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NCR vs DRO: Evaluation of Effectiveness, Teacher Preference, and Fidelity of Implementation

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NCR versus DRO: Evaluation of Effectiveness, Teacher Preference and Fidelity
of Implementation

by

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A thesis defense submitted in partial fulfillment
of the requirements for the degree of
Master of Arts
Applied Behavior Analysis
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Table of Contents

List of Figures	ii
Abstract	iii
Introduction	5
Methods	12
Participants	12
Teachers	12
<i>Teacher A</i>	12
<i>Teacher B</i>	12
<i>Teacher C</i>	12
Students	13
<i>Student A</i>	13
<i>Student B</i>	13
<i>Student C</i>	13
Setting	14
Target Behaviors	14
Data Collection	16
Student Behavior	16
Teacher Implementation Fidelity	17
Inter-observer Agreement (IOA)	18
Surveys	19
Teacher Preference	19
Design	19
Functional Assessment	19
Baseline	21
Training	21
NCR Phase	22
DRO Phase	23
Choice Phase	23
Results	24
Surveys	25
Discussion	28
Future Research	34
References Cited	35

Appendices	37
Appendix 1: Duration Data Sheet	38
Appendix 2: Frequency Data Sheet	39
Appendix 3: Fidelity Data Sheet	40
Appendix 4: Teacher Preference Survey	41
Appendix 5: Final Survey	42
Appendix 6: NCR Training Protocol	43
Appendix 7: DRO Training Protocol	44
Appendix 8: IRB Approval	45

List of Figures

Figure 1. Change in percentage and frequency of problem behavior across baseline, NCR, and DRO phases.

26

Abstract

Previous research has demonstrated that non-contingent reinforcement (NCR) and differential reinforcement of other behaviors (DRO) are effective procedures in reducing problem behavior of children both in and out of the classroom. However, few studies have assessed which procedure is most socially acceptable among teachers. In addition, studies have not recorded data on fidelity of implementation among teachers. A non-concurrent multiple baseline across teachers design was used to (a) demonstrate the effect of NCR and DRO on the problem behaviors of school aged children with no identified developmental disability, and (b) assess implementation fidelity of each procedure by the teacher. This study further assessed which procedure was preferred by teachers by the addition of questionnaires and a choice phase in which teachers ultimately chose which procedure to implement. Results showed that both procedures significantly reduced problem behavior across all participants, with the DRO procedure having the greatest effect. The procedure that was preferred most by teachers varied across participants. One of the three participants preferred the NCR procedure, one preferred the DRO procedure and the last participant gave mixed results between the procedure she said she preferred in the surveys and the procedure she chose to implement in the final choice phase.

Introduction

Schools are environments in which children can potentially encounter positive adult and peer role models, experience academic success, and create enduring peer and adult relationships. However behavioral issues within the school setting are challenges that teachers and administrators face which consume a significant amount of educator and administrator time and greatly hinder the social and academic performance of those involved (Rasmussen & O’Neill, 2006; Sugai et al., 2011). By reducing these behaviors, the student may have a better chance of meeting his potential (Lassen, Steele, & Sailor, 2006). There are a number of behavioral procedures that can be used within the classroom to improve challenging behaviors. Two of these procedures, noncontingent reinforcement (NCR) and differential reinforcement of other behaviors (DRO), have been evaluated both in and out of the classroom setting extensively, and have been proven effective in reducing problem behaviors (Austin & Soeda, 2008; O’Callaghan, Allen, Powell, & Salama, 2006; Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993; Vollmer, Marcus, & Ringdahl, 1995).

Vollmer et al. (1993) describes an NCR procedure as, “a response-independent or time-based delivery of stimuli with known reinforcing properties” (p. 10). In an NCR procedure the reinforcer is delivered independent of whether the behavior occurred or not. The effects of NCR can be attributed to a number of different components. First, response independent reinforcer delivery can be functionally explained as an extinction

procedure because the contingent relationship between behavior and reinforcement has been eliminated, therefore resulting in a decrease in the undesirable behavior. However, Vollmer et al. (1995) explain that NCR may also function as an establishing operation (although in current terms, this would be considered an abolishing operation). By receiving reinforcement noncontingently, the individual is less motivated to demonstrate the problem behavior in order to receive reinforcement.

It was reported in the late 80's that the most widely used technique for the reduction of undesirable behaviors was that of differential reinforcement procedures (Lennox, Miltenberger, Spengler, & Erfanian, 1988). Of these procedures, perhaps the most popular is differential reinforcement of other behaviors (DRO). DRO was described by Miltenberger (2008) as, "a procedure in which the reinforcer is delivered after intervals of time in which the problem behavior does not occur. DRO involves reinforcing the absence of the problem behavior" (p. 338). This procedure is found to be effective through the use of reinforcement and extinction procedures. When the behavior occurs, reinforcement is not provided, thus discontinuing the contingency set up between behavior and reinforcement. Also, when the behavior does not occur for a previously determined period of time, reinforcement is provided.

In order to determine which procedure, NCR or DRO, was more effective in reducing problem behaviors, a few studies assessed the effects of both in similar situations. Vollmer et al. (1993) used DRO and NCR procedures to decrease the SIB of three adult females with developmental disabilities. For one participant, a reversal design was used. For the two other participants, treatment effects were compared using a multielement within-subject design and multiple baseline across-subjects design. For

these participants, one experimenter was associated with the DRO procedure and one with the NCR procedure. The researchers found that NCR initially suppressed SIB more effectively, however, both treatments were considered equally effective over time. Similar results were shown for the first participant. While the results showed that both treatments were equally effective in reducing SIB, the researchers suggest that NCR may be considered a superior procedure. First, they explain that in two of the three participants, extinction-induced behavior was recorded in the DRO procedure. Also, the rate of reinforcement was much higher in the NCR condition. Finally, the researchers state that NCR may be an easier procedure to implement than DRO. They go on to state that this is valuable when considering teachers or caregivers responsible for numerous students or children at once, such as in a classroom. However, it is important to note, that data on which procedure was preferred by implementer were not taken in order to determine the superior procedure.

Another study conducted by Vollmer et al. (1995) assessed the effect of both NCE (noncontingent escape) and DNRO (differential negative reinforcement of other behaviors). This study aimed to decrease escape maintained SIB of two young males. It was similar to the Vollmer et al. (1993) study, however, instead of providing positive reinforcement the researchers allowed the individuals to escape from a task for 30s on a fixed time-based interval. The design also differed from the previous study in that the DNRO condition was only provided to one of the two participants. Again, both treatments proved to be equally effective with NCE having a more immediate effect on the behavior. This study extended the research of the previous study, by assessing the effectiveness of the procedures on behavior maintained by negative reinforcement. The

researchers conclude by stating that teachers may be more inclined to use a fixed-time reinforcement schedule of escape or attention to decrease socially disruptive behavior as it is effective and requires less response effort. Again, no actual data were taken on which procedure teachers would prefer to implement in their classroom.

A later study conducted by Kodak, Miltenberger, and Romaniuk (2003) evaluated the effects of NCE and DNRO in not only reducing problem behavior but also increasing compliance in two children with developmental disabilities. The study found that, both NCE and DNRO produced large decreases in problem behavior. Subsequently, the two procedures led to a significant increase of compliance in both children. The authors hypothesized that either (a) compliance was reinforced, adventitiously, (b) the demand became less aversive to individuals as they were provided with frequent breaks and thus reduced the establishing operation for escape, or (c) NCE and DNRO somehow made praise an effective reinforcer for compliance. It is unclear which of these three explanations are valid, however it does provide some evidence that an NCR and DRO procedure may in fact encourage alternative behaviors. However, this study also did not evaluate which procedure was preferred by the implementer.

A number of research studies have used these two procedures in the natural environment (Austin & Soeda, 2008; Conyers et al., 2004; Kodak et al., 2003; Lalli, Casey, & Kates, 1997; O'Callaghan et al., 2006) and of these there were a few studies conducted in the classroom setting (Austin & Soeda, 2008; Conyers et al., 2004). Conyers et al. (2004) conducted a study in which a DRO procedure was used to reduce the problem behaviors of 25 children in a preschool classroom. While the procedure was highly effective and demonstrated results desired by both the experimenter and the

teacher, it was described as, “somewhat labor intensive” (p. 413). The researchers suggested that future research find a procedure that is equally effective but easier to implement in a classroom setting. As previously described, NCR could be considered the solution to this problem.

Vollmer et al. (1995) used the NCE procedure in the classroom setting as treatment to reduce SIB of two boys; eighteen and four. All of the sessions were conducted in a classroom in the boys’ schools. Although this study came close to being considered a natural environment, it was not the boys’ usual classroom and the treatment was not implemented by the teachers. The results found that NCE reduced problem behavior for both participants. NCE was compared to DNRO for one of the participants and it was found that NCE reduced SIB more significantly than that of DNRO. However, it was not reported which procedure was preferred. Similarly, Lalli, Casey, and Kates (1997) used NCR to treat severe problem behaviors displayed by children aged 3, 7, and 9. The researchers primarily implemented the treatment, however, upon seeing that the treatment was effective they trained both the children’s parents and teachers in the use of the procedures. After implementation they assessed whether the treatment had the same effect. They found similar response patterns to the results during researcher implementation. However, one aspect of this study that was lacking was that while treatment integrity was collected for therapist implementation, it was not collected for teacher or parent implementation. Also, no data were collected on which procedure the parents and teachers preferred. Both of these elements would have been useful information to ensure that both parents and teachers were able to implement the procedure with high fidelity.

A recent study conducted by Austin and Soeda (2008) used NCR to decrease the off-task behavior of typically developing third grade students. In this study, the teachers were trained in the use of NCR. The results showed that teacher implementation of NCR in the classroom reduced the amount of off-task behavior for two students. This study is one of the few studies found that used NCR to decrease disruptive behavior in the classroom, and with typically developing children. It extended the research by showing that this procedure can be implemented by the primary teacher. However, implementation fidelity and preference was not collected. Therefore it cannot be determined if the procedure was implemented correctly by the teacher or whether the teacher approved of the procedure. This study was also interesting in that it analyzed the effectiveness of a teacher chosen initial fixed-time schedule. The researchers allowed the teacher to select the schedule of reinforcement to ensure that she would be able to implement the treatment effectively. The researchers explain that allowing teachers' input in deciding reinforcer delivery schedules could potentially contribute to greater treatment maintenance. They also comment that teacher choice of reinforcement schedules did not appear to have any adverse effect on the effectiveness of the treatment. However, the researchers did not compare the results directly to data of a treatment in which the teacher was given a FT schedule.

The current study aimed to extend the literature on the comparison of NCR and DRO in the classroom setting. Although many researchers have noted that NCR may be an easier procedure to implement than DRO, there are no data to support this hypothesis other than anecdotal reports. None of the research found reported social validity measures. By allowing the implementers or teachers to rate the two procedures in

terms of ease of implementation, this study assessed which procedure was most appropriate in the classroom. In addition, this study further examined which procedure was preferred by allowing teachers to choose which procedure they would like to implement in the last phase of the study. Finally, this study extended further into the area of treatment fidelity by teachers. Not only is it important to note that NCR and DRO *can* be implemented but also to know if each procedure is implemented correctly. Through the use of fidelity measures, researchers were able to determine whether the procedures were being implemented correctly throughout the intervention phases of this study.

Methods

Participants

Teachers. Three elementary school teachers were chosen from two schools. Teacher/Student pair A were located in a Montessori school and Teacher/Student Pairs B and C came from a private school combining both middle school and high school students. These teachers had little to no training in the field of behavior analysis. Teachers who had extensive training in behavior analysis were excluded from the study (i.e., had certification in behavior analysis or completed three or more classes specific to behavior analysis). It was required that teachers be willing to dedicate a few hours per week to data collection, survey completion, and to implementing the procedures. Also, it was necessary for them to have a student in their classroom that was engaging in minor problematic behaviors.

Teacher A. Teacher A was a 41-year-old woman who had been teaching for 18 years. She had been teaching at the Montessori school for 2 years. She referred Student A for leaving his work area and wandering around the classroom.

Teacher B. Teacher B was 32-years-old and in his eighth year of teaching. He taught ninth and tenth grade. He referred Student B for talking to peers in the classroom frequently throughout designated work times.

Teacher C. Teacher C was 24-years-old and in her second year of teaching. She taught third and fourth grade and was also the schools Spanish teacher. She referred Student C for minor disruptive noises occurring frequently in the classroom during independent work time.

Students. One student from each teacher's classroom was selected based on teacher referral for mild disruptive problem behaviors occurring frequently throughout the school day. Students with self-injurious, aggressive, or severe disruptive behaviors were not included. Students were within the age range of 8-15 years and had no identified developmental disabilities. Problem behaviors included disruptive noises, talking to peers, and out of seat. These behaviors had to occur frequently enough to make data collection possible.

Student A. Student A was an 8-year-old boy in the third grade. He attended a Montessori School for 5 years. Student A's mother worked in another classroom in the school as a teachers aid. Teacher A described him as smart and focused on activities that he was interested in. However, he lost focus when involved in work that was difficult or uninteresting. She explained that he often wandered around the room and socialized with other students in order to avoid work that he did not want to complete.

Student B. Student B was a 15-year-old male in the ninth grade. He had a diagnosis of ADHD. Teacher B described him as a bright social student but explained that his socializing throughout the school day limited his academic performance. Teacher B said that when Student B talked to peers at inappropriate times, he reprimanded him and redirected him to his work.

Student C. Student C was an 11-year-old male in the fourth grade. He had a diagnosis of ADHD (Attention Deficit Hyperactivity Disorder). Teacher C described him as an active and anxious student that was frequently disruptive in the classroom. She explained that if Student C was reprimanded, the behavior would escalate and he often ended up in ISS (In-School Suspension).

Setting

Research on Student/Teacher Pair A was conducted in a typical Montessori classroom. Montessori schools are characterized by an emphasis on independence, freedom within limits, and respect for a child's natural psychological development. They contain mixed age classrooms, student choice of activities from within a prescribed range of options, uninterrupted blocks of work time, and a constructivist model of education. The classroom contained work stations with a number of activities the student could choose from, three large work tables, and a large mat for circle time and independent floor work.

Research on Student/Teacher B and C was conducted in the teachers' regular classroom at a private middle/high school specializing in students with learning difficulties. Sessions lasted for 30 min during the typical instruction time. Each classroom contained a desk for each child, a board, a teacher desk, as well as a group work table.

Target Behaviors

Student A was referred by Teacher A for frequently leaving his work area and wandering around the classroom. Out of seat/away from work was defined as any instance in which Student A left his designated work space within 5 ft if sitting (he often worked on the floor and would scoot on his bottom) and any time he spent standing. This includes the amount of time he took to set up or clean up his work space, gather materials, or wandered around the classroom. The definition excluded any amount of time he spent talking to a teacher or other adult. This behavior was calculated using percentage of time he was away from work. A timer was started when the observation

began and the time on the timer for the onset and offset of the behavior was recorded.

This method allowed the data collector to calculate a percentage as well as a total number of occurrences throughout the observation.

Student B was referred by Teacher B for talking to peers. Talking to peers occurred during independent work within the classroom as well as during group instruction in the classroom. The behavior was scored if Student B spoke to the other students in his classroom. This included instances when a student approached him and he responded, instances in which he asked for help with work or to borrow materials, and instances in which he initiated conversation regarding any subject with any student in the classroom. During group instruction, this included instances in which he spoke with a member of the group regarding any subject other than the subject being discussed in group and instances in which he spoke with students not in his group. During group instruction this excluded times when he was expected to discuss the material being covered in group. The frequency of the behavior was recorded by putting a check mark in the interval in which it occurred. If Student B spoke with one student for a continuous period of time it was only marked once. If he left the conversation and returned, it was marked as a second occurrence. For example, if he had a conversation with one student then spoke with another then returned to the first student, it was marked as occurring 3 times and so on.

Student C was referred by Teacher C for disruptive noises. Disruptive noises were defined as any occurrence in the classroom when he made noises either vocally or using body to object or object to object contact that was audible from across the room. Noises included words excluding instances in which he raised his hand and was speaking

with a teacher or when a teacher addressed him first. If the teacher was no longer attending to Student C and the student continued to speak to her, the behavior began to count as disruptive noise. Instances in which Student C crinkled papers or squeaked his chair were also excluded as these instances were not occurring frequently enough to be disruptive and were considered to be common noises from a majority of the students in the classroom. Vocal noises also included non-work utterances such as whines. One instance of a disruptive noise included one episode in which the behavior was continuous and had no more than a 10 s pause in between occurrences. This rule did not apply to different topographies of behavior. If student C shifted from clapping to singing in under 10 s this would count as two occurrences. For the behavior to be scored it must have been audible from the table at the other side of the room where observers were instructed to sit. The behavior was only scored in the interval in which it began and was not scored again in the next interval unless more than 10 s passed between instances.

Data Collection

Student behavior. Data on student problem behavior were collected 3-5 times a week for approximately 30 min per observation. For Student A, percentage of duration of out of seat/away from work was collected. An onset/offset data sheet was used to calculate the start time and end time of the behavior (see Appendix 1). From this data, a total duration was calculated and divided by the total time of observation to obtain a percentage of total time out of seat/away from work. For a frequency count of Student B and Student C behaviors, the time was broken into 1 min intervals in which the experimenter marked tallies for each time the behavior occurred within that minute in order to record the frequency of occurrence of the behavior (see Appendix 2). The time

of day and approximate duration of data collection (30 min) for each student remained the same throughout all phases of the study, based on a referral time provided by the teacher.

Teacher implementation fidelity. In order to collect implementation fidelity, a data sheet was created indicating the amount of time at which the reinforcement interval was set. (see Appendix 3) The total number of minutes of observation was divided by that number to determine an estimated number of times reinforcement should have been provided. The data sheet included 1 box for each potential reinforcement time. Using a stopwatch which was started at the beginning of the observation and stopped at the end, the observer wrote down the time that reinforcement was delivered. From this, it could be determined if the reinforcement was delivered in a timely manner. For example, if the interval time was set at 3 min, and the observation period was 30 min total, there were 10 opportunities for reinforcement. The data sheet had 10 boxes and every box in which reinforcement was warranted should have had a time in increments of 3 min. If reinforcement was delivered within 1 min, it was considered a correct application of the procedure. Also included on the data sheet was whether the MotivAider was set to the appropriate time and kept on the teacher at all times during the duration of the observation. Fidelity was determined by calculating the number of intervals in which the reinforcement was delivered appropriately and dividing that by the total number of opportunities for reinforcement and multiplying by 100.

Inter-observer agreement (IOA). All data were collected through direct observation in the classroom. IOA for frequency of student behavior was determined by comparing each interval scored by an independent observer and the researcher and

determining if they were an agreement or disagreement. An agreement occurred if the same number of occurrences were scored in both intervals. A disagreement occurred if a different number of occurrences were scored in both intervals. A percentage was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. IOA for duration of student behavior was calculated by comparing onset and offset times and marking them as an agreement if they were within 2 s and a disagreement if they were 3 s or more apart. The number of agreements was divided by the number of agreements plus disagreements and multiplied by 100 to calculate a percentage of IOA. For implementation fidelity both observers' data sheets were compared. An agreement was defined as both observers scoring the time of reinforcement within 2 s of each other. A disagreement would occur when they were more than 2 s apart. IOA was calculated by dividing the number of agreements by the number of agreements plus disagreements then multiplying by 100.

Behavior data IOA were recorded for 30% of observation sessions for Student A and was calculated at 99.42%. IOA was recorded for 26.3% of sessions in which implementation fidelity was recorded for Teacher A and was calculated at 100%.

Behavior data IOA were recorded for 40.91% of observation sessions for Student B and was calculated at 98.52%. IOA was recorded for 100% of sessions in which implementation fidelity was collected for Teacher B and was calculated at 96.67%.

Behavior data IOA were recorded for 48.48% of sessions for student C and was calculated as 97.7%. IOA was recorded for 100% of sessions in which implementation fidelity was collected for Teacher C and was calculated at 100%.

Surveys. To record teacher preference, the teachers filled out a short 5-point likert scale survey weekly regarding the contextual fit of the procedure, and a longer survey prior to the choice phase that compared the two procedures to determine which procedure was preferred by the teachers (see Appendix 4 and 5). The daily surveys filled out by the teachers were collected at the end of each week. The final surveys were collected upon completion of the choice phase for Teachers A and C, and at the completion of the final DRO phase for Teacher B.

Teacher preference. The teachers had the opportunity to choose the procedure he or she would like to use for the final phase of the study. Each teacher indicated which procedure he or she would like to implement in the classroom.

Design

A non-concurrent multiple baseline across participants with a series of reversals of the DRO and NCR conditions within the intervention phase was used. The final phase was a teacher choice condition.

Functional Assessment. A functional assessment was conducted for each student involved in the experiment. First, the researcher conducted a Functional Assessment Interview (FAI) (O'Neill et al., 1997) with teachers who participated in regards to the student with problem behavior in their classrooms. Through this FAI a hypothesis was developed about the function of the behavior and when the behavior was most likely to occur. With this information, the researcher collected ABC data in the classroom at a time when the teacher indicated the problem behavior occurred most often, in order to support the hypothesis developed. ABC data was collected until a minimum of 20 occurrences of problem behaviors were observed.

Through the ABC observation and interview process it was determined that prior to the initiation of this research, Teacher A was not immediately redirecting Student A when he wandered around the room as she was usually helping other students in the classroom and did not immediately see it happen. As a result, Student A's wandering behavior was reinforced with attention from peers and avoidance of unpreferred activities for a short period of time. Prior to the initiation of this research, Teacher B was redirecting Student B almost immediately upon seeing him speak to a peer. This redirection involved a lot of animated attention in the form of jokes directed towards Student B. As a result of talking to peers, Student B was receiving teacher attention. Similarly, when Student C made disruptive noises in the classroom, Teacher C responded by providing attention, in the form of reprimands, immediately after the noise. The teacher assistant in this classroom was also providing attention contingent on Student C's disruptive noises in the form of reprimands and eye-rolls.

Student A had a hypothesized function of access to attention from peers and escape from an unpreferred task. Student B had a hypothesized function of access to teacher and student attention and escape from an unpreferred task. Student C also had a hypothesized function of both access to teacher and student attention and escape from an unpreferred task.

Upon completion of the functional assessment, the researcher met with the teacher to discuss the procedures that would take place. A concise overview of the various aspects of the study was provided. At this time the teacher had the opportunity to ask any questions he or she may have had and state any concerns regarding the procedure.

Baseline. Baseline data were collected during the time of the day the teacher indicated the behavior was most problematic. Teachers were instructed to conduct class as they normally would. Baseline continued until clear patterns of student behavior were established through visual analysis of the data. Baseline data were also used to determine the inter response time (IRT) for setting the MotivAider. The average IRT was taken from baseline data and used in the treatment procedure. Average IRT was calculated by adding up all IRT's and dividing by the total number of times. After baseline data were collected, teachers were trained in either the NCR or DRO procedure (whichever they implemented first which was determined by the flip of a coin).

Training. The teacher was given a task analysis for how to complete the NCR or DRO procedure (see Appendix 6 and 7). Training for only the procedure that the participant began with occurred after baseline. The subsequent procedure was trained prior to the first use. The researcher explained all of the steps while modeling them outside of class time. After the researcher modeled all of the steps in the task analysis, the teacher was required to practice each step in front of the researcher. The researcher provided feedback, including both positive comments and correction for inaccurate aspects of the performance. The teacher had another opportunity to practice until the procedure was completed with 100% accuracy. If the procedure was implemented with less than 90% fidelity for two observation sessions in a row, during implementation, the teacher was retrained on that procedure. Only one teacher required retraining. The initial training lasted approximately one hour and the retraining lasted approximately 30 min.

NCR phase. An initial interval of time was determined by using the average inter-response time (IRT) during baseline data collection. However, the IRT changed due

to teacher indication that the IRT was not feasible within their classroom constraints as it did not allow them enough time to help other students in the classroom. Thus, the interval was extended until the teachers indicated that the time was acceptable. For all teachers, this occurred at 5 min. The teacher set this time to a MotivAider given to him/her by the researcher. Making sure this device was on his/her person at all times, s/he waited until the device began to vibrate. Regardless of whether the behavior took place, the teacher provided reinforcement to the student at the end of the interval (when the MotivAider vibrated). Reinforcement was determined by the hypothesized function of the student's problem behavior. For Student A, the hypothesized function was escape from an unpreferred task and access to peer attention. This student was given a token board and received one minute of free time with a friend of his choice at the end of the observation for every token he received. For Students B and C, the hypothesized function was escape from an unpreferred task and access to teacher attention. Both of the teachers stated that escape was unacceptable during instruction time. Thus, when the interval ended, teachers were instructed to provide a specific praise statement to the student. For example, the teacher would approach the student and provide a statement such as, "I am proud of you", "Great job doing your work" or "Thank you for sitting so nicely". If the student was exhibiting the behavior when the interval ended, the teacher waited until the behavior was discontinued for 10 s and then provided reinforcement, so as to not reinforce the problem behavior. At the end of each phase that NCR was used, the teacher filled out a survey to determine whether the procedure was effective, appropriate, and acceptable (see Appendix 4).

DRO phase. An interval of time was determined in the same way as the NCR procedure which was set at 5 min. For teacher A, lowering the interval to 3 min, per teacher request, on session 15 was attempted, however, after implementation, the teacher did not feel this was feasible. Therefore the interval was increased to 5 min for all subsequent sessions. During the DRO phase, teachers set that interval time to the MotivAider making sure that the device was on his or her person at all times. If the behavior occurred within the interval, the teacher did not deliver reinforcement within that interval. When the MotivAider vibrated the teacher did not provide reinforcement and the interval reset itself. If the behavior did not occur before the MotivAider vibrated, the teacher delivered reinforcement and the interval was automatically reset. Every phase that DRO was used in the classroom the teacher filled out a survey to determine whether the procedure was effective, appropriate, and acceptable (see Appendix 4).

Choice Phase. During the final phase the teacher had the opportunity to choose which procedure he or she wanted to implement. This gave the researchers an idea of which procedure fit best, contextually, and would allow the teacher to include the procedure on a regular basis within the classroom.

Results

In Baseline, Student A's behavior was occurring on average 37.56% of observation sessions. After the implementation of the NCR procedure, Student A's behavior was reduced to an average of 23.78%. When the DRO procedure was implemented the behavior was recorded at an average of 17.68%. The NCR procedure was implemented again and the behavior was occurring for an average of 20.45% of observation sessions. The final phase of DRO was then implemented and the behavior was further reduced to an average of 13.72%. During the choice phase, the teacher elected to implement the NCR procedure and the behavior occurred an average of 8.16%. Implementation fidelity was recorded for 100% of observations during implementation. Overall, fidelity averaged 84.31%. The NCR procedure was implemented with 87.62% fidelity and the DRO procedure was implemented with 78.79% fidelity.

In Baseline, Student B's behavior was occurring at an average rate of .85 instances of talking to peers per min. After the implementation of the first NCR phase the behavior was reduced to an average of .28 occurrences per min. Subsequently, the first DRO phase resulted in an average of .22 occurrences per min. The second round of NCR resulted in a slight increase to .43 per min and the final DRO phase was recorded at an average rate of .23 per min. A final choice phase was not implemented due to time constraints which will be discussed further in the discussion section. Overall, NCR resulted in an average rate of .35 occurrences per min and DRO resulted in an average rate of .22 occurrences per min. Data recorded on Teacher B fidelity of the NCR and DRO procedures averaged 83.3% and 78.325% respectively.

In Baseline, student C's behavior was occurring at an average rate of .95 disturbing noises per min. When the DRO Procedure was implemented the behavior reduced to an average rate of .092 disturbing noises per min. After the implementation of NCR the behavior was further reduced to an average rate of .023 occurrences per min. Only one phase of each procedure was conducted due to time constraints resulting from an extended baseline which will be discussed further in the discussion section. Ultimately, teacher B chose to implement the DRO procedure and the behavior was reduced to 0 occurrences per min. Teacher B fidelity of the NCR and DRO procedure were both 100% with all sessions in which fidelity data were recorded, 100% of the time the procedure was implemented correctly.

It is important to note that a good comparison of the effectiveness of the DRO and NCR procedures would have extended a number of phases within the study in order to achieve a more steady and consistent rate of behavior, however, this studies primary focus was on that of fidelity of implementation and teacher preference.

Surveys

Teacher A rated the NCR and DRO procedure at a 4 for all weekly surveys. Despite Teacher A's consistent rating of a 4 for all procedures, in the final survey she gave the NCR procedure a 5 and the DRO procedure a 3. She indicated that the NCR procedure was easier to implement, had a greater effect on the behavior, and was more time efficient than the DRO procedure.

Teacher B rated the NCR procedure at a 2 on the weekly survey stating that the student appeared "bothered" by the reward. The DRO procedure also received a 2. On the overall survey he rated the DRO procedure at a 2 and the NCR procedure at a 1

stating that the DRO procedure was the easiest to implement. He further indicated that neither procedure reduced problem behavior or was time efficient.

Figure 1

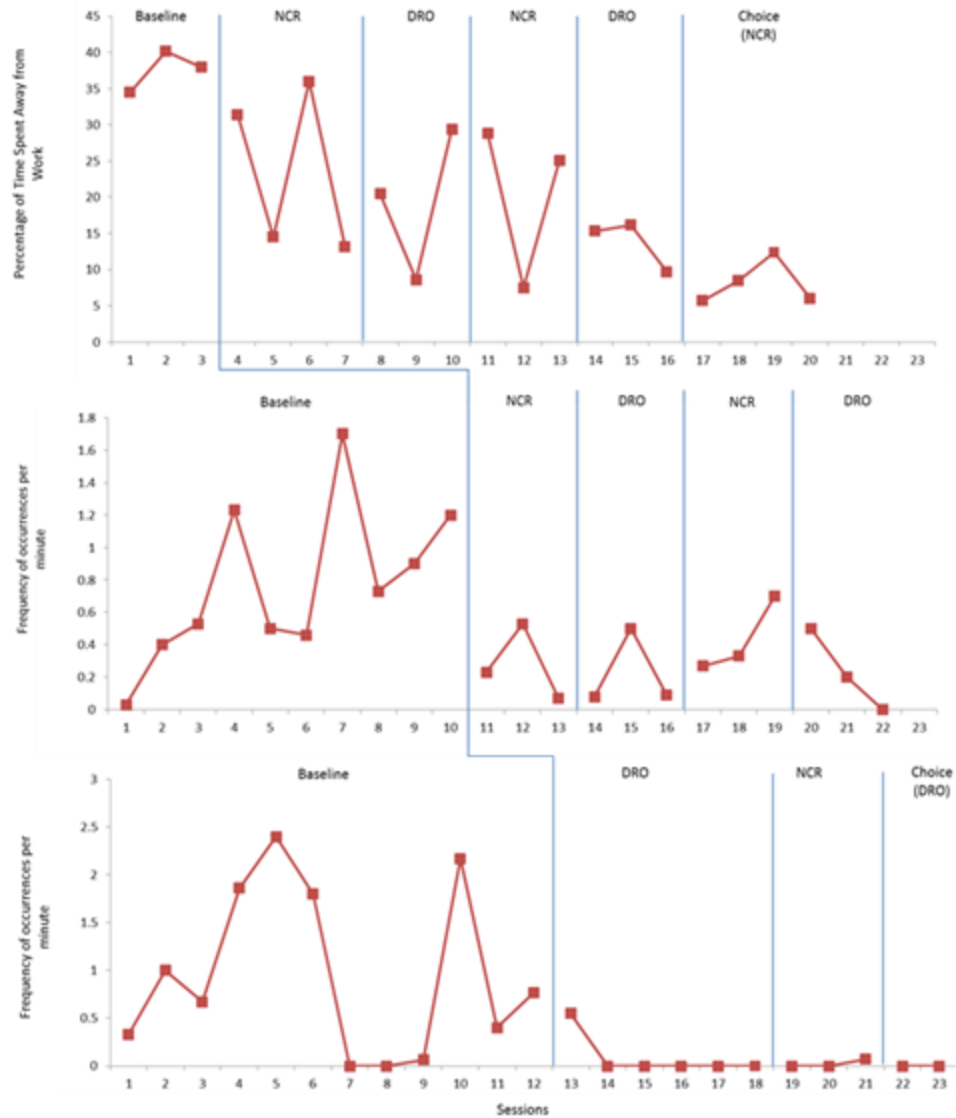


Figure 1. Panel A denotes percentage of time away from designated work area for Student A across observation sessions. Panel B denotes frequency of occurrences of talking to peers for Student B across observation sessions. Panel C denotes frequency of disturbing for Student C across observation sessions.

Teacher C's weekly surveys of the NCR procedure showed she rated the procedure at a 1 on a scale from 1 to 5. She rated the DRO at a 3. However, in her final survey, comparing the two procedures, she gave the NCR procedure a 2 and the DRO procedure a 1, stating that the NCR procedure was the easiest to implement. Despite this rating, teacher A chose to implement the DRO procedure in the choice phase.

Discussion

Results showed that both procedures significantly reduced problem behavior in the classroom setting for all three participants. Teacher/Student Pair A showed some reductions in both the NCR and DRO phases, however, the largest reduction in problem behavior occurred mostly in the DRO phases. Implementation fidelity was greater in the NCR phases and Teacher A preferred the procedure that was implemented with the greatest fidelity (NCR). Teacher/Student pair C showed the largest reduction in problem behavior during the NCR phase. However, the DRO phase was only slightly less effective. Both procedures were implemented with 100% fidelity across all sessions for Teacher C so the difference in behavior reduction may not be contributed to the percentage of fidelity. Teacher/Student Pair B showed the largest reduction in problem behavior occurring in the DRO phase. However, Teacher B averaged 70.42% fidelity for the DRO procedure and 75% fidelity for the NCR procedure. Thus, the procedure that was implemented with the lowest fidelity resulted in the greatest reduction in problem behavior and despite the low fidelity of both procedures the behavior was still drastically reduced.

Overall, for all teachers, it appeared that the DRO procedure had a greater overall effect on problem behavior. However, the NCR procedure was consistently implemented with a higher percentage of fidelity. NCR had the highest percentage of fidelity across all participants. This is likely due to the requirement that the teachers watch for the behavior throughout the interval in the DRO procedure. With a classroom of approximately 20

other students, it was difficult for teachers to keep a constant eye on the target student. Thus, it would appear that NCR might be a better fit for classrooms. However, the surveys were inconsistent with this hypothesis for most of the participants. Teacher A gave both procedures a ranking of 4 throughout all the weekly surveys agreeing that the procedures were easy, improved the student's behavior, and that she could do them every day. However, the final survey which compared the two procedures revealed that Teacher A preferred the NCR procedure significantly over the DRO procedure. She stated that, "I liked the NCR better for my Montessori classroom. I felt better about it and it seemed to work better." Teacher A was consistent with the hypothesis that teachers would overall prefer the NCR procedure due to its effectiveness and ease of implementation.

Teacher B stated that he preferred the procedure that was implemented with the least fidelity (DRO). However, both procedures were ranked very low, with the DRO procedure being ranked only slightly higher, he said, due to the contingency set up between behavior and reinforcement. Teacher B likely ranked the procedures low due to his belief that a student should be intrinsically motivated. He stated in the final comparative survey that, "NCR was a waste. Interrupting a child who is working to tell him he's doing good is counterproductive (you don't get credit for doing what you're supposed to do). DRO wasn't as bad, but my kids are in high school and there is a certain level of behavior required. Overall, neither of these did well in my class and I'd advise trying both strategies on younger kids." He did not believe in consistent reinforcement for work that he stated the student "should already be doing." The survey ranking could not be compared to a final choice phase for Teacher/Student Pair B as there

was not enough time to implement the choice procedure prior to the end of the school year. However, when asked if he were to continue using one of the two procedures, teacher B stated that he would choose the DRO procedure over the NCR procedure but that he had no future plans for implementing either procedure in his classroom.

For Teacher C, data from the preference surveys were inconsistent with which procedure the teacher ultimately decided to implement in the classroom. She chose to implement the DRO procedure during the choice phase, however, her surveys consistently ranked the NCR procedure higher than the DRO procedure. It is unclear whether this was due to the teacher not fully understanding the difference between the procedures. The first day that the DRO procedure was implemented no fidelity data was taken and the behavior did not occur again throughout the entire phase. Due to the lack of behavior, the teacher was providing reinforcement after every interval which made the DRO procedure identical to the NCR procedure. This teacher may have been confused between the two procedures. While she was given thorough training in both, she did not see much difference between them in practice. Teacher C also did not find the two procedures valuable. She stated that the procedures were ineffective in reducing the problem behavior. She said that when the researchers were collecting data, the student's behavior was reduced to 0, however, when they were not there (and the procedures were not being used) the behavior returned, contributing the reduction of problem behavior to possible reactivity that was occurring due to the presence of the researchers. A suggestion was made to use the procedures throughout the school day however, the teacher stated that it was too time consuming to keep up with all day and she did not like

to disturb Student C while he was working. Thus, both procedures for both Teacher B and Teacher C were perceived as not contextually appropriate for their classrooms.

It is not entirely clear why the procedures were not socially acceptable to Teachers B and C. Perhaps they would have been more accepted if teachers were offered more choices during the initial implementation of the procedures such as length of interval times and which procedure was implemented first. Also, Teachers B and C both taught at the same school, which focused on a population of students who struggle with a number of learning problems. The classrooms were structured in a way that required students to work quietly and independently for most of the day. The teacher often stated that they felt like they were disturbing the students by providing praise statements. However, Teacher A taught at a school that encouraged collaborative work throughout the day and allowed students to talk and walk around the classroom for most of the day. This environment may have been more conducive to providing frequent time-based reinforcement.

It is important to note that the way in which DRO was implemented was a departure from the typical DRO procedure. Typically, the implementer would be instructed to reset the interval when the behavior occurred. However, the teachers in this research were instructed to wait out the interval in order for researchers to collect data on implementation fidelity. It was often too difficult to determine if the teacher was resetting the interval, thus preventing researchers from knowing if they should also reset their interval.

There were a number of issues that arose during data collection. The interval time that was originally going to be implemented was based on the baseline

IRT's for all three participants. However, these times were calculated at somewhere between 1 and 3 min. These IRT's were used for the first day of implementation however, the teachers consistently stated that the length of the interval was not going to work in their classroom and it did not give them enough time to help and work with other students. Therefore, researchers asked the teachers for suggestions on the shortest interval time they could use that would fit in their classroom and this was the interval time that was used. For all three participants the interval time ended up being 5 min. Despite the length of the interval, the procedures continued to reduce problem behavior drastically, which may suggest that the length of the interval may not need to be as short as research suggests and further research should look into appropriate interval times in the natural setting such as the classroom.

Another concern that occurred was that, for Teachers B and C, providing reinforcement, even at an interval of 5 min, was reported by the teachers to be disruptive when a student was working even though these praise statements were only lasting at most 2-3 s. Therefore, for the final Teacher/Student Pair, a token board was used to reduce the amount of disruption that would occur during times of reinforcement. The token board allowed the teacher to quickly deliver reinforcement without pulling the students attention away from an activity for too long. It was unclear whether the use of the token board in combination with the NCR/DRO procedures was an important factor in reducing the student's problem behavior. However, reductions in behavior for Student A were comparable to the reduction of the target behaviors for Students B and C for which researchers did not use a token board.

Previous research has repeatedly evaluated the effects of the NCR and DRO procedures in a lab or controlled setting, however, few studies have aimed to implement and evaluate the procedures in more natural settings such as the classroom. Contingencies outside of the classroom are not as easily controlled. For example, Student C's mother set up an outside contingency for good behavior during baseline data collection. Thus, the student's behavior was reduced to zero for a number of days during baseline data collection which extended the baseline for almost two months. Once the behavior returned to a higher rate, the procedures were implemented, however, only enough time for one phase of each procedure plus the choice phase was possible due to the school year ending. Similarly, Student B's behavior during baseline was variable. Moreover, a number of observation sessions had to be cancelled due to sick days (teacher and student), field trips, and changes to the usual schedule.

Fidelity for teacher B, on several occasions, was affected due to frequent absence from the classroom. The class had a teacher assistant who was not trained in the procedure and Teacher B would leave the class to go to the bathroom, speak with another teacher or the principal, or discipline a student. Teacher B was sometimes out of the class when the MotivAider went off and was not able to provide reinforcement to the student in time. Also, on a few occasions, when the MotivAider went off, the teacher would be helping another student and would be unable to reach the student to provide reinforcement in time. During retraining, the teacher stated that he understood the procedure but that he did not agree with the way that it was implemented and it was often too difficult for him to get to the student in time to provide reinforcement, or he did not feel comfortable interrupting the student during independent work.

Future Research

The IRT was the intended method for determining an interval for the reinforcement schedule. Since this was not feasible, teachers and researchers collaborated to determine an appropriate interval time. Future research should examine how much, if any, an extended interval might compromise the effectiveness of both NCR and DRO. Also, researchers should determine how long the interval can be extended before the procedure no longer produces effective outcomes in the classroom setting.

Social validity outcomes were quite variable across teachers and procedures. Research should further evaluate ways to improve the contextual fit of these procedures and ways to alter the procedures to fit the preferences of the teachers in the classroom. Finally, researchers discovered that despite low implementation fidelity of the procedures for one teacher, target behavior was significantly reduced. Future research should determine at what percentage of implementation fidelity the procedures continue to be effective.

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Appendices

Appendix 2

Student Behavior Data Collection Sheet

Date: _____ Student: _____ Procedure: NCR

DRO

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Minute Intervals																														
# of Occurrences																														
Minute Intervals																														
# of Occurrences																														
Minute Intervals																														
# of Occurrences																														

Appendix 3

Fidelity

Date: _____ Teacher: _____ NCR or DRO: _____

	1. Is the pager set to the appropriate time?		
	2. Was the pager kept on the person at all times?		

Interval (5 min)	1	2	3	4	5	
Time of Reinforcer Delivery						

Date: _____ Teacher: _____ NCR or DRO: _____

	3. Is the pager set to the appropriate time?		
	4. Was the pager kept on the person at all times?		

Interval (5 min)	1	2	3	4	5	6
Time of Reinforcer Delivery						

Date: _____ Teacher: _____ NCR or DRO: _____

	5. Is the pager set to the appropriate time?		
	6. Was the pager kept on the person at all times?		

Interval (5 min)	1	2	3	4	5	6
Time of Reinforcer Delivery						

Appendix 4

Teacher Preference Survey

Participant: _____

Date: _____

Procedure: NCR DRO

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. This procedure was easy to do.					
2. This procedure improved the student's behavior.					
3. This procedure was time efficient.					
4. I could do this procedure every day.					

5. Overall, I rate this procedure (1-5 5= excellent, 1= not appropriate for my classroom)

Notes

Appendix 5

Final Survey

Teacher: _____ Date: _____

Procedure: **NCR** **DRO**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The NCR procedure was easier to do than the DRO procedure.					
2. The DRO procedure was easier to do than the NCR procedure.					
3. The NCR procedure reduced the student's problem behavior more than the DRO procedure.					
4. The DRO procedure reduced the student's problem behavior more than the NCR procedure.					
5. The NCR procedure was more time efficient than the DRO procedure.					
6. The DRO procedure was more time efficient than the NCR procedure.					
7. I could do the NCR procedure every day.					
8. I could do the DRO procedure every day.					
9. I prefer the DRO procedure over the NCR procedure.					
10. I prefer the NCR procedure over the DRO procedure.					

Overall I rate the NCR procedure (1-5 5= excellent, 1= not appropriate for my classroom)

Overall I rate the DRO procedure (1-5 5= excellent, 1= not appropriate for my classroom)

Final Notes:

Appendix 6

Non Contingent Reinforcement Training Protocol

Explanation of Procedure:

Non Conditioned Reinforcement is a time based schedule reward system that occurs independent of whether the student has taken part in the behavior. This procedure is thought to work because the student will no longer need to take part in the problem behavior in order to gain access to something reinforcing to him/her because s/he will be receiving the reward regardless.

Target Behavior:

Steps:

1. Set the MotivAider to the given time. _____
2. Keep the MotivAider on you at all times.
3. When the MotivAider vibrates, the reward is delivered.
4. If the behavior is occurring when the pager vibrates, wait 10s until the behavior has been discontinued.
5. After the reward is delivered, reset the MotivAider to the given time.

MotivAider Operating Instructions:

1. Place the slide switch in the SET position.
2. Use the ^ and v keys to enter the amount of time.
3. To activate, place the slid switch in the RUN position. The MotivAider will count down to 0:00, and vibrate briefly.
4. You will need to swith the slide switch to SET after this to make sure it doesn't start again before you are done delivering reinforcement.
5. When, you are ready to start another interval set the slide switch to RUN again.

Appendix 7

Differential Reinforcement of Other Behaviors Training Protocol

Explanation of Procedure:

Differential Reinforcement of Other Behaviors (DRO) is a reward schedule that is time-based. Time is broken down into intervals, if the problem behavior has not occurred within an interval of time, a reward is provided to the student. If the problem behavior does occur, the child is not rewarded, and in taking part in the behavior, the student does not get the reward that s/he is seeking.

Target Behavior:

Steps:

1. Set the MotivAider to the given time. _____
2. Keep the MotivAider on you at all times.
3. If the behavior occurs, MotivAider is reset once the behavior is discontinued.
4. If the behavior has not occurred when the MotivAider vibrates, the reward is delivered.
5. The MotivAider is reset once the reward has been delivered.

MotivAider Operating Instructions:

6. Place the slide switch in the SET position.
7. Use the ^ and v keys to enter the amount of time.
8. To activate, place the slid switch in the RUN position. The MotivAider will count down to 0:00, and vibrate briefly.
9. You will need to switch the slide switch to SET after this to make sure it doesn't start again before you are done delivering reinforcement.
10. When, you are ready to start another interval set the slide switch to RUN again.

Appendix 8



DIVISION OF RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd. MDC035 • Tampa, FL 33612-4799
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January 25, 2012

Jacquelyn Lansdale
ABA-Applied Behavior Analysis

RE: **Expedited Approval** for Initial Review
IRB#: Pro00005966
Title: NCR versus DRO: Evaluation of Effectiveness, Teacher Preference, and Fidelity of Implementation

Dear Jacquelyn Lansdale:

On 1/25/2012 the Institutional Review Board (IRB) reviewed and **APPROVED** the above referenced protocol. Please note that your approval for this study will expire on 1/25/2013.

Approved Items:
Protocol Document(s):

[Study Protocol](#) 1/15/2012 12:09 PM 0.03
Study involves children and falls under 45 CFR 46.404: Research not involving more than minimal risk.

Consent/Assent Documents:

Name	Modified	Version
Child written assent.pdf	1/25/2012 1:48 PM	0.01
Parental Consent Form.pdf	1/25/2012 1:48 PM	0.01
Teacher Consent Form.pdf	1/25/2012 1:48 PM	0.01

(Verbal Assent is not stamped).

Please use only the water marked/stamped consent forms found under the "Attachment Tab" in the recruitment of participants. Please note that these documents are only valid during the approval period indicated on the stamped document.

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review

research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval by an amendment.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

A handwritten signature in black ink that reads "John A. Schinka, Ph.D." The signature is written in a cursive style.

John Schinka, PhD, Chair
USF Institutional Review Board

Cc: Various Menzel, CCRP
USF IRB Professional Staff