recordings from both participants so that the research assistant had access to the video from home. Through this technological modality, the complexity of travel distance was minimized so that video was more feasibly reviewed. Frequency data for graphical display derived from data gathered from the principal investigator’s video review.

Data to implement intervention. To enhance practitioner feasibility while striving to maintain a rigorous intervention, in vivo data for Monday through Friday was accumulated upon introduction of the treatment package. The principal investigator calculated interresponse time (IRT) for the DRO by averaging data from the entire week. If, for example, the public school facility only was in session Tuesday through Friday, IRT only integrated data from the four days to be used for the upcoming week. Reese et al. (1998) discussed the difficulty with DRO implementation because the protocol is time consuming and cumbersome. The intent of the study was to establish a protocol feasible
for use by practitioners in school settings. Employing a model that evaluates data on a week by week basis may have more selling power (e.g., be more likely to be implemented) when attempting to convince potential users. It is important to clarify that in vivo data was used only for the purpose of obtaining the IRT for which the timer interval was set.

Data to compare for school feasibility. As previously mentioned, data for each participant was assessed every other day for IOA between the principal investigator and research assistant. Data was used for the purpose of simple agreement. Further, to assess the practical application of in vivo data collection, frequency of target behaviors were compared on an everyday basis between the principal investigator’s video review data and in vivo data from classroom staff. Table 14 further clarifies the data collection schedule.

Table 14

Data Collection Schedule

<table>
<thead>
<tr>
<th>What?</th>
<th>In vivo data</th>
<th>IOA data</th>
<th>Comparison of in vivo to IOA data</th>
<th>Treatment integrity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who?</td>
<td>Classroom staff</td>
<td>Principal investigator and research assistant</td>
<td>Principal investigator</td>
<td>Principal investigator</td>
</tr>
<tr>
<td>When?</td>
<td>Daily</td>
<td>An every other</td>
<td>Daily</td>
<td>An every other</td>
</tr>
<tr>
<td>What?</td>
<td>In vivo data</td>
<td>IOA data</td>
<td>Comparison of in vivo to IOA data</td>
<td>Treatment integrity</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------</td>
<td>----------</td>
<td>-----------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>day basic</td>
<td></td>
<td></td>
<td>day basic</td>
<td>rotation schedule</td>
</tr>
<tr>
<td>rotation</td>
<td></td>
<td></td>
<td>rotation schedule</td>
<td>on opposing days to IOA</td>
</tr>
<tr>
<td>schedule (e.g., Monday, Wednesday, Friday, Tuesday)</td>
<td></td>
<td></td>
<td>(e.g., Tuesday, Thursday, Monday)</td>
<td></td>
</tr>
<tr>
<td>Why?</td>
<td>To average</td>
<td>To assess the dependent variable for consistency throughout the study</td>
<td>To monitor and validate the feasibility of the DRO with an embedded token economy throughout the study</td>
<td>To document implementation of the independent variable for use in school settings</td>
</tr>
<tr>
<td>weekly in vivo data to obtain IRT for interval reset</td>
<td>To average</td>
<td>To assess the dependent variable for consistency throughout the study</td>
<td>To monitor and validate the feasibility of the DRO with an embedded token economy throughout the study</td>
<td>To document implementation of the independent variable for use in school settings</td>
</tr>
</tbody>
</table>
**Stability**

The primary target of the intervention was to obtain near zero rates of challenging behaviors (e.g., vocalizations, hair touching) in the table tasks setting. After obtaining stability among behavior one during the baseline phase, the most recent week’s in vivo data for behavior one was averaged for IRT. At this time, the first behavior for each participant was exposed to the whole interval DRO with an embedded token economy. A visual timer (e.g., a timer with a red sliver exposed to represent the length of time remaining in the interval) was utilized throughout the intervention to enhance comprehension of the protocol for both participants. A standard analog clock was thought by the principal investigator to be lacking in concreteness for the specific individuals in the study. The visual timer provided clarity for the participants (e.g., when the red sliver finished, participants learned to expect a token at that moment) while establishing a simple mechanical process for both the participants and practitioners.

After establishing stability on the initial behavior, the next behavior was exposed to the intervention, and then the remaining behavior was exposed to the intervention. When behaviors one and two were exposed to the intervention, IRT was determined by averaging in vivo data for behaviors one and two. Similarly, when all behaviors were being exposed to the intervention, IRT was determined by averaging in vivo data for all behaviors. After obtaining stability among all three behaviors with the last behavior being stable for a minimum of three data points, the intervention was then removed. Maintenance of the intervention was explored through in vivo data and video recording for a three-week duration of time.
Maintenance

After removal of the intervention, the average response rates for each behavior were calculated. If, throughout the maintenance phase, the rate of any targeted behavior had exceeded twenty percent above the mean for two consecutive days, the intervention would immediately be reinstated across all behaviors in the one-on-one setting. The rationale for this clause was to resume therapeutic effect for targeted behaviors.

Preference Assessment

Prior to introduction of the protocol, classroom staff and participants’ parents were asked to recommend preferences for both children. Classroom staff exposed participants to the suggested preferences to fully determine the poignancy of reinforcers. Suggested preferences were reevaluated at the beginning of each month by staff and parents to minimize satiation and to ensure reinforcer potency.

Token Board

During the intervention phase, participants were presented with a token board at the beginning of table tasks. Staff verbally and visually (e.g., sign language, tokens) communicated the behavioral expectation to the child. At this time, the participant was asked to preselect a backup reinforcer from a choice of two. Reinforcers were held by the staff member. After the participant chose their reinforcer by pointing, staff provided scripted verbiage such as, “First work, then hug. Remember, stay quiet to earn hug today.” Staff used tokens representing the desired reinforcer; however, if an activity or object was highly desired and a token was not available to represent the activity or object, a star token was then used to represent the highly motivating reinforcer. Tokens
representing the desired reinforcer were used to enhance concrete understanding of the protocol (e.g., if the participant earns a token that depicts “hug”, the participant better understands that they are working for a hug).

Timer

The timer was set to the appropriate IRT and was displayed within close proximity (e.g., within one foot) to the participant. Staff ensured that participants did not have the opportunity to tamper with the timer. The timer was for use by staff only. To further enhance experimental control, intermittent praise was distributed to participants contingent on their positive behavior throughout the intervention.

Reinforcement Delivery

A token representing the desired reinforcer was gained after each occasion the timer exhausted without the occurrence of the target behavior(s). The timer setting varied dependent on the IRT. Reinforcers were delivered after three tokens had been earned by the participant. Immediately after obtaining three tokens, the participant was provided with defined praise such as, “That was good quiet! You earned a hug!” accompanied by the reinforcer. The participant had access to the reinforcer for a maximum of one minute. At this juncture, staff cleared the token board, had the student choose their desired reinforcer from a choice of two, reset the timer, and used scripted verbiage to explain, “First work, then more hugs. Remember, voice stays quiet.” If, however, the work setting was concluding and the participant had not yet earned all three tokens, then staff explained to the participant that three icons were needed to earn the reinforcer. No
reinforcer was given at the time and the participant was given the request to transition to a new work setting.

*Interval Reset*

As implied in the whole interval DRO title, participants were expected to refrain from any instance of target behaviors throughout the entire duration of the IRT. If, during the intervention, the participant chose to engage in a target behavior, the timer interval was immediately reset by the staff member. The token board was presented to the participant and scripted verbiage was again stated in support of the behavioral goal. For example, if the participant began to make vocalizations, the timer was reset with verbiage offered such as, “When you make noise, I start the timer again. Remember, stay quiet to earn hugs.” The principal investigator sought to induce the opportunity for reinforcement by resetting the timer. Further, resetting the timer provided participants with immediate feedback about their behavior.

*Turning the timer.* If the participant continuously emitted the target behavior at a rate of two occurrences within five seconds, staff turned the timer, facing it away from the participant, to communicate that the intervention had been halted. Further, this was done to minimize the impact of interval reset as an attention seeking mechanism for the participant. The intervention resumed after the participant demonstrated zero rates of the target behavior after a five second duration of time (e.g., five seconds exhausted without any target behavior and the timer was then reset).
Treatment Integrity

The primary intent of evaluating treatment integrity is to determine variables responsible for the treatment outcome (Armstrong et al., 1997). The behavioral literature should systematically define the treatment intervention to allow for future replications of the protocol (Armstrong; Kazdin, 1997). Having this underlying knowledge lends support to monitoring and evaluating treatment integrity throughout the course of behavioral interventions. As a result, treatment integrity was monitored on a basic rotation schedule after onset of the intervention through review of video records (see Appendix B). Performance feedback to staff revolved around maintaining and refining integrity. In addition, all classroom staff, including the principal investigator, reviewed video together once per week.

Visual Analysis

The data obtained from the principal investigator’s daily video review was entered into an Excel spreadsheet. Graphs were derived from the entered data and were analyzed through visual means. Baseline data was gathered on both participants across behaviors until stability for the first behavior had been acquired. Observing a consistent pattern of behavioral responding in baseline phase allows for predictions to be made in regards to future responding (Horner et al., 2005). The treatment package sought to strengthen external validity through replicating intervention effects across different participants and different behaviors.
Conclusion

The previous paragraphs specified components of the treatment package, a whole interval DRO with an embedded token economy. In the procedure, tokens are exchanged on a three to one ratio for back-up reinforcers, scripted instruction, and praise. Both DRO and token economies are reinforcement based protocols that hold promise when seeking to extinguish target behaviors among children with autism. The design of the intervention package could offer classroom practitioners a user-friendly option when seeking reinforcement based procedures as the initial modality for treatment.
CHAPTER FOUR

Results

Chapter four provides results for (a) functional behavior assessments, (b) functional analyses, (c) social validity measures, (d) treatment integrity, and (e) interobserver agreement in relationship to the DRO protocol with an embedded token economy. Visual analyses of data for both participants are presented and considerations are discussed.

Functional Behavior Assessments

Prior to implementation of the intervention, the online version of the Motivation Assessment Scale (MAS; Durand & Crimmins, n.d.) was completed for both participants. Classroom staff collectively answered questions to complete the process in a representative manner. The results for participant one signified that vocalizations were motivated by both escape and sensory reasons while hair touching and breathing were also motivated by sensory reasons. For participant two, MAS results confirmed that vocalizations were primarily sensory seeking in function although scores also suggested that the behavior contained tangible and escape components. For participant two, perseverative hand movements and scratching classroom materials were found to be sensory seeking. The following tables display scores generated from questions on the MAS.
Table 15

**Participant One MAS Scores**

<table>
<thead>
<tr>
<th></th>
<th>Sensory</th>
<th>Escape</th>
<th>Attention</th>
<th>Tangible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocalizations</td>
<td>14</td>
<td>17</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Hair Touching</td>
<td>19</td>
<td>15</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>Breathing</td>
<td>14</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 16

**Participant Two MAS Scores**

<table>
<thead>
<tr>
<th></th>
<th>Sensory</th>
<th>Escape</th>
<th>Attention</th>
<th>Tangible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocalizations</td>
<td>17</td>
<td>13</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Perseverative Hand</td>
<td>23</td>
<td>11</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>Scratching</td>
<td>15</td>
<td>11</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

**Functional Analyses**

While the MAS provided preliminary results on behavior functions, functional analyses supplied a thorough and comprehensive explanation of target behaviors for both participants. As previously mentioned in chapter three, participants were exposed to four conditions. The following paragraphs and figures illustrate the function of each behavior for individual participants.

**Participant one.** A functional analysis was conducted to evaluate vocalizations, hair touching, and breathing behaviors demonstrated by participant one. Conditions
revealed that vocalizations occurred most frequently during free play with a mean rate of 5.87, although the results were not significant in comparison to competing functional analysis conditions. Hair touching was found to be escape in function with a mean rate of 2.9 while breathing behaviors were most prevalent in the free play condition. Figures one, two, and three depict functional analysis results for participant one.

*Figure 1:* Rate of vocalizations for participant one across all conditions.
**Figure 2:** Rate of hair touching behavior for participant one across all conditions.

**Figure 3:** Rate of breathing behavior for participant one across all conditions.
Participant two. For participant two, results verified that the function of vocalization behaviors was attention with the mean rate of behavior being 5.27. Vocalization results are complex, however, as the rate was not found to be important in comparison to other functional analysis conditions. Figure four displays vocalization variability across conditions for participant two.

Perseverative hand movements were motivated by escape with a mean behavior rate of 3.8. Scratching classroom materials was found to be tangible in function with a rate of 1.72. Although scratching behaviors were thought to occur most frequently in the tangible condition, the behavior did not occur to obtain tangible objects. Rather, the participant scratched items at a high rate after gaining access to them; indicating limitations in this component of the functional analyses. The results of the functional analyses for participant two are presented in Figures four through six.
Figure 4: Rate of vocalizations for participant two across all conditions.

Figure 5: Rate of perseverative hand movements for participant two across all conditions.
Figure 6: Rate of scratching classroom materials for participant two across all conditions.

Social Validity Results

Mean ratings for each item on the Behavior Intervention Rating Scale (BIRS; Elliott & Treuting, 1991) were evaluated for participants one and two. Measures for each participant were independently completed by three classroom staff members and one parent. After obtaining individual measures, the four ratings were averaged together for intervention onset and closure (see Appendix F). Onset measures for participant one yielded an average of 4.9 out of a possible total score of 6.0 while closure measures similarly averaged 4.9. Onset measures for participant two averaged at 4.6 with closure measures reported at 4.9. Cumulatively, BIRS results for both participants verified that
targeting near zero rates of these behaviors was perceived as socially important to the success of both participants.

*Social importance of behavior change goals.* The dependent variables chosen were selected based on their social significance. Partaking in behaviors such as those exhibited by the participants (e.g., vocalizations, perseverative hand movements) limited their participation in school and community interactions.

*Social acceptance of procedures and results.* Upon completion of social validity measures, results indicated that one of the classroom staff members was neutral to many components of the behavior protocol while the other two staff members and both families agreed with or strongly agreed with intervention features. The BIRS provided evidence that indirect consumers valued behavior change results among both participants.

*Treatment Integrity Results*

Treatment integrity was assessed through video review by the principal investigator for 44% of treatment sessions for participant one and 52% of sessions for participant two. For participant one, treatment integrity results ranged from 84% to 100% and for participant two, treatment integrity results ranged from 86% to 100%. See Appendix B for further information on treatment integrity for both participants. Results suggest that intervention components, not an extraneous variable, were responsible for the reduction of challenging behaviors.
Interobserver Agreement Results

IOA was collected for 64% of baseline sessions for participants one and two. Throughout the intervention phase, IOA was assessed for 84% of the sessions for participant one and 70% of the sessions for participant two. During the maintenance condition, IOA was assessed 66% of the sessions for participant one and 100% of the sessions for participant two. Although a basic rotation schedule was utilized, private blog sites allowed for increased access to video recordings; therefore, increasing the percentage of sessions measured for IOA. Observer drift was minimized by systematically assessing IOA over a significant portion of the study. Operational definitions were frequently monitored for consistency which increased the rigor of the treatment package, resulting in high levels of agreement.

Agreement ranged between 80% and 100% for participant one throughout all phases while agreement for participant two ranged from 67% to 100%. Although 67% agreement may be concerning when evaluating IOA, the low rate of behaviors potentially deflated the percentage of agreement as, during this session, the student exhibited only 3 responses. Appendix G further conveys the results of IOA conducted by the principal investigator and research assistant.

IOA for school feasibility. The study examined whether in vivo data was capable of being precisely measured as practitioners were engaged in instructional practices. Results of in vivo and IOA data were matched to determine the feasibility of implementing a DRO with an embedded token economy treatment package for non-clinical practitioners (see Appendix H).
Feasibility IOA results. Results signify that agreement between in vivo data and the principal investigator’s video review data contained mild discrepancies. During all phases for participant one, vocalization agreement ranged from 67% to 87%. For participant one, hair touching agreement ranged from 80% to 100% and breathing agreement ranged from 84% to 100% during all phases. Video review data produced higher occurrences of behaviors.

During all phases for participant two, vocalization agreement ranged from 75% to 96%. For participant two, perseverative hand movement agreement ranged from 91% to 100% and finger scratching agreement ranged from 75% to 97% during all phases. As expected, one would assume that agreement would be higher through video review as opposed to in vivo data collection. Variables (e.g., turning to gather more instructional materials, being interrupted by classroom visitors) inhibited practitioner’s from observing every behavior during in vivo procedures.

Data to implement intervention. Throughout the intervention, weekly data was averaged for each behavior. The interresponse time (IRT) was then calculated to determine the timer interval for the following week. Averaging data on a weekly basis offers a more practical approach for applied practitioners in search of user-friendly behavioral interventions. The following table delineates the interresponse times obtained weekly for both participants with autism.
Table 17

*Interresponse Times for Participants One and Two*

<table>
<thead>
<tr>
<th>Intervention week</th>
<th>Participant one IRT</th>
<th>Participant two IRT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week one</td>
<td>16 seconds</td>
<td>15 seconds</td>
</tr>
<tr>
<td>Week two</td>
<td>30 seconds</td>
<td>15 seconds</td>
</tr>
<tr>
<td>Week three</td>
<td>45 seconds</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Week four</td>
<td>87 seconds</td>
<td>24 seconds</td>
</tr>
<tr>
<td>Week five</td>
<td>120 seconds</td>
<td>77 seconds</td>
</tr>
<tr>
<td>Week six</td>
<td>77 seconds</td>
<td>60 seconds</td>
</tr>
<tr>
<td>Week seven</td>
<td>90 seconds</td>
<td>71 seconds</td>
</tr>
<tr>
<td>Week eight</td>
<td>120 seconds</td>
<td>240 seconds</td>
</tr>
</tbody>
</table>

The succeeding portion of chapter four specifies intervention results in relationship to the research questions:

1. Does a whole interval Differential Reinforcement of Other Behaviors (DRO) protocol with an embedded token economy reduce target behaviors among school age children with autism?

2. Are back-up tokens presented on a three to one ratio potent enough to maintain low rates of challenging behavior until the desired reinforcer is delivered?

3. After removal of the intervention, do the effects of the DRO with an embedded token economy maintain?
Visual Analysis

**Participant One**

*Baseline phase.* Following the guidelines proposed by Horner et al. (2005), visual analysis was conducted based on graphical representations of data throughout baseline, intervention, and maintenance phases. For participant one, vocalization baseline results (e.g., the first behavior to receive the intervention) showed a consistent pattern of responding with a neutral trend as represented in Figure 7. Hair touching behavior showed a slightly descending trend during baseline phase while breathing behavior was neutral. Throughout baseline phase for vocalizations, hair touching, and breathing behaviors, variability was recorded which may have resulted from extraneous factors influencing performance (e.g., setting events).
Figure 7. Target behaviors across baseline, intervention, and maintenance conditions for participant one.
Intervention phase. As represented in Figure 7, the mean level among all behaviors for participant one were significantly altered after onset of the DRO with an embedded token economy intervention. During baseline phase for vocalization behavior, rates averaged at 6.45 while the intervention phase resulted in a mean rate of .96. Baseline rates of hair touching behavior were 1.35, averaging at .32 during the intervention phase. During baseline phase for breathing behavior, rates averaged at .28 while the intervention phase resulted in a mean rate of .03. Variability diminished upon staggered introduction of the intervention (e.g., independent variable) for each behavior, reducing vocalization and hair touching to near zero levels with descending trend lines. Breathing behavior remained at zero levels with the exception of one data point, communicating a stable but neutral trend for this behavior.

A functional relationship is said to exist as an immediate change depicted significant alterations, attributing changes to the intervention rather than extraneous events. Within subject replication (e.g., a multiple baseline design of one subject across three behaviors) enhanced internal validity as experimental effects were distributed across three different points in time (Horner et al., 2005). Overall, the DRO with an embedded token economy was found to establish experimental control after onset of the intervention for participant one.

Maintenance phase. Target behaviors were monitored once per week for three consecutive weeks after removal of the treatment package. During this time, the intervention was completely discarded in an effort to obtain information about
maintenance of behavior. For participant one, maintenance results verified that mean rates stabilized at near zero occurrences of behavior.

During the maintenance phase for vocalization behavior, rates averaged at .2. For hair touching behavior, rates averaged at .2 and breathing behavior averaged at .06 during the maintenance phase. Video recordings provided support that participant one continued to self-prompt quiet by touching his throat or mouth throughout the maintenance condition. By obtaining self-prompting strategies, one would expect that prompt dependency would be minimized, reducing participant reliance on adult feedback and prompts.
Figure 8: Displays of target behaviors across baseline, intervention, and maintenance conditions for participant two.
Participant Two

Baseline phase. The data in Figure 8 show a slightly ascending trend for vocalization behaviors among participant two during the baseline phase. In contrast, a neutral trend was found for perseverative hand movements while a descending trend occurred with scratching behaviors. Similar to participant one, variability was present particularly in the initial baseline phase, although the intervention phase produced a stable rate of behaviors.

Intervention phase. As displayed in Figure 8, mean rates were significantly reduced after onset of the treatment package. During baseline phase for vocalization behavior, rates averaged at 5.1 while intervention onset resulted in a mean rate of 2.12. A descending trend occurred when vocalizations were exposed to the DRO with an embedded token economy intervention. Following introduction of the independent variable, an immediate change was demonstrated for vocalization behavior.

During the baseline phase for perseverative hand movements, rates averaged at 1.73 while the intervention phase resulted in a mean rate of .17. The baseline phase for finger scratching behavior resulted in a mean rate of .41 with the intervention resulting in an average rate of zero. Perseverative hand movements and scratching behaviors displayed a neutral trend throughout the intervention phase while an immediate change was not demonstrated for these particular behaviors; therefore, threatening the strength of experimental effects. The neutral trend in the two behaviors could be attributed to the participant’s reduced anxiety as a result of the intervention. When the first behavior received the intervention, the participant independently began to utilize self-calming
strategies (e.g., squeezing hands together) which influenced the frequency of all target behaviors. While the last two behaviors for participant two impose limitations to the strength of the study, reductions in behavior rates lend support to the use of the intervention when working among children with autism.

**Maintenance phase.** For participant two, results suggest that near zero rates among all target behaviors were maintained following removal of the intervention. During the maintenance phase for vocalizations, rates averaged at .3. For perseverative hand movements, rates averaged at .37 and scratching behaviors averaged at .03 during the maintenance phase. Participant two continued to self-prompt quiet by touching her throat or mouth throughout the maintenance phase. The results are encouraging and suggest that children with autism have the potential to maintain low levels of behavior after being exposed to a DRO treatment package.

**Back-up Tokens**

A review of anecdotal reports indicated that for both participants, target behaviors occurred immediately after three tokens had been distributed. Participant compliance during timer intervals was noted during this time. After one month of intervention, target behaviors generally ceased during work time, but occurred for both participants after receiving three tokens and redeeming their desired reinforcement. Behaviors occurred throughout reinforcement time, but discontinued immediately when the timer was reset to begin the process again. The pattern continued throughout the intervention phase and was accepted by practitioners as reinforcement time was
synonymous with a break from work tasks. The results are encouraging as participants clearly recognized the contingencies of the intervention.

*Mastering the protocol.* Upon the second week of intervention, participants were observed to point at the timer prior to exhaustion of the interresponse time, indicating comprehension of the timer interval. During week seven of intervention, participant two continuously attempted to place tokens on the token board, simultaneously making eye contact with the practitioner. Participants independently began running the intervention by week eight, placing a token on the board after the timer exhausted and using an isolated finger to count with left to right progression after three tokens had been earned. The observations support the influential impact of rule-based, visual interventions when working among children with autism.

*Self-monitoring.* Both participants intermittently self-monitored the timer after the second week of intervention and from an observational standpoint, were noted to have considerably less anxiety during work sessions. Participant two began putting her fingers to her lips as if to self-prompt maintenance of quiet and by week four of intervention, began saying “Shh”. This was an exceptional breakthrough as the participant is non-verbal and had not consistently imitated any verbiage in the past. Cumulatively, back-up tokens on a three to one ratio were found to be effective in maintaining near zero rates of challenging behaviors among both participants.

*Conclusion*

The study evaluated both the process and the product (e.g., outcome) of the DRO treatment package while analyzing maintenance and feasibility for applied practitioners.
Further research is warranted to fully determine the potency of the treatment package across varying populations and settings. The next chapter will summarize findings and limitations of the intervention.
CHAPTER FIVE

Discussion

Chapter five presents a summary of findings from the DRO protocol with an embedded token economy to reduce challenging behaviors among children with autism. The impact of the results in relation to current trends in the field of special education such as Response to Intervention (RtI) and Positive Behavior Supports (PBS) are commented upon. Limitations of the study are considered. Future directions for research are summarized when examining reinforcement based interventions for use in special education classrooms.

Findings

The DRO treatment package explored the efficacy of scripted instruction and praise among two school aged participants with autism. A whole interval DRO procedure was utilized with interresponse times determined on a weekly basis to enhance feasibility for practitioners. If a target behavior occurred during the interresponse time, an interval reset application was applied and scripted instruction was verbally administered.

An embedded token economy on a three to one ratio was found to be substantial enough to maintain near zero rates of target behaviors among both participants. The utilization of intermittent praise was thought to support near zero behavior rates as participants worked towards accumulating three tokens.
Dependent variables. Overall, the results support the use of a DRO treatment package when seeking to reduce target behaviors among children with autism. Mean behavior levels (i.e. dependent variables) were significantly reduced after onset of the protocol, indicating intervention success. Further, visual analyses of the graphs signified an immediate change after implementation of the treatment package, providing further evidence of experimental control.

Independent variable. Systematic implementation of the independent variable (e.g., DRO treatment package) accompanied with the high percentage of treatment integrity verify that extraneous factors were not responsible for the reduction of behaviors. The active manipulation of the independent variable confirms that a functional relationship between the intervention and behavior change did exist. The following portion explores the implications for the three research questions examined throughout the study.

Implications

Research Question One

Participant one. The independent variable, a whole interval DRO protocol with an embedded token economy, was actively manipulated to verify that the intervention was responsible for the behavior change. Findings presented in Figure 7 imply that the application of a DRO with an embedded token economy intervention quickly induces behavior change among the targeted dependent variables (e.g., vocalizations). Additionally, the treatment package generalizes to other dependent variables not being targeted. The results imply that educators can access and apply DRO interventions to not
only treat one challenging behavior, but rather, a series of challenging behaviors in a relatively short period of time. The study supported that educators can use a weekly interresponse time (IRT) to determine the DRO interval size and that the token economy was effective when used in combination with DRO.

*Participant two.* Findings in Figure 8 verify that the DRO treatment package quickly induces behavior change among the initial targeted dependent variable (i.e., vocalizations). Question one was proven and the implication to the field is that the DRO treatment package may be easier to use than DRO alone. Integrating a token economy into the treatment package provides visually defined structures for participants with autism, enhancing expedited behavior change. The importance of the findings is that the DRO treatment package may offer a powerful selling point to practitioners in search of quick acting interventions.

*Research Question Two*

*Participant one.* The second research question explored back-up tokens presented on a three to one ratio. Results were evaluated to examine whether low rates of challenging behavior could be maintained until the desired reinforcer was delivered. The results confirmed that back-up tokens were potent enough to maintain near zero rates of challenging behaviors, suggesting that using tokens on a three to one ratio is simplistic to use for public school practitioners. Using an embedded token economy was also found to maintain instructional momentum, an important consideration because using DRO alone results in continual work breaks needed to provide reinforcement, particularly when the IRT is small. The token economy prolonged participant work sessions as opposed to
halting instruction to deliver reinforcement when intervals exhaust (i.e., DRO alone). Tokens provided more opportunity for instructional practices and were found to work effectively when combined with the DRO intervention. The importance of the findings is that the treatment package offers an easy intervention to apply in classroom settings.

Participant two. Results for participant two signify that target behaviors ceased throughout the intervention with behaviors emerging only during reinforcement time. The findings are important because the rule-based, visual structure of the DRO with an embedded token economy clearly articulates when behaviors are allowed to occur and when behaviors are unacceptable. The embedded token economy (i.e., independent variable) presents a predictable rule-base which may allow for increased independence and self-monitoring.

Research Question Three

Participant one. The third research question explored whether the effects of the DRO with an embedded token economy maintain after removal of the intervention. For participant one, maintenance results signified that mean rates of challenging behaviors stabilized at zero occurrences after removal of the DRO treatment package for three consecutive weeks (see Figure 7). The findings are important because DRO with an embedded token economy is a relatively concise intervention that does not obligate practitioners to continuously pour energy into treatment for students. Behavior change is experienced right away as opposed to intervening throughout an entire semester or school year. Further, the intervention can be removed with the implication that positive results should remain in place.
Participant two. Maintenance results signify that mean rates of challenging behaviors stabilized at near zero occurrences (see Figure 8). The fact that the dependent variables were maintained without specific maintenance contingencies demonstrates their utility in field settings. When considering interventions for applied practitioners in public school settings, evidence of behavioral maintenance is an important attribute for often overwhelmed service providers.

Points of Convergence

Ethics. As discussed in chapter two, previous literature has described DRO as an intervention capable of maintaining instructional momentum as opposed to interrupting classroom activities (Cowdery et al., 1990). Anecdotal observations throughout the DRO treatment package confirmed that instructional momentum was maintained while reinforcement time allowed for breaks contingent on positive behavior throughout the academic session. The findings support the idea that the treatment package does not take away from instructional time, an important attribute for many practitioners that struggle with fitting all academic content into daily lessons. Further, as previously discussed by Homer and Peterson (1980) and Poling and Ryan (1982), DRO was again found to have no reported side effects as a result of treatment; therefore justifying this intervention as an ethically enticing choice for use among students with disabilities.

Interval size. Earlier research had found that averaging interresponse times from the preceding five sessions allowed individuals the opportunity to experience success during the DRO intervention (Vollmer et al., 1995). The DRO with an embedded token economy replicated this premise and found that averaging data from five sessions
increased reinforcement potential. Averaging data from the previous five sessions allows for a more accurate portrayal of the interresponse time rather than a heightened and less attainable interval length. The findings are substantial as this approach requires only weekly as opposed to daily interval resets thus making the intervention easier while maintaining effectiveness.

Additionally, this study supported previous research which suggested that interval size should be relatively small while corresponding with the response rate (Reese et al., 1998; Repp et al., 1991). By reducing the interval length by a small portion (e.g., 30 seconds), the reduction of target behaviors was reinforced with more density; therefore controlling behaviors more efficiently through the DRO treatment package.

Whole interval DRO. Barton et al. (1986) explored the effect of whole interval and momentary DRO procedures in reducing target behaviors in an elementary school classroom. Target behaviors such as noncompliance, head-weaving, light-gazing, hand-flapping, and finger-moving were targeted among students with multiple disabilities. The results had suggested that whole interval DRO is most valuable when seeking to reduce behaviors at the beginning of the intervention. Replicating the previous research, the whole interval DRO treatment package was found to establish this behavioral reduction at intervention onset among similar perseverative behaviors. The results are important because we obtained further evidence that whole interval DRO is efficiently capable of reducing challenging behaviors among students with disabilities in an elementary school setting.
Points of Divergence

Logistics. As previously discussed, DRO is known to provide reinforcement contingent on the absence of target behaviors for a set interval of time (Didden et al., 1997; Lovaas, 2003; Mazaleski et al., 1993; Newman et al., 1997; Repp et al., 1991; Thompson, Iwata, Hanley, Dozier, & Samaha, 2003; Vollmer et al., 1995). Thompson et al. (2003) have suggested that because reinforcers are delivered contingent on the absence of a target behavior, there is no opportunity for accidental reinforcement. By contrast, a concern during the DRO treatment package was that accidental reinforcement did have the potential to occur. Practitioner error induced deviations in the DRO procedure. For example, with visually oriented behaviors such as hand movement, scratching classroom materials, and hair touching, the practitioner needed to continuously monitor participants’ target behaviors. If the practitioner turned to attend to another student or to gather materials, occurrences in target behaviors may have been missed. Additionally, auditorally oriented behaviors such as vocalizations and breathing may have been missed if the classroom was too noisy. As a result, participants may have been reinforced although a target behavior was exhibited (i.e., accidental reinforcement). Although there is a logistical challenge that has been observed, the findings are substantial because accidental reinforcement did not seem to negatively impact the effectiveness of the intervention procedures. Future research should address this logistical consideration.

Feasibility. Past research has suggested that DRO requires continuous monitoring and recording of data to reset intervals (Vollmer et al., 1995). With this past research in
mind, feasibility was considered during the DRO treatment package to promote sustainability of the intervention in an applied, public school setting. The study found that collecting data for a maximum duration of ten minutes per school day, a reasonable period of time, is efficient when programming for DRO intervals. Additionally, averaging data from the preceding five sessions promotes feasibility for applied practitioners in search of mechanisms catering to time constraints. The following section presents current trends in special education, justifying the use of reinforcement based interventions among the population of children with challenging behaviors.

Current Trends

Response to Intervention (RtI) and Positive Behavior Supports (PBS) suggest that reinforcement based procedures should be explored as the initial modality when implementing interventions in school facilities (Connecticut State Department of Education, 2005; OSEP Center on Positive Behavioral Interventions and Supports et al., 2000). Collaborative and proactive approaches such as RtI and PBS potentially enhance the outcomes of behavioral interventions. The integration of these trends with the principles of Applied Behavior Analysis (ABA) offer systematic processes to improve socially significant behavior among children (Cooper et al., 1987). In addition, utilizing reinforcement based behavior protocols deriving from ABA have demonstrated substantial alterations in challenging behaviors (Lerman et al., 2004). Current literature discusses the need for schools to incorporate reinforcement based behavioral technologies into classrooms servicing children with autism (Lerman). For these reasons, a comprehensive reinforcement based treatment package was implemented while
simultaneously evaluating treatment integrity, contributing to current trends in education practices.

*Teacher education.* Literature suggests that practitioners would benefit from formal instruction in evidence-based practices for children with autism and behavioral challenges. Continual training and supervision should be provided to support educators (Connecticut State Department of Education, 2005). Outside consultants and in-house staff with expertise in evidence-based behavior technologies should be utilized to enhance teacher competency through both informal and formal means (Lerman et al., 2004; National Research Council, 2001; Sailor et al., 2006). Providing support to novice practitioners may enhance skill proficiency among educators in school systems. Although practitioners need extended training, the DRO with an embedded token economy provides a practitioner friendly approach to intervening for challenging behaviors.

*Evidence-based practices.* User-friendly options need to be identified for practitioners in search of reinforcement based protocols for behavior problems (OSEP Center on Positive Behavioral Interventions and Supports et al., 2000). A systems change needs to evolve throughout school facilities, beginning with informing educators about feasible, evidence-based practices. The intent of the DRO treatment package was to provide further evidence for reinforcement based procedures when working among children with challenging behaviors. The treatment package was supported by literature suggesting that differential reinforcement and token economies encompass the notion of PBS while providing an acceptable treatment alternative to punitive procedures.
While further research needs to focus on accumulating evidence for behavioral practices, the study sought to extend reinforcement based options for decreasing behaviors. Special education is an applied, problem solving discipline through which continued research is needed to further validate evidence-based practices (Horner et al., 2005). The following portion addresses limitations of the DRO treatment package, followed by suggestions for future research.

Limitations of the Study

Limitations will be considered in the following paragraphs. Functional behavior assessments and analyses, interobserver agreement, treatment integrity, and procedural variations will be discussed in respect to the DRO treatment package. In addition, limitations of phases and applied usage of the treatment package will be considered.

Functional behavior assessments and analyses. Both functional behavior assessments and functional analyses were conducted to determine behavior functions among all behaviors for both participants. Comparing results between information extrapolated from the Motivation Assessment Scale (MAS; Durand & Crimmins, n.d.) and the functional analysis conditions verified discrepancies in behavior functions. For example, the MAS confirmed that hair touching behavior for participant one was motivated by sensory. In contrast, functional analysis conditions verified that hair touching behavior for participant one was motivated by escape; communicating conflicting behavior functions.

A rationale for the discrepancies of behavior functions could be that the MAS provided a subjective assessment of behavior. Classroom staff contributed to the
assessment, although staff had difficulty determining a joint response. Private events (e.g., opinionated head thoughts) about each participant’s behaviors influenced varied responses between classroom staff. Emotional components (e.g., past experience with participants) induced drift as staff attempted to collectively complete the MAS. Functional analyses were thought to provide a more thorough means of obtaining behavior functions as systematic, controlled application of conditions creates more accurate results.

Further research needs to be conducted on the reliability of measures such as the MAS in comparison to functional analysis conditions. Researchers should evaluate the potency of condensed, online measures (e.g., MAS) to determine accuracy of results. Alternatively, the duration and rotation (e.g., drawing conditions from a hat) of functional analysis conditions should be also explored. Limiting functional analysis conditions to one week in duration as opposed to two weeks could ultimately result in more practitioners being willing to apply these conditions. Finding more feasible mechanisms to determine behavior functions would greatly benefit behavioral interventions in applied settings.

*IOA inflation.* Interobserver agreement was collected throughout the study by the principal investigator and research assistant, although simple agreement may have artificially inflated the percentage of agreement scores. Caution must be taken when interpreting IOA scores conducted using a simple agreement format. A high percentage of agreement does not verify that recorders observed the same instances of behavior (Cooper et al., 2007). Future research should examine agreement by calculating behavior-
by-behavior IOA to determine the number of behaviors in which observers agreed on the occurrence or nonoccurrence of behaviors (Cooper et al.). Utilizing this format could produce a more accurate depiction of agreement scores when targeting numerous behaviors.

**IOA deflation.** While IOA percentages during baseline and intervention phases may have been inflated, maintenance IOA could have been diminished as a result of near zero behavior rates. For example, the principal investigator and research assistant obtained 67% agreement for participant two during the maintenance condition. In this phase, slight deviations in recording (e.g., the principal investigator recording three occurrences, the research assistant recording two occurrences) minimized agreement scores. An explanation for recording differences may have occurred because the magnitude of vocalization behavior for participant two altered significantly. Vocalizations became difficult to decipher as outward vocalizations reduced towards the end of the study.

**Feasibility IOA.** Feasibility agreement across behaviors ranged from 80% to 98% during baseline and intervention phases, meeting the 80% agreement criteria set by Cooper et al. (2007). Agreement scores communicate that in vivo data collection by practitioners in an applied classroom setting has the potential for precision in implementation. The maintenance condition for both participants showed reduced agreement scores; however, the low rate of behaviors (e.g., only three occurrences) collapsed the percentage of agreement. Continued in vivo agreement research should be
conducted to further justify the feasibility of a DRO treatment package for use in reducing challenging behaviors among children with autism in applied facilities.

*Treatment integrity.* In addition to agreement scores for participant behaviors, IOA should also be utilized when examining treatment integrity. The principal investigator was the sole assessor for integrity which could have induced observer drift throughout the process. Continued studies should verify the accuracy of integrity scores by employing an agreement component.

*Integrity components.* Integrity assessments indicated that when participant one displayed a target behavior, the practitioner immediately reset the timer for 84% of the time, a low score in relation to other integrity components. When working with participant two, the practitioner immediately reset the timer for 86% of the time. The integrity reduction when resetting the timer could have resulted from the multi-tasking required of practitioners during in vivo sessions (e.g., the practitioner was required to monitor student behavior, document in vivo data, reset the timer, and continue instruction while taking data on educational objectives); however, practitioners were observed to provide scripted verbiage during this time (e.g., “Remember, stay quiet. First stay quiet, then goldfish.”), although the timer was not reset.

When the timer was exhausted, the practitioner immediately gave defined praise accompanied by a token for 86% of the time for participant two. One explanation for the variability (e.g., integrity not meeting 100%) with the independent variable was that the timer was turned at a slight angle away from the practitioner. Although the angle jeopardized the fidelity of the intervention (e.g., the practitioner could not clearly see the
visual timer the moment it was exhausted), participants were offered a clear view of the visual timer. The principal investigator and classroom staff prioritized visual accessibility to participants in an effort to enhance their comprehension of the visual timer. Treatment integrity measures indicated strong scores for the remaining questions targeted for the DRO with an embedded token economy intervention.

_Treatment integrity meetings._ When the integrity measure indicated drift in the protocol (see Appendix B), performance feedback was delivered the next day to classroom staff during a morning meeting. Meeting time was dedicated to communicating variations in integrity performance, reviewing operational definitions, and clarifications specific to the DRO treatment package. To maintain high levels of integrity, video recordings of both participants were reviewed by all classroom staff on a weekly basis. Findings were synonymous to past research, suggesting that weekly treatment integrity meetings help to maintain adherence to the intervention protocol (Eikeseth, 2001).

_Treatment package._ Although results indicate treatment effectiveness, parsimonious behavioral interventions should originally be considered when making treatment choices. Multi-component protocols have the potential to impact treatment adherence. Utilizing a DRO intervention with an embedded token economy, scripted instruction, and praise may induce ambiguities in treatment delivery. Specific intervention components should continue to be examined separately to refine behavioral interventions.

_Baseline phase levels._ Typically, among multiple baseline designs across behaviors, one behavior is exposed to an intervention while other behaviors linger in
baseline levels; however, for participants one and two, slightly descending trends occurred while behaviors were in the baseline phase. The occurrence complicates the determination that the intervention was responsible for behavior change. The predicted pattern of performance (e.g., trends should have been ascending or neutral) may have been altered as a result of generalized behavior effects (Kazdin, 1982). Alterations in one behavior (e.g., the first behavior exposed to the intervention) could have been associated with changes in other behaviors. The limitation in treatment results could have occurred when baseline phases for participants one and two were extended for too long of a time period. Future research should examine generalization across behavior responses to establish a clear relationship between an intervention and its effects.

*Setting events.* Graphical displays for both participants identified variability throughout both baseline and intervention phases. Setting events (e.g., morning interactions affecting subsequent behaviors) impacted the rate of behavior for participants one and two. For participant one, medical issues (e.g., gastrointestinal problems) served as a setting event with considerable influence on target behaviors throughout the remainder of the day. For participant two, setting events such as medical issues, lack of sleep, and breakfast refusal impacted the frequency of target behavior occurrences.

*DRO procedural variations.* When utilizing a whole interval DRO procedure, reinforcement is only delivered contingent on the absence of target behaviors during the entire interval (Cooper et al., 2007). A limitation occurred when participant one began displaying high rates of eye closing behavior through covering eyes with his shirt or hands. During this time, however, the participant was not partaking in any target
behaviors, resulting in delivery of reinforcement after having received three back-up tokens.

When implementing a DRO intervention, practitioners run the risk of reinforcing other types of inappropriate behavior that emerge during treatment (Foxx, 1982). To contend with the emergence of eye closing behavior, practitioners began providing reinforcement contingent on the absence of target behaviors and eye closing behaviors. Eye closing behaviors were not integrated into the DRO interval reset, although eye closing was monitored at the moment the timer was exhausted (e.g., momentary DRO). If eye closing was displayed the moment the timer was exhausted, the practitioner would wait until the participant had eyes open and would then provide reinforcement (e.g., a token paired with scripted praise). Further research should investigate the emergence of other behaviors during DRO interventions to determine best practices when combating with challenging situations.

**Maintenance.** Upon removal of the DRO treatment package, a maintenance phase was employed to determine whether behavioral effects were maintained; however, ethical quandaries exist when removing a successful intervention. Extended research should examine maintenance variations such as momentary DRO. Using a format such as momentary DRO would alleviate ethical concerns inherent when removing behavioral interventions.

**Future Research for Independent Variables**

The following portion will discuss interval length and procedural variations to enhance continued application of the DRO treatment package. Variations in single
subject designs and reinforcement based treatment packages will be considered. Additionally, autism support and feasibility for applied practitioners will be discussed.

*Procedural variations.* Limited research is available on DRO variations such as continuous interval application and interval reset. Throughout the study, an interval reset procedure was used meaning that once a target behavior was displayed, the timer interval was immediately reset. In contrast, continuous interval application can be defined as a target behavior occurs and in response, the practitioner allows the interval to continue. Using continuous interval application strengthens extinction (e.g., the behavior is not attended to (Lindberg et al., 1999). Once the interval is exhausted, reinforcement is not delivered and the timer is then reset.

When examining variations such as interval reset and continuous interval application, practitioner preference needs to be considered. For some, interval reset may provide the best means of delivering immediate performance feedback, although extinction qualities are minimized in the approach. Interval reset adheres to the natural desire of practitioners to teach appropriate behaviors while working with students. For some staff, however, continuous interval application may provide a more feasible approach in applied classroom settings. Letting the interval continue after a behavior occurs may reduce practitioner responsibility to continuously maintain the timer. By applying continuous interval application, practitioners may be able to more readily use a DRO protocol within the classroom setting; allowing them to walk away from the timer to tend to other tasks in the room. The relaxed design of continuous interval application may be more compelling to use as opposed to the cumbersome monitoring required of the
interval reset variation. Further research for DRO variations should be prioritized to identify the most feasible strategy for applied use.

*Whole interval and momentary DRO.* When employing DRO, procedural variations need to be determined while simultaneously considering intervention practicality for educators. Barton et al. (1986) found that the initial usage of whole interval DRO was most effective in reducing challenging behaviors. Further evaluation of procedural variations identified momentary DRO as successful at maintaining low rates of behavior after initial suppression through whole interval DRO. The advantage to using momentary DRO is that practitioners are not required to monitor participant behavior at all times, rather, observation of behavior is only necessary at the moment the timer is exhausted (Cooper et al., 2007). Using momentary DRO may be a more cost effective approach to reducing challenging behaviors in school settings as one-on-one support may be minimized. Future research should explore the effectiveness of momentary DRO as a procedural variation at the onset of the intervention.

*Intervals.* Previous studies have examined time series designs which involve altering interval length on a day-by-day basis (Reese et al., 1998). Other studies have adjusted the DRO interval based on learner performance from the preceding session (Cooper et al., 2007; Poling & Ryan, 1982); however, practitioner confusion may occur when the interval is continuously altered, thus, limiting the consistency and predictability of the interval length. If the subject experienced success the day prior, interresponse time (IRT) may be inflated and minimize opportunity for reinforcement on the following day. A differentiated approach involves averaging intervals on a weekly basis; minimizing
practitioner time spent configuring data (Barton et al., 1986). When instituting IRT on a weekly basis, data would only need to be averaged once per week as opposed to daily.

Studies need to further evaluate length of time intervals with the fundamental understanding that extended intervals minimize the opportunity to obtain reinforcement (Reese et al., 1998). Utilizing an interval size slightly less than the mean IRT typically results in effectiveness of the protocol (Cooper et al., 2007). Reductions in interval size should be explored to identify the most effective and efficient strategy.

*Single subject designs.* Throughout the study, a whole interval DRO with an embedded token economy was systematically used to induce near zero rates of behavior among two participants with autism. A multiple baseline design across behaviors verified the functional relationship between the intervention and its effects. While extended studies should seek replication of the multiple baseline design across behaviors when using this treatment package, variations in single subject design methodology should alternatively be explored. For example, a changing criterion design could evaluate the incremental progression of interresponse times (IRT) throughout a DRO intervention. Focusing explicitly on IRT could enhance understanding about the influence of interval times in relation to the success of DRO. Intricacies of the treatment package could also be evaluated through reversal designs, component analyses, and multiple baseline designs across settings and individuals.

*Treatment packages.* Although DRO may be used as a single intervention, further research should explore treatment packages and their influence on inducing behavior change (Cooper et al., 2007). Through melding behavior reduction procedures into one
package, more efficient behavior change is likely to result (Cooper et al.). As discussed in chapter four, participants naturally began to self-monitor their behavior throughout the intervention. Combining DRO procedures, token economies, and self-monitoring could consequently result in a more comprehensive means of intervening with challenging behaviors (Shabani et al., 2001).

*Treatment integrity*. Applied Behavior Analysis, PBS, and RtI address the critical importance of monitoring and controlling for treatment integrity when programming for challenging behaviors (Goss et al., 2007; Schwartz & Baer, 1991). Research suggests that treatment integrity is jeopardized when intensive interventions are chosen (Vaughn & Roberts, 2007). Intermittently conducting treatment integrity checks was imperative to maintain adherence to intervention procedures. The DRO treatment package sought to provide a scripted, rule based intervention for use among practitioners with varied experience levels. The treatment package offers a reinforcement based option that holds potential for controlled implementation by practitioners. Extended research needs to be conducted on evidence-based interventions for application by professionals with diverse educational backgrounds.

*Feasibility*. When examining DRO procedures, two distinctive advantages exist, being that DRO is relatively simplistic to use while straightforwardly working on an undesired behavior by reinforcing its absence (Foxx, 1982). Although DRO is known to be fairly basic, practitioners are often resistant or reluctant to use the procedure because they lack experience using behavioral protocols. Procedural variations of DRO need to be examined to encourage usage by busy and often overwhelmed applied practitioners.
Technical expertise and refinement. Extended research should focus on the pragmatics of DRO interventions in applied settings. Differential Reinforcement of Other behaviors (DRO) research exists, although the technical jargon can be threatening and intimidating for practitioners seeking to gain information about DRO procedures. Real world situations and case studies should be explored and written accounts should be made publically available to applied practitioners. Manuals incorporating practical, step-by-step procedures need to be published for access to educators and support staff in school settings. Utilization of manuals will enhance the understanding of DRO while promoting treatment integrity for those willing to apply the intervention.

Autism support. All individuals deserve to be respected members of their community schools; however, the recent rise in autism diagnoses leaves educators unprepared to provide appropriate and dignified behavioral interventions for this population. In addition to continued research on Positive Behavior Supports, feasible protocols for use in school facilities needs to be emphasized. Educators must enlist continued assistance from experts in the field to shape best practices when working among this sensitive population. Research should explore approaches to teaching current and future educators about reinforcement based procedures while striving to limit resistance and negativity. First, behavior change among professionals needs to occur before differences can be made in the delivery and fidelity of behavioral technologies for children with autism.
Future Research for Dependent Variables

Generalizability. Future research should delve into generalization procedures when using a DRO with an embedded token economy. Rigorous programmatic steps such as training multiple exemplars should be incorporated to facilitate generalization among extended studies (Stokes & Baer, 1977). Replicating intervention effects across participants and settings would increase the external validity of the treatment package. In addition, this reinforcement based intervention should be systematically applied across varying ages and populations (e.g., typically developing individuals, individuals with disabilities, early childhood populations, and geriatric populations) and among different settings (e.g., preschool and school age settings, employment and supported living environments) to determine the generalized potency of the intervention. Evaluating the generalizability of this treatment package in relation to group dynamics would also be important to explore. Using whole class interventions may provide a cost effective and time saving approach to behavior problems (Filcheck et al., 2004).

Conclusion

The results of the study, a DRO protocol with an embedded token economy to reduce challenging behaviors among children with autism, supports the use of a reinforcement based treatment package. Empirical evidence demonstrates the effectiveness of the DRO intervention throughout clinical facilities, although generalized applications in applied school settings should be of primary focus. Historically, cumbersome implementation of the protocol was reported; inhibiting past usage of the
DRO among practitioners (Reese et al., 1998). The results provide evidence that a DRO treatment package is feasible for use in school settings.

Treatment integrity was consistently monitored with data supporting the ease in application for special education service providers. Interobserver agreement between in vivo and video review data ranged from 80% to 98% during baseline and intervention phases; communicating that in vivo data collection by practitioners in an applied setting has the potential for precision in implementation.

Results concluded that upon onset of the intervention, the rate of target behaviors significantly reduced. Participants independently began running the intervention by week eight, articulating the influential impact of rule-based and visually supported interventions when working among children with autism. Overall, the study supported the efficacy of a DRO treatment package when reducing behaviors among children in applied facilities. Further studies should be conducted to refine procedures in support of feasible, reinforcement based treatment options.
APPENDICES
APPENDIX A

BEHAVIOR INTERVENTION RATING SCALE
Behavior Intervention Rating Scale

1=strongly disagree    3=neutral    6=strongly agree

1. This would be an acceptable intervention for the child’s problem behavior.
   1  2  3  4  5  6
2. Most teachers would find this intervention appropriate for challenging behaviors.
   1  2  3  4  5  6
3. The intervention should prove effective in changing the child’s problem behavior.
   1  2  3  4  5  6
4. I would suggest the use of this intervention to other teachers.
   1  2  3  4  5  6
5. The child’s problem behavior is severe enough to warrant the use of this intervention.
   1  2  3  4  5  6
6. Most teachers would find this intervention suitable for the problem behavior described.
   1  2  3  4  5  6
7. I would be willing to use this in the classroom setting.
   1  2  3  4  5  6
8. The intervention would not result in negative side effects for the child.
   1  2  3  4  5  6
9. The intervention would be an appropriate intervention for a variety of children.
   1  2  3  4  5  6
10. The intervention is consistent with those I have used in classroom settings.
    1  2  3  4  5  6
11. The intervention was a fair way to handle the child’s problem behavior.
    1  2  3  4  5  6
12. The intervention is reasonable for the behavior problem described.
    1  2  3  4  5  6
13. I like the procedures used in the intervention.
    1  2  3  4  5  6
14. This intervention was a good way to handle the child’s challenging behaviors.  
1 2 3 4 5 6  

15. Overall, the intervention would be beneficial for the child.  
1 2 3 4 5 6  

16. The intervention would quickly improve the child’s behavior.  
1 2 3 4 5 6  

17. The intervention would produce a lasting improvement in the child’s behavior.  
1 2 3 4 5 6  

18. The intervention would improve the child’s behavior to the point that it would not noticeably deviate from other classmates’ behavior.  
1 2 3 4 5 6  

19. Soon after using the intervention, the teacher would notice a positive change in the problem behavior.  
1 2 3 4 5 6  

20. The child’s behavior will remain at an improved level even after the intervention is discontinued.  
1 2 3 4 5 6  

21. Using the intervention should not only improve the child’s behavior in the classroom, but also in other settings (e.g., other classrooms, home).  
1 2 3 4 5 6  

22. When comparing this child with a well-behaved peer before and after the use of the intervention, the child’s and the peer’s behavior would be more alike after using the intervention.  
1 2 3 4 5 6  

23. The intervention should produce enough improvement in the child’s behavior so the behavior is no longer a problem in the classroom.  
1 2 3 4 5 6  

24. Other behaviors related to the problem behavior also are likely to be improved by the intervention.  
1 2 3 4 5 6
APPENDIX B

AVERAGE PERCENT OF TREATMENT INTEGRITY
**Average Percent of Treatment Integrity for Participants One and Two**

<table>
<thead>
<tr>
<th>Treatment integrity questions</th>
<th>Average percent of treatment integrity for participant one</th>
<th>Average percent of treatment integrity for participant two</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Did the practitioner give the subject a choice of 2 reinforcers at the onset of the activity?</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>2. Did the practitioner preview the work tasks in a “First__then” format?</td>
<td>95%</td>
<td>95%</td>
</tr>
<tr>
<td>3. Did the practitioner keep the token economy in clear view throughout the entirety of the session?</td>
<td>100%</td>
<td>95%</td>
</tr>
<tr>
<td>4. Did the practitioner keep the visual timer within clear view throughout the session (with the exception of turning the timer)?</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>5. When the timer was exhausted, did the practitioner immediately (within 3 seconds) give defined praise accompanied with the token?</td>
<td>100%</td>
<td>86%</td>
</tr>
<tr>
<td>6. If the subject displayed a target behavior, did the practitioner immediately</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment integrity questions</td>
<td>Average percent of treatment integrity for participant one</td>
<td>Average percent of treatment integrity for participant two</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
</tbody>
</table>

7. If the subject displayed high rates of the target behavior, did the practitioner turn the timer in effort to temporarily remove the intervention?

100% 95%
APPENDIX C

DATA SHEET FOR PARTICIPANT ONE
**Circle behaviors being targeted**

**Setting:** Table

<table>
<thead>
<tr>
<th>Behavior 1: Vocalizations:</th>
<th>Behavior 2: Hair touching to self:</th>
<th>Behavior 3: Breathing behavior:</th>
</tr>
</thead>
<tbody>
<tr>
<td>To include throat, screaming, whining, and guttural sounds. When there is a brief pause (breath) and the sound resumes, this would be considered as a second occurrence and so on. If the vocalization is prolonged to include numerous sounds strung together or one single sound, then a tally is made for one occurrence with a 3 count. Attempts at initial consonant sound imitation and humming is excluded for this category.</td>
<td>If the fingers linger in hair, then a tally is made for one occurrence, a count of thousand one, thousand two, thousand three, a second tally is made, a count of thousand one, and so on. However, when the hand is removed from the hair and then returns, this would be considered as a second occurrence.</td>
<td>Breathing behavior: Breathing behavior may be tallied each time the subject blows from mouth up into nose and breathing into a cupped hand. Each time the subject takes a breath while cupping hand or breathes from mouth up into nose, and then exhales, this would be considered as one occurrence of breathing behavior. The next breath in and exhalation would be considered as a second occurrence.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date:</th>
<th>Adult leading:</th>
<th>IRT for this session:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration (start-stop):</th>
<th>Rate (occurrence÷min)=</th>
<th>Rate (occurrence÷min)=</th>
<th>Rate (occurrence÷min)=</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 minutes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Observer:
In vivo/Video
DRO: Yes/ No
Reinforcers chosen:
Activity/Notes:
APPENDIX D

DATA SHEET FOR PARTICIPANT TWO
**Circle behaviors being targeted**

<table>
<thead>
<tr>
<th>Setting: Table</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Behavior 1:</strong> Perseverative hand movements: Up and down, side to side, cupped, or whole hand movement. If the hand movement is prolonged, then a tally is made for one occurrence, a count of thousand one, thousand two, thousand three, a second tally is made, a count of thousand one, and so on.</td>
</tr>
<tr>
<td><strong>Behavior 2:</strong> Scratching: Scratching is tallied as one occurrence when the subject sweeps her fingers across a surface (e.g., table or toy) with whole hand movement. Scratching is further defined as the hand being open with palm facing upwards, hand is lifted and then returns to the surface.</td>
</tr>
<tr>
<td><strong>Behavior 3:</strong> Vocalizations: To include throat, whistling, and guttural sounds. When there is a brief pause (breath) and the sound resumes, this would be considered as a second occurrence and so on. Does not pertain to screaming or loud breathing behavior. If the vocalization is prolonged, three count.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult leading:</td>
</tr>
<tr>
<td>IRT for this session:</td>
</tr>
</tbody>
</table>

| Duration (start-stop): 10 minutes |
| Rate (occurrence÷min)= |
| Rate (occurrence÷min)= |
| Rate (occurrence÷min)= |

Observer: In vivo/Video
DRO: Yes/ No
Reinforcers chosen: Activity/Notes:
APPENDIX E

CONSENT FORMS
Implementing a Differential Reinforcement of Other Behaviors (DRO) Protocol with an Embedded Token Economy

Dear parents,

I would like to conduct research on the impact of a DRO with an embedded token economy to reduce challenging behaviors among children with autism. I would like to do this because minimal literature is available on reinforcement based interventions for children. I would like your child to take part in this project. If you decide to do this, your child will be asked to choose a reinforcer (e.g., hugs, ball toy) to work for. The DRO intervention is designed to reduce behaviors while increasing compliance. Each time your child engages in appropriate behavior, he/she will earn a token. If your child is disruptive, no token will be given. Your child will be working towards earning three tokens. Once three tokens are earned, your child will receive a reinforcer and verbal praise. I will be implementing the intervention in a one-on-one setting.

The biggest risk of this project is that your child could become dependent on the DRO with an embedded token economy. In order to minimize this, I will lengthen the time your child is expected to be appropriate. Eventually, your child may be expected to have appropriate behaviors for the entire school day or until the intervention is no longer needed.

Confidentiality will be maintained to the limits of the law. The information from this project will be shared among members of the research team. With your permission, after conclusion to the study, the results will be shared with officials from your child’s school. If the results from this study are published or presented at scientific meetings, names of subjects or parents will not be provided for the sake of maintaining confidentiality.

If your child takes part in this project, we anticipate a decrease in challenging behaviors in the school setting. The results of this project may help other educators use reinforcement based interventions. Taking part in this project is entirely up to you and no one will hold it against you if you decide not to participate. If your child does take part, they may stop at any time. Further, your child’s participation in this study will not affect their educational programming or quarterly grades.

If you want to know more about this research project, please call me at 440.313.8636 or my advisor, Dr. Lyle Barton, at 330.672.2294. This project has been approved by Kent State University. If you have questions about Kent State University’s rules for research, please call Dr. John West, Vice President of Research, Division of Research and Graduate Studies (Tel. 330.672.2704). You will get a copy of this consent form.

Sincerely,

Leah Gongola, M.Ed.
Implementing a Differential Reinforcement of Other Behaviors (DRO) Protocol with an Embedded Token Economy

I agree to let my child, ____________________, take part in this project. I know what he/she will have to do and that we can stop at any time.

Signature ___________________________________ Date ____________________________
______________________________________________________________________________

Video Consent Form
I agree to video recording at Craddock Elementary School from January 2008 until May 2008.

Signature ___________________________________ Date ____________________________
______________________________________________________________________________

I have been told that I have the right to see the video before it is used. I have decided that I:

____ want to see the tapes

____ do not want to see the tapes

Sign below if you do not want to see the tapes. If you want to see the tapes, you will be asked to sign after seeing them.

Signature __________________________________
______________________________________________________________________________

Leah Gongola and other researchers from Kent State University may/may not (circle one) use the tapes made of my child. The original tapes may be used for:

____ this research project

____ teacher education

____ a private blog site for use by researchers and parents involved in this study (only accessed by a private password)

____ presentation at professional meetings

Signature ___________________________________ Date ____________________________
Implementing a Differential Reinforcement of Other Behaviors (DRO) Protocol
with an Embedded Token Economy

Teacher and Educational Assistant Consent Form

I agree to take part in this project. I know what I will have to do and know that I may choose to stop at any time.

Signature __________________________ Date __________________________

______________________________________________________________________________

Video Consent Form

I agree to video recording at Craddock Elementary School from January 2008 until May 2008.

Signature ___________________________________ Date __________________________

I have been told that I have the right to see the video before it is used. I have decided that I:

___ want to see the tapes

___do not want to see the tapes

Sign below if you do not want to see the tapes. If you want to see the tapes, you will be asked to sign after seeing them.

Signature __________________________________

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___ presentation at professional meetings

Signature ___________________________________ Date __________________________
APPENDIX F

MEAN RATINGS FOR EACH ITEM ON THE BIRS
### Mean Ratings for Each Item on the BIRS

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean onset ratings for participant one</th>
<th>Mean closure ratings for participant one</th>
<th>Mean onset ratings for participant two</th>
<th>Mean closure ratings for participant two</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. This would be an acceptable intervention for the child’s problem behavior.</td>
<td>5.25</td>
<td>5.25</td>
<td>5.00</td>
<td>5.25</td>
</tr>
<tr>
<td>2. Most teachers would find this intervention appropriate for challenging behaviors.</td>
<td>4.50</td>
<td>5.00</td>
<td>4.25</td>
<td>4.75</td>
</tr>
<tr>
<td>3. The intervention should prove effective in changing the child’s problem behavior.</td>
<td>5.00</td>
<td>5.25</td>
<td>4.75</td>
<td>5.25</td>
</tr>
<tr>
<td>4. I would suggest the use of this intervention to other teachers.</td>
<td>5.50</td>
<td>4.75</td>
<td>4.75</td>
<td>5.25</td>
</tr>
<tr>
<td>5. The child’s problem behavior is severe enough to</td>
<td>5.50</td>
<td>4.50</td>
<td>4.75</td>
<td>5.00</td>
</tr>
<tr>
<td>Item</td>
<td>Mean onset ratings for participant one</td>
<td>Mean closure ratings for participant one</td>
<td>Mean onset ratings for participant two</td>
<td>Mean closure ratings for participant two</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------</td>
<td>----------------------------------------</td>
<td>---------------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>6.</td>
<td>3.50 5.00</td>
<td>4.00 5.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>5.00 5.00*</td>
<td>5.25 5.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>5.75 4.25</td>
<td>5.75 4.75</td>
<td>5.25 4.75</td>
<td>4.75 5.00</td>
</tr>
<tr>
<td>9.</td>
<td>5.25 4.75</td>
<td>4.50 5.00</td>
<td>4.67* 5.33*</td>
<td>5.25 5.00</td>
</tr>
<tr>
<td>10.</td>
<td>4.67* 5.33*</td>
<td>4.75 5.00</td>
<td>4.75 5.00</td>
<td>5.00 5.00</td>
</tr>
<tr>
<td>11.</td>
<td>4.75 5.50</td>
<td>4.75 5.50</td>
<td>4.75 5.50</td>
<td>5.50 5.50</td>
</tr>
</tbody>
</table>

warrant the use of this intervention.

6. Most teachers would find this intervention suitable for the problem behavior described.

7. I would be willing to use this in the classroom setting.

8. The intervention would not result in negative side effects for the child.

9. The intervention would be an appropriate intervention for a variety of children.

10. The intervention is consistent with those I have used in classroom settings.

11. The intervention was a fair way to handle the child’s
<table>
<thead>
<tr>
<th>Item</th>
<th>Mean onset ratings for participant one</th>
<th>Mean closure ratings for participant one</th>
<th>Mean onset ratings for participant two</th>
<th>Mean closure ratings for participant two</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.</td>
<td>The intervention is reasonable for the behavior</td>
<td>5.00</td>
<td>5.25</td>
<td>5.00</td>
</tr>
<tr>
<td>13.</td>
<td>I like the procedures used in the intervention.</td>
<td>5.50</td>
<td>5.25</td>
<td>5.00</td>
</tr>
<tr>
<td>14.</td>
<td>This intervention was a good way to handle the child’s challenging behaviors.</td>
<td>5.25</td>
<td>5.25</td>
<td>5.00</td>
</tr>
<tr>
<td>15.</td>
<td>Overall, the intervention would be beneficial for the child.</td>
<td>5.50</td>
<td>5.25</td>
<td>5.00</td>
</tr>
<tr>
<td>16.</td>
<td>The intervention would quickly improve the child’s behavior.</td>
<td>5.25</td>
<td>5.00</td>
<td>4.25</td>
</tr>
<tr>
<td>17.</td>
<td>The intervention would produce a lasting improvement</td>
<td>4.50</td>
<td>4.50</td>
<td>4.50</td>
</tr>
<tr>
<td>Item</td>
<td>Mean onset ratings for participant one</td>
<td>Mean closure ratings for participant one</td>
<td>Mean onset ratings for participant two</td>
<td>Mean closure ratings for participant two</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>----------------------------------------</td>
<td>------------------------------------------</td>
<td>----------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>18. The intervention would improve the child’s behavior</td>
<td>4.75</td>
<td>4.50</td>
<td>3.75</td>
<td>4.75</td>
</tr>
<tr>
<td>to the point that it would not noticeably deviate from other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>classmates’ behavior.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Soon after using the intervention, the teacher would notice a</td>
<td>5.00</td>
<td>4.75</td>
<td>4.25</td>
<td>4.50</td>
</tr>
<tr>
<td>positive change in the problem behavior.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. The child’s behavior will remain at an improved level even after</td>
<td>4.50</td>
<td>4.25</td>
<td>3.75</td>
<td>4.25</td>
</tr>
<tr>
<td>the intervention is discontinued.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. Using the intervention should not only improve the child’s</td>
<td>4.75</td>
<td>4.75</td>
<td>4.50</td>
<td>4.75</td>
</tr>
<tr>
<td>behavior in the classroom, but also in other settings (e.g., other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>classrooms, home).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Mean onset ratings for participant one</td>
<td>Mean closure ratings for participant one</td>
<td>Mean onset ratings for participant two</td>
<td>Mean closure ratings for participant two</td>
</tr>
<tr>
<td>---------------------------------------------------------------------</td>
<td>----------------------------------------</td>
<td>------------------------------------------</td>
<td>----------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>22. When comparing this child with a well-behaved peer before and</td>
<td>4.67*</td>
<td>4.50</td>
<td>4.25</td>
<td>4.75</td>
</tr>
<tr>
<td>after the use of the intervention, the child’s and the peer’s</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>behavior would be more alike after using the intervention.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23. The intervention should produce enough improvement in the</td>
<td>4.67*</td>
<td>5.00</td>
<td>4.00*</td>
<td>4.33*</td>
</tr>
<tr>
<td>child’s behavior so the behavior is no longer a problem in the</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>classroom.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24. Other behaviors related to the problem behavior also are</td>
<td>4.00</td>
<td>4.75</td>
<td>4.00*</td>
<td>3.50*</td>
</tr>
<tr>
<td>likely to be improved by the intervention.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The following scale was used on the BIRS: 1= Strongly Disagree, 3= Neutral, 6= Strongly Agree.

*Items left uncompleted by one of the parents.
APPENDIX G

RESULTS OF IOA FOR PARTICIPANTS
### Results of IOA for Participant One

<table>
<thead>
<tr>
<th>Phase</th>
<th>% IOA for vocalizations</th>
<th>% IOA for hair touching</th>
<th>% IOA for breathing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>98%</td>
<td>94%</td>
<td>85%</td>
</tr>
<tr>
<td>Intervention</td>
<td>95%</td>
<td>99%</td>
<td>93%</td>
</tr>
<tr>
<td>Maintenance</td>
<td>80%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

### Results of IOA for Participant Two

<table>
<thead>
<tr>
<th>Phase</th>
<th>% IOA for vocalizations</th>
<th>% IOA for perseverative hand movement</th>
<th>% IOA for finger scratching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>89%</td>
<td>94%</td>
<td>99%</td>
</tr>
<tr>
<td>Intervention</td>
<td>96%</td>
<td>99%</td>
<td>93%</td>
</tr>
<tr>
<td>Maintenance</td>
<td>67%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
APPENDIX H

RESULTS OF FEASIBILITY IOA FOR PARTICIPANTS
### Results of Feasibility IOA for Participant One

<table>
<thead>
<tr>
<th>Phase</th>
<th>% IOA for vocalizations</th>
<th>% IOA for hair touching</th>
<th>% IOA for breathing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>87%</td>
<td>80%</td>
<td>87%</td>
</tr>
<tr>
<td>Intervention</td>
<td>93%</td>
<td>91%</td>
<td>84%</td>
</tr>
<tr>
<td>Maintenance</td>
<td>67%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

### Results of Feasibility IOA for Participant Two

<table>
<thead>
<tr>
<th>Phase</th>
<th>% IOA for vocalizations</th>
<th>% IOA for perseverative hand movement</th>
<th>% IOA for finger scratching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>96%</td>
<td>98%</td>
<td>97%</td>
</tr>
<tr>
<td>Intervention</td>
<td>93%</td>
<td>91%</td>
<td>80%</td>
</tr>
<tr>
<td>Maintenance</td>
<td>75%</td>
<td>100%</td>
<td>75%</td>
</tr>
</tbody>
</table>
REFERENCES
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Specialist Program, Kent State University, Kent, Ohio.


Goetz, E., Holmberg, M., & LeBlanc, J. (1975). Differential reinforcement of other behavior and noncontingent reinforcement as control procedures during the
modification of a preschooler’s compliance. *Journal of Applied Behavior Analysis, 8*, 77-82.


Noncontingent reinforcement and differential reinforcement of other behavior.


